Caryville Steam Plant

Site Certification Application

VOLUME 1

GULF POWER Company

APRIL, 1975

COPY NO. 50

AMENDMENT STATUS PAGE

Periodically throughout the life of this document, new pages will be added, some existing pages will be deleted, and some existing pages will be amended and replaced. Such changes are called amendments and are accomplished to reflect updated information and agreements between Gulf Power Company and various regulatory agencies.

Insert latest amended pages and dispose of superseded pages in accordance with the amended page status indicated below.

NOTES: A. A zero in the amendment number column indicates an original page. An arabic number in this column indicates the latest amendment number to a page.

B. On an amended text or table page, that portion of the text or table affected by the latest amendment is indicated by a vertical line and an amendment number in the outer margin of the page, and the latest amendment number and date is shown at the bottom of that page.

C. Amendments to figures (illustrations) are indicated by the latest amendment number and its date above the title block.

D. Occasionally a page of text, a table, or a figure may be replaced which has been amended only, for example, to correct a misspelled word or to improve its visual appearance. Such a page will not have the vertical line, amendment number, etc.

E. To improve readability of the following tabular information, a double-space break separates every fifth entry.

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AMENDMENT STATUS PAGE

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E. To improve readability of the following tabular information, a doublespace break separates every fifty entry.

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Introduction (1)	0
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Figure 5.4-3 through Figure 5.4-18	0
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S2-1 through S2-28	0
S2-29 through S2-34	2
S3-i/S3-ii (Section 3 of Appendix B)	2
S3-1 through S3-36	0
S1-i/S1-ii (Section 1 of Appendix C)	2
Figure 2.5B-1 through Figure 2.5B-54	2
S2-i/S2-ii (Section 2 of Appendix C)	2
Table 2.5A-1 through Table 2.5A-3	2
S1-i/S1-ii (Section 1 of Appendix D)	2
Table 2.7A-1 through Table 2.7A-3	1
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S1-ii	0
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5.0 ENVIRONMENTAL EFFECTS OF PLANT OPERATION

BOOK TABLE OF CONTENTS (Continued)

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

BOOK TABLE OF CONTENTS (Continued)

PREFACE

PREFACE

The Caryville Site Certification Application document is structured as specified in the guidelines adopted by the Florida Department of Pollution Control (FDPC). Information provided by Gulf Power Company pursuant to these guidelines is presented in two volumes. The following discussion of the document's format is intended to facilitate review and amendment as required.

A comprehensive book table of contents is provided in each volume for easier reference. This table of contents shows that the document consists of six chapters:

1.0 Pertinent Applicant Information

2.0 The Site

3.0 The Plant

4.0 Environmental Effects of Site Preparation, and Plant and Associated Transmission Facilities Construction

5.0 Environmental Effects of Plant Operation

6.0 Environmental Measurements and Monitoring Programs

Each of the chapters, as appropriate, is further subdivided into major sections and subsections.

A detailed chapter table of contents is included at the beginning of each chapter to which it applies. Within each section, the narrative is presented first, followed by a list of references in numerical order as
encountered in the narrative, then tables, and figures (illustrations). 2
An appendix is referenced in some sections where greater explanation of material has been required. The appendix is located behind the index tab titled "APPENDICES" at the end of Chapter 6.

While an attempt was made to follow the sequence of information requirements within the FDPC guidelines, some deviation was felt warranted. Liberty has been taken with subsection paragraphing to achieve a flow of continuity of thought and to emphasize important information.

As required, and noted in the Introduction, amendments to the Application
will be issued to include additional information, to delete information, 2
and/or to revise information presently contained in the Application. The following procedures will be followed:

A. <u>Amendments To The Narrative</u> - When a change is made to the Application's narrative, the existing page will be removed and replaced by the latest amended page. The new page will be

marked in the lower right-hand corner with an amendment number and effective date. To indicate specific portions of the narrative amended, a vertical bar will be drawn in the right-hand margin adjacent to the applicable changes. An amendment number will also be placed adjacent to this vertical bar.

Where it is necessary to insert additional pages between existing pages within a section, lowercase letters will be added to the page number. For example, to insert one additional page between pages 3.2-4 and 3.2-5, the insert will be numbered 3.2-4a.

B. Amendments To The Tables - The procedure for inserting an amended table in the Application is the same as that for inserting amendments to the narrative.

Where it is necessary to insert additional tables between existing tables within a section, lowercase letters will be added to the table number. For example, to insert one additional table between tables 2.7-1 and 2.7-2, the insert will be numbered 2.7-1a.

C. Amendments To The Figures - When a change is made to a figure in the Application, the existing page will be removed and replaced by the latest amended page. An amendment number and effective date will also be placed above the title block of the replacement page.

The procedure for inserting additional figures in the Application is the same as that for inserting additional tables.

2

INTRODUCTION

INTRODUCTION

In 1970, the Congress of the United States enacted the National Environmental Policy Act (NEPA). The purposes of the Act have recognized the integral importance of earth's natural resources to man's survival and, subsequently, NEPA established guidelines to assure responsible use of these resources. Basically, these guidelines state that one must:

A. "Utilize a systematic, interdisciplinary approach which will ensure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man's environment;

B. "Identify and develop methods and procedures... which will ensure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations; and

C. "Include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment a detailed statement on:

   1. "The environmental impact of the proposed action;

   2. "Any adverse environmental affects which cannot be avoided;

   3. "Alternatives to the proposed action;

   4. "Relationships between local short-term uses of man's environment and long-term productivity; and

   5. "Any irreversible and irretrievable commitments of resources."

These guidelines have been applied to diverse areas of State and Federal government decision making. Already they have had profound influence in redirecting the allocation and use of the nation's natural resources in both maintaining long-term productivity as well as in achieving more apparent short-term goals.

The electrical power industry was one of the first industries to feel the impact of this Federal Act. Within the State of Florida, the siting of electrical power plants and associated transmission lines has been recognized as having a "significant impact upon the welfare of the population, the location and growth of industry, and the use of the natural resources of the State." Subsequently, in 1973, the Legislature of the State enacted the Florida Electrical Power Plant Siting Act (FEPPSA), Sections 403.501-403.516 Florida Statutes. Reflecting the philosophy of NEPA, the FEPPSA codified the procedures for achieving the policy of the State of Florida which states that: "...while recognizing the pressing need for increased power generation facilities, the State

shall ensure...that the location and operation of electrical power plants will produce minimal adverse effects on human health, the environment, the ecology of the land and its wildlife, and the ecology of State waters and their aquatic life. It is the intent [of the State] to seek courses of action that fully balance the increasing demands for electrical power plant location and operation with the broad interest of the public."

Under the Power Plant Siting Act, the Florida Department of Pollution Control has been given the responsibility for assuring that, for a specific site, the construction and operation of a power plant can be conducted within the broad interest of the public. The procedure for carrying out this responsibility is the process of interagency evaluation of an Electrical Power Plant Site Certification Application coordinated by the Department of Pollution Control and subsequent review of the findings through public hearings.

The Gulf Power Company, anticipating the need for additional electric generating facilities beginning in early 1979, entered into this process in January 1974 with the submission to the Department of a preliminary application for certification of a site located northeast of the town of Caryville, Florida. (Since that submittal, the operational date of the initial unit has been delayed to early 1980.) Gulf has been working to refine its application following the regulations of Chapter 17-17 FAC and the guidelines for application preparation. 1

The revised application, presented here, reflects significant refinement of the original submittal. Nevertheless, during the preparation of the document, it was realized that definitive treatment of many areas could not be readily accomplished. This is due to: (a) the naturally variable process of power plant design engineering, (b) the eminently new requirements for engineering design to achieve State and Federal effluent limitations, (c) the fact that some State and Federal regulations are currently under revision, (d) the limited knowledge of and ability to meaningfully predict the significance of short- and long-term impacts of natural resource allocation and use, and (e) the recently conceived, initiated, and presently untested nature of the present application and review process.

Additionally, in order to meet the intent of the act -- to provide electric power with minimal impact on the environment and within the broad public interest --, industry must meaningfully apply the information developed within the application to the decision-making process for engineering design, construction, and plant operation. To achieve this goal, Gulf approached the preparation of the application as a process, emphasizing the need to meet the intent and requirements of the guidelines by producing defensible information upon which responsible decision making could be based. This document, then, should be viewed as the base design which will evolve further through subsequent evaluation and review to achieve a final plan which is most responsive to the above stated objectives.

At this initial submittal, the document does not completely address several areas of the Guidelines. For the convenience of the reviewer, these areas are listed below:

	Section	Description
A.	2.3	An archaeological study of the plant site and associated transmission lines rights-of-way.
B.	2.6	Description of site meteorology.
C.	2.7	Discussion of regional and site specific aquatic ecology.
D.	2.8	Description of site ambient air.
E.	4.3	Discussion of projected ecological effects of transmission lines rights-of-way.
F.	4.4	Discussion of resources committed due to site construction activities.
G.	5.1	Discussion of projected effects of operation of the intake structure and discharge system.
H.	5.5	Discussion of projected effects of transmission line operation.
I.	5.7	Discussion of resources committed due to plant operation.
J.	6.2	Comprehensive surface and groundwater monitoring program.
K.	6.3	Aquatic biota sampling techniques.
L.	6.5	Procedures for collecting ambient air data.
M.	Ten Year Site Plan (Update)	Socio economic information and predictions.

In most cases (areas B, C, D, E, H, J, K, L), the information has been developed and is currently being edited and prepared for inclusion in a subsequent Amendment to this Site Certification Application. In other

cases (areas A, F, G, I, M), the information is currently being developed. In all cases, Gulf has reviewed the relative importance of the available information and the anticipated new information in light of the impact that this additional information may have on decision making. In no case should any of this information potentially diminish or jeopardize the suitability of this site.

As future demands require, this site will be incrementally developed to a full 3,000 megawatts (MW) capacity. For this reason, this Site Certification Application addresses the ultimate 3,000 MW site capacity and its environmental effects in addition to the initially planned two 500 MW Units. Gulf recognizes that as additional units are added up to 3,000 MW, this Application will be updated to assure that the environmental effects of these additional Units will be within those projected for the full capacity.

Gulf Power Company believes that the Caryville site can be developed for electric power generation with minimal adverse impact upon the environment and natural resources of Florida and within the broad public interest.

1. PERTINENT INFORMATION

1.0 Pertinent Applicant Information

1.0 PERTINENT APPLICANT INFORMATION

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1.0 PERTINENT APPLICANT INFORMANT

LIST OF FIGURES

1.1 Applicant's Legal Identity

This section gives necessary information pertaining to the applicant's legal name, location, and business entity, and it gives remarks of additional information that will help identify the applicant.

1.1.1 Legal Name

The applicant's legal name is The Gulf Power Company.

1.1.2 Address

The applicant's mailing address is: Post Office Box 1151, Pensacola, Florida, 32520.

1.1.3 Address of Official Headquarters

The applicant's address of official headquarters is: 75 North Pace Boulevard, Pensacola, Florida, 32505.

1.1.4 Business Entity

The applicant is a corporation orgainzed and existing under the Laws of the State of Maine.

1.1.5 Name and Title of Business Head

The applicant's business head is Mr. R. F. Ellis, Jr. Mr. Ellis is the President and General Manager of Gulf Power Company.

1.1.6 Name, Title, and Business Address of Applicant's Official Representative Responsible for Obtaining Certification

The applicant's official representative responsible for obtaining site certification is Mr. K. W. Prest, Jr. Mr. Prest's title is Environmental Engineer. His address is Post Office Box 1151, Pensacola, Florida, 32520.

1.1.7 Site Location: Counties

The proposed site is to be located in Holmes and Washington Counties, Florida.

1.1.8 Nearest Incorporated City

The nearest incorporated city to the applicant's proposed plant site is Caryville, Florida.

1.1.9 Site Latitude and Longitude

The applicant's proposed plant site is located at latitude 30 degrees, 47 minutes, 37 seconds North (30° 47' 37" N) and longitude 85° 47' 33" W (West). (See figure 1.1-1.)

1.1.10 Site Coordinates

The applicant's proposed plant site is located at the following coordinates:

Coordinates

Universal Transverse Mercator		Florida Grid	
Northerly	Easterly	Northerly	Easterly
3407150	615535	N-650,000	E-1,594,000

1.1.11 Nameplate Generating Capacity: Existing and Proposed

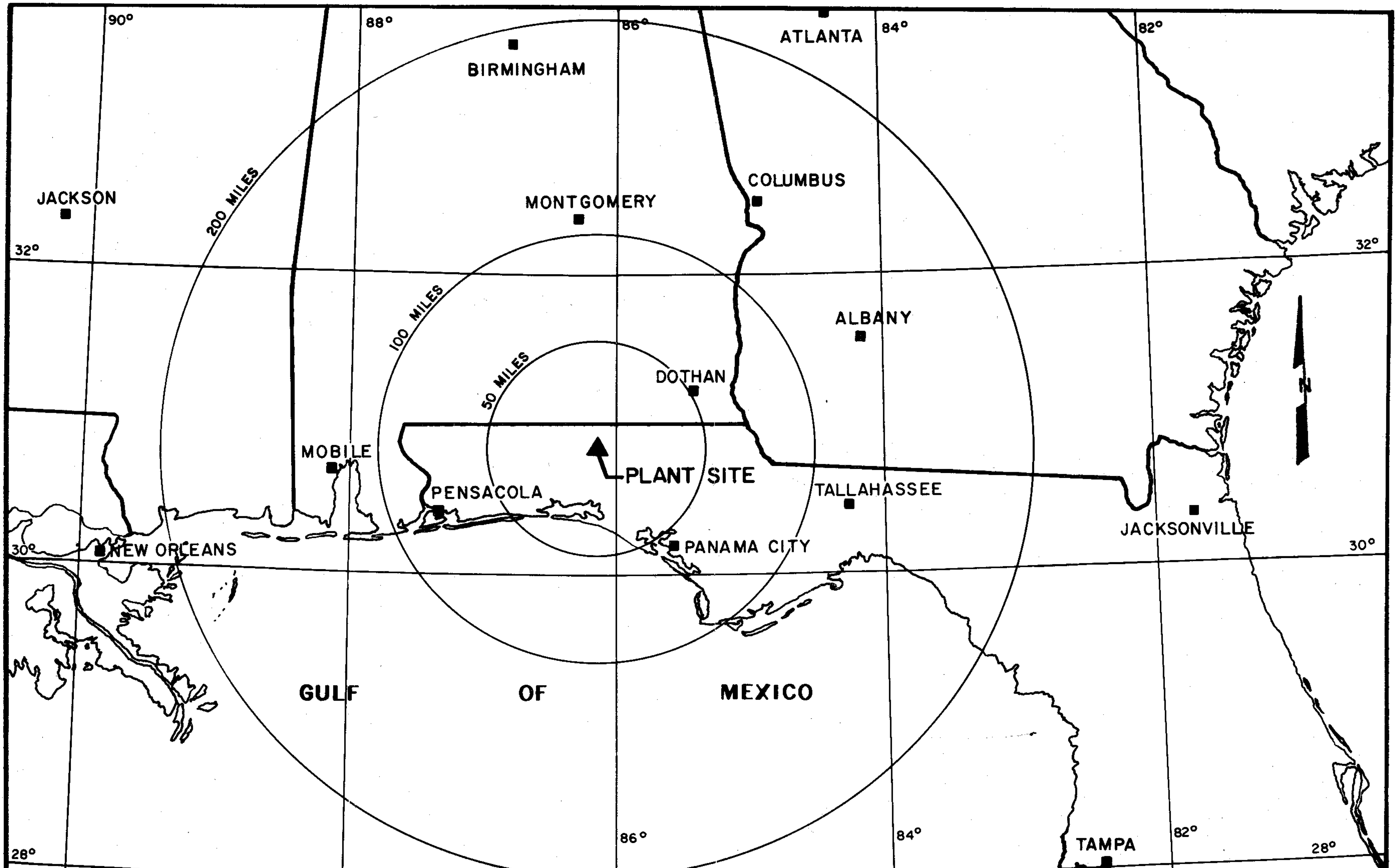
There is no existing nameplate generating capacity. The proposed plant will have an initial nameplate generating capacity of 500 megawatts (MW), 1980. 1
This will be increased to 1,000 MW in 1981. The ultimate nameplate generating capacity will be 3,000 MW.

1.1.12 Certification of Good Standing

Gulf Power Company has paid all fees and taxes required by law and its Permit to do business in the State of Florida is in effect. Refer to a copy of the Florida Secretary of State's certification at the end of this section.

1.1.13 Remarks

Gulf Power Company is, in the remaining chapters of this Site Certification Application, referred to as "Gulf."



CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

90° 88°

GULF POWER Company

GULF POWER CO.
CARYVILLE STEAM PLANT

SITE LATITUDE AND LONGITUDE

FIGURE 1.1-1

CSP-ER-1

STATE OF FLORIDA)
:
OFFICE OF SECRETARY OF STATE)

I, Bruce Smathers, Secretary of State of the State of Florida, do hereby certify that GULF POWER COMPANY, a corporation organized and existing under the Laws of the State of Maine, is duly qualified as a foreign corporation to transact business within the State of Florida.

Said corporation has paid all fees and taxes as required by law, to date, and its Permit is still in force and effect.

GIVEN UNDER my hand and the Great Seal of the State of Florida, at Tallahassee, the Capitol, this the 20th day of February, A. D., 1975.

Bruce A. Smathers

SECRETARY OF STATE

2. THE SITE

2.0 The Site

2.0 THE SITE

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2.0 THE SITE

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2.0 THE SITE

LIST OF FIGURES (Continued)

2.0 THE SITE

LIST OF FIGURES (Continued)

2.1 SITE LOCATION AND LAYOUT

2.1.1 Site Coordinates and Location

Gulf's proposed power plant site is in Northwest Florida about 1.5 miles northeast of the incorporated town of [redacted]e. Its approximately [redacted] acre area will be bisected by the Holmes/Washington County line. Figures 2.1-1 and -2 show the coordinates and location of the site.

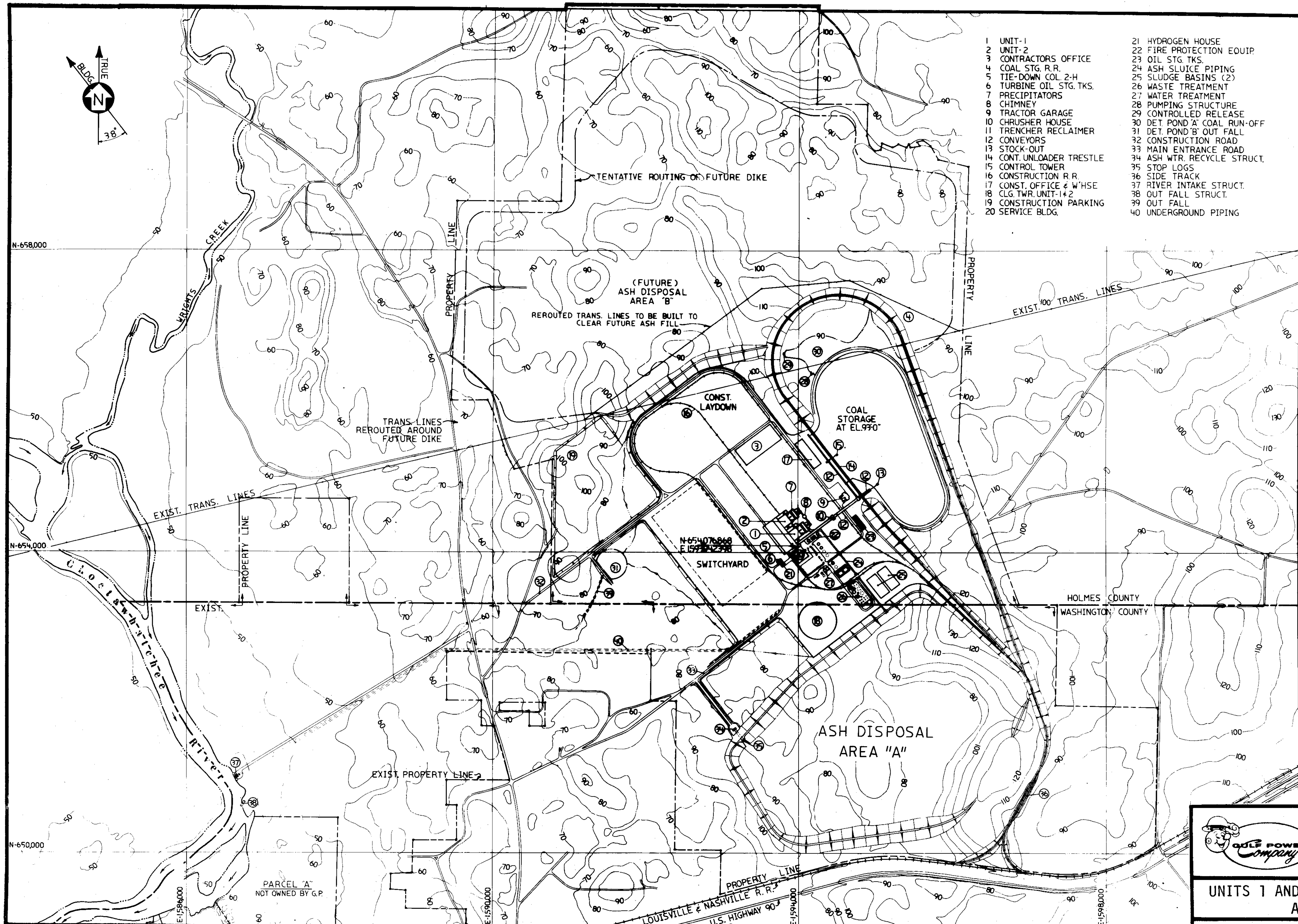
2.1.2 Site Layout

The site's layout is shown in figure 2.1-1. Property adjacent to the site is presently used for agriculture and timber harvesting. As shown in this figure, there are no parks or other public facilities within the site's boundaries.

Transportation links to the proposed site include two Federal highways and one State highway and a Class I railroad. The major east-west highways are [redacted]. No. [redacted] and [redacted]nterstate No. [redacted], and the major north-south highway is [redacted]lorida No. [redacted]. The Louisville and Nashville [redacted] Railroad will serve the proposed site.

2.1.3 Site Acreage

Total acreage of the site proper and the plant intake facilities are shown in figure 2.1-1. Gulf has designed the site to use to a maximum the land required by the facilities for power generation. The plant site proper will occupy approximately 31 percent of the property; the two ash disposal areas associated with 3,000 megawatts of power generation will require about 33 percent; and the planned 90-day coal stockpile will need nearly eight percent.



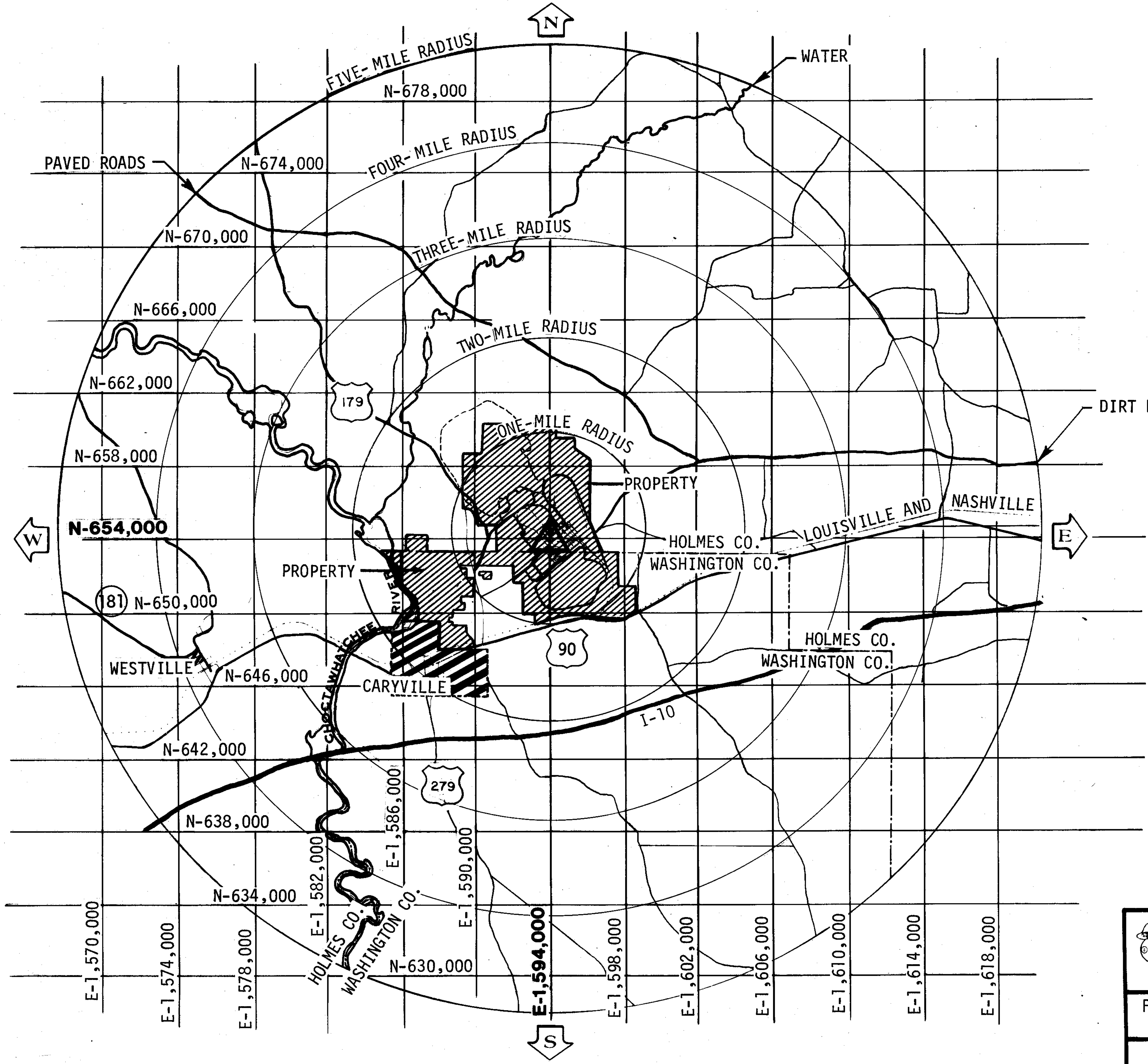
NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

UNITS 1 AND 2 - GENERAL ARRANGEMENT AND MAP OF SITE

FIGURE 2.1-1



NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

GULF POWER CO.
CARYVILLE STEAM PLANT

FLORIDA GRID COORDINATES WITHIN FIVE MILES OF THE CARYVILLE PLANT SITE

FIGURE 2.1-2

2.2

2.2 Regional Demography, and Land and Water Use

2.2.1 Five-Mile Radius Political Map

Figure 2.2-1 shows a five-mile radius area from the proposed plant site in concentric circles. As shown in this figure, the site lies within two counties, Washington and Holmes. Therefore, information throughout this document will always deal with Washington and Holmes counties as the resident counties of the site. Other counties which may be influenced by the construction or operation of the plant or its associated transmission lines are identified separately. Figure 1.1-1 locates the plant site with respect to the Panhandle of Florida.

2.2.2 Populations of the Plant Area

Table 2.2-1 gives the population of towns within a five-mile radius of the proposed plant site as of 1970 (1).

2.2.3 Present and Projected Land Use

2.2.3.1 Present Land Use

2.2.3.1.1 Agriculture - Table 2.2-2 (2, 3) and figure 2.2-2 both indicate that the predominate existing ~~land use~~ within the five-mile radius area of the proposed plant site is ~~agricultural forestry~~.

2.2.3.1.2 Commercial - The only commercial development in the area is found southwest of the proposed site in the towns of Caryville and Westville. This commercial development consists of highway-oriented retail outlets such as gasoline service stations and food stores, and several community shopping establishments.

Consumer services.

2.2.3.1.3 Residential - Widely-scattered residential development -- some in permanent structures and others in mobile homes -- is found throughout the five-mile radius, including the site itself. Some of the residences are located on land which is farmed or used for commercial timbering.

scattered

2.2.3.1.4 Industrial - Three ~~industrial area~~s are located within the five-mile radius area: One is Arnold Lumber Mill located north of U. S. Highway No. 90 and west of the proposed plant site. Harrison Lumber Mill is the second and Caryville Mat and Timber Company, the third, both of which are located south of U. S. Highway No. 90 on Florida Route No. 279.

3 lumber mills

2.2.3.1.5 Transporation - Transportation routes located within the five-mile radius area are either highways or railroads. The major highway is U.S. Highway No. 90, and east-west highway running across the entire Florida panhandle from Pensacola to Jacksonville. Other highways found in the five-mile radius are Florida Route No. 179, which runs from

2 Fed. highways
1 RR - main line

U.S. Highway No. 90 north to Pittman, and Florida Route No. 279, which runs south from U.S. Highway No. 90 to Vernon. U. S. Interstate No. 10, a partially completed expressway which closely parallels U. S. Highway No. 90, lies approximately one mile to the south of the site. U. S. Interstate No. 10 is scheduled for completion by early 1979. Numerous, well-graded, county roads are found throughout the five-mile area. These county roads provide east-west and north-south access.

The Louisville and Nashville Railroad parallels U. S. Highway No. 90 to the north and passes along the southern edge of the site. The railroad runs in an east-west direction throughout the five-mile radius area.

There are no airports located within the five-mile radius. Figure 2.2-3 shows the main east-west air routes within two miles of the proposed site. There are no restrictions imposed by the Federal Aeronautics Administration as air traffic is at high altitudes.

2.2.3.1.6 Water Courses - Joining at a point west of the proposed plant site are the Choctawhatchee River and Wrights Creek. Hathaway Mill Creek, a contributory to Wrights Creek, is north of the proposed site. Numerous sloughs run along the entire western edge of the five-mile radius area.

2.2.3.2 Projected Land Use - The only sources for projected land use in the five-mile area are two recently completed planning studies undertaken for Holmes and Washington counties. These plans are shown in figure 2.2-4.

The proposed plans indicate the area is projected to remain as it currently exists, with some additional concentrations of development within the city limits of Caryville and Westville. Emphasis is on upgrading existing development, expanding residential development on the peripheries, and on new industrial uses scattered throughout. The following seven general recommendations for the Westville area are extracted from the RMBR Planning Design Group plan for Holmes County (4):

A. Maintenace of Westville as a support community.

B. Rehabilitation of existing housing resources.

C. Preservation of the flood plain to the east of the existing development.

D. New growth oriented to the north and west.

E. New residential construction, primarily single family.

F. Expansion of existing pattern.

G. Enlargement of existing commercial uses.

The RMBR Planning Design Group proposal for Washington County recommends the following projected development for Caryville (5):

A. Preserve and improve existing residential areas. Use policies (such as provision of public services and street improvements) to encourage infilling of vacant lots in these areas to provide the compact form necessary for efficient, low-cost, public services.

B. Look toward a consolidation of industrial uses in the vicinity of the railroad and U. S. Highway No. 90, with expansion of present business areas there, both north and south of the railroad tracks. As the narrow area between these two major transportation routes provides a poor living environment, look toward relocation of residential uses from this area .

C. Institute controls to guide future development in areas indicated on the land-use plan as residential expansion areas, to prevent inappropriate development, and to schedule development compatible with extension of community services. Some portions of these areas contain scattered individual dwellings or clusters of dwellings, but in general contain much vacant land. Areas for parks should be reserved.

D. Concentrate commercial uses in existing locations along both sides of U. S. Highway No. 90, with provision of adequate areas for parking and a minimum of traffic entrance points to protect the traffic potential of this major arterial. Adequate crossings and traffic controls should be provided to maintain pedestrain crossing safety.

E. Institute controls to ensure that inappropriate development does not occur in the flood plain of the Choctawhatchee River and Cypress Slough.

F. Consider planning additional recreation areas along the Choctawhatchee River to take advantage of this natural resource, both for local residents and for tourists. Increased accessibility of this area to tourists due to U. S. Interstate No. 10 can be exploited to increase the town's econmic base.

G. Require developers of new residential areas in the town to provide small neighborhood park areas to serve these neighborhoods as they develop. Plan neighborhood parks in existing residential areas.

H. Cooperate with county officials in guiding development of the area between the south boundary of the town and U. S. Interstate No. 10 to provide a good pattern of land uses in this important area. Consider location of regional commercial uses here to generate employment.

2.2.4 Zoning Restrictions

As of 2 January 1975, no zoning exists within the radius area around the proposed plant site.

2.2.5 Other Sources of Effluents

Figure 2.2-5 indicates the locations of Arnold Lumber Mill, Harrison Lumber Company, and the Caryville Mat and Timber Company. Each of these industries produce effluents.

2.2.6 Present Major Water Uses

The only major water supply within the five-mile radius is the Caryville water tank, a 40,000-gallon tank over a 12-inch well. This facility is used by the residents of Caryville on a fee basis for drinking and home use. The only other major, water-use areas are the Choctawhatchee River and Wrights Creek, both of which are used as fishing and recreation areas.

Construction of farm ponds in the area is minor. No major farm irrigation systems presently exist in the five-mile radius.

2.2.7 References

(1) Florida Statistical Abstract, 1973.

(2) Eric Hill Associates. Research and Analysis: Washington County, RMBR Planning/Design Group, June, 1974.

(3) Eric Hill Associates. Research and Analysis: Holmes County, RMBR Planning/Design Group, June, 1974.

(4) Plan and Implementation: Holmes County, RMBR Planning Design Group, June, 1974.

(5) Plan and Implementation: Washington County, RMBR Planning Design Group, June, 1974.

TABLE 2.2-1

POPULATION OF TOWNS WITHIN FIVE-MILE RADIUS OF PROPOSED PLANT SITE

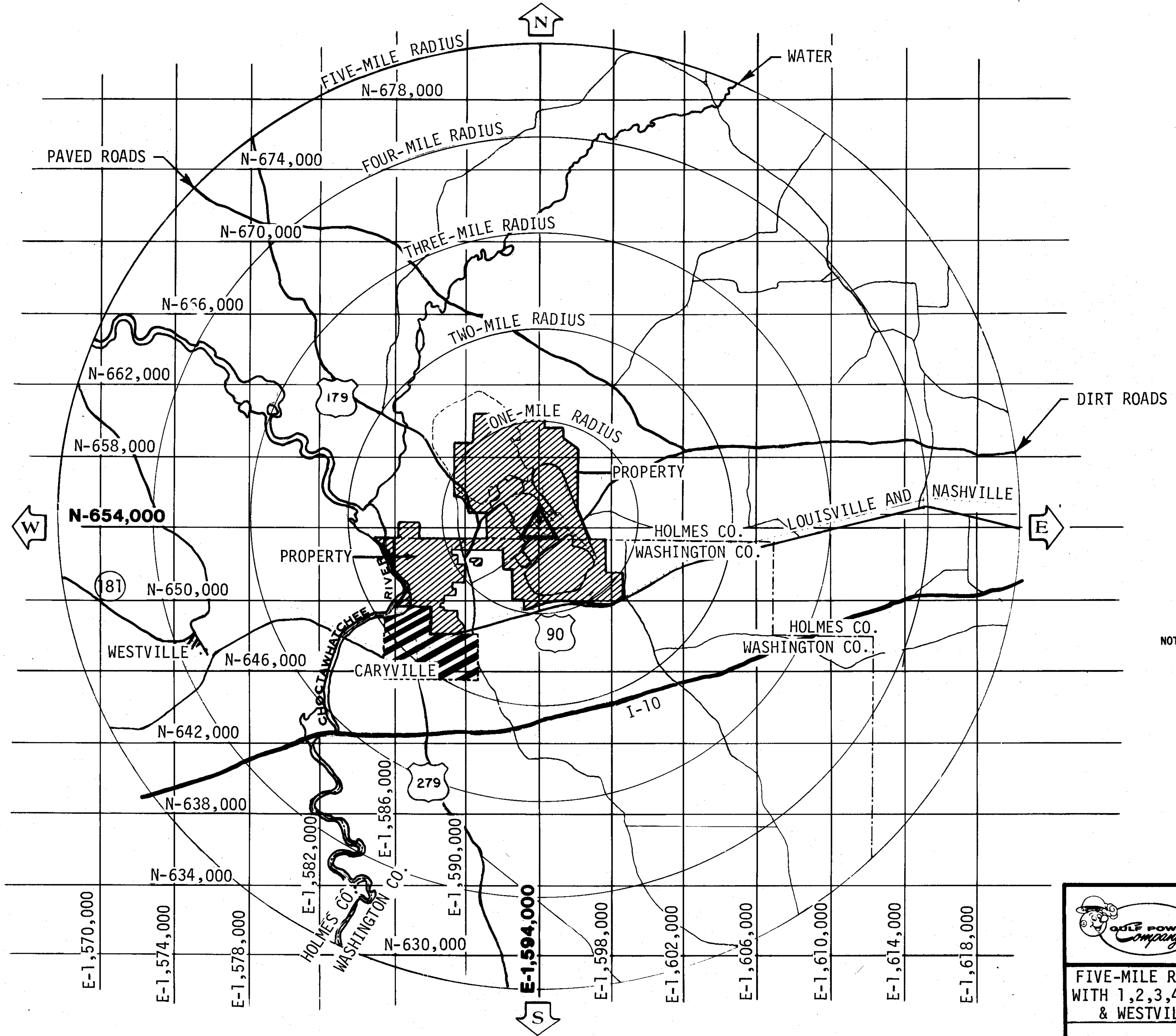
Community	Population
Incorporated	
Caryville	724
Westville	274
Unincorporated	
None	0
Total	998

Reference: 1970 U.S. Census

TABLE 2.2-2

EXISTING LAND USE WITHIN FIVE-MILE RADIUS OF PROPOSED PLANT SITE, BY ACRES AND BY PERCENT OF TOTAL

Land Use	Approximate Acres	Percent of Total Land
Residential	87.3	0.2
Public/Semi-Public	40.0	0.1
Commercial	13.0	-
Industrial	36.5	0.1
Transportation	25.0	0.1
Wildlife Preserve	0	-
Hunting Areas	0	-
Sanctuaries	0	-
Total Developed Land	201.8	0.5
Undeveloped and Agricultural Land	50,827.2	99.3
Total	51,029.0	99.8



△ PLANT SITE

NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

GULF POWER Company

GULF POWER CO.
CARYVILLE STEAM PLANT

FIVE-MILE RADIUS AREA FROM PLANT SITE WITH 1,2,3,4&5 MILE LINES, & CARYVILLE & WESTVILLE CITY LIMITS OUTLINED

FIGURE 2.2-1

2.2 Regional Demography, and Land and Water Use

2.2.1 Five-Mile Radius Political Map

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The Louisville and Nashville Railroad parallels U. S. Highway No. 90 to the north and passes along the southern edge of the site. The railroad runs in an east-west direction throughout the five-mile radius area.

There are no airports located within the five-mile radius. Figure 2.2-3 shows the main east-west air routes within two miles of the proposed site. There are no restrictions imposed by the Federal Aeronautics Administration as air traffic is at high altitudes.

2.2.3.1.6 Water Courses - Joining at a point west of the proposed plant site are the Choctawhatchee River and Wrights Creek. Hathaway Mill Creek, a contributory to Wrights Creek, is north of the proposed site. Numerous sloughs run along the entire western edge of the five-mile radius area.

2.2.3.2 Projected Land Use - The only sources for projected land use in the five-mile area are two recently completed planning studies undertaken for Holmes and Washington counties. These plans are shown in figure 2.2-4.

The proposed plans indicate the area is projected to remain as it currently exists, with some additional concentrations of development within the city limits of Caryville and Westville. Emphasis is on upgrading existing development, expanding residential development on the peripheries, and on new industrial uses scattered throughout. The following seven general recommendations for the Westville area are extracted from the RMBR Planning Design Group plan for Holmes County (4):

A. Maintenace of Westville as a support community.

B. Rehabilitation of existing housing resources.

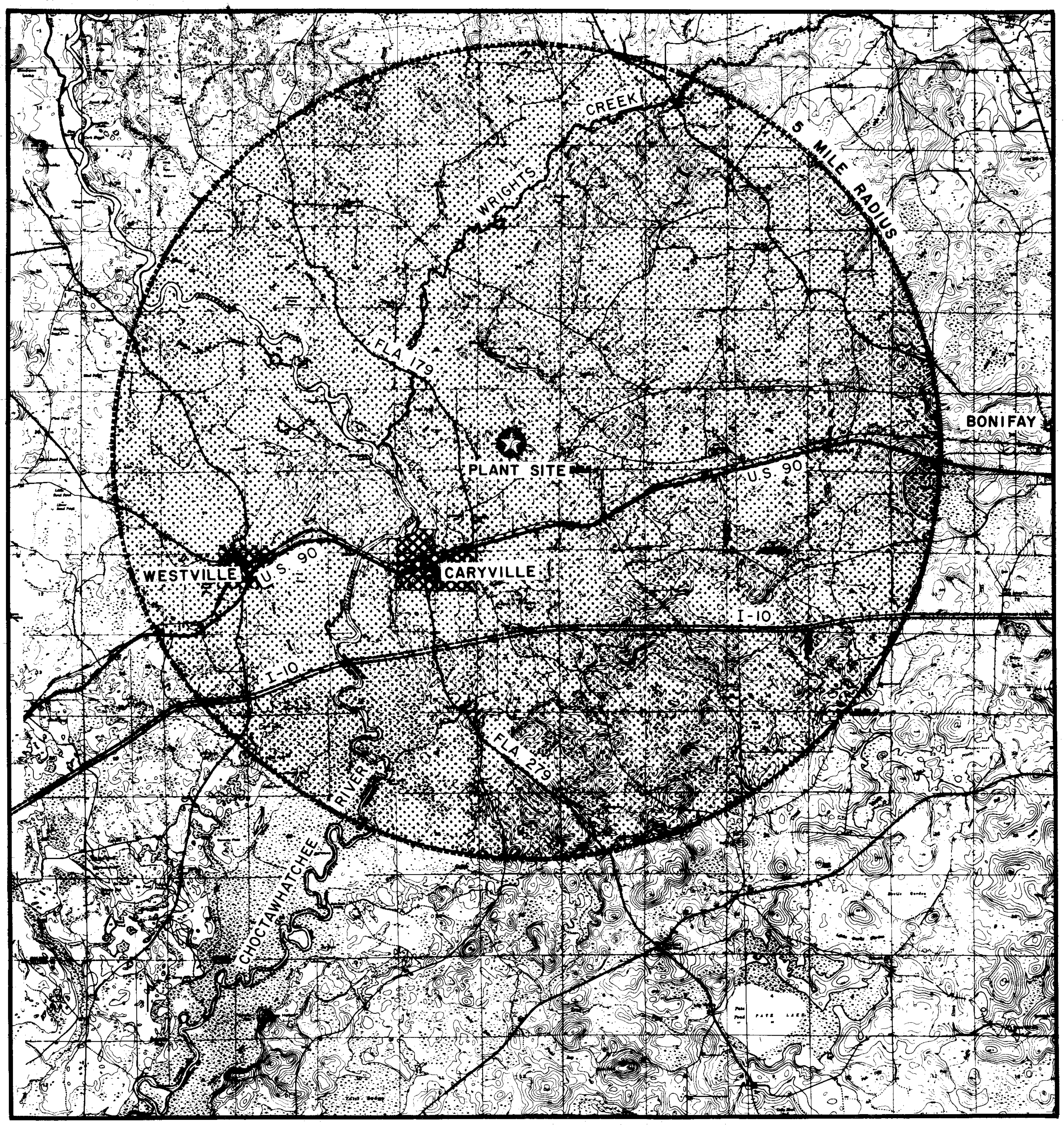
C. Preservation of the flood plain to the east of the existing development.

D. New growth oriented to the north and west.

E. New residential construction, primarily single family.

F. Expansion of existing pattern.

G. Enlargement of existing commercial uses.



NORTH

SCALE 1" = 8000'

DEVELOPED AREAS

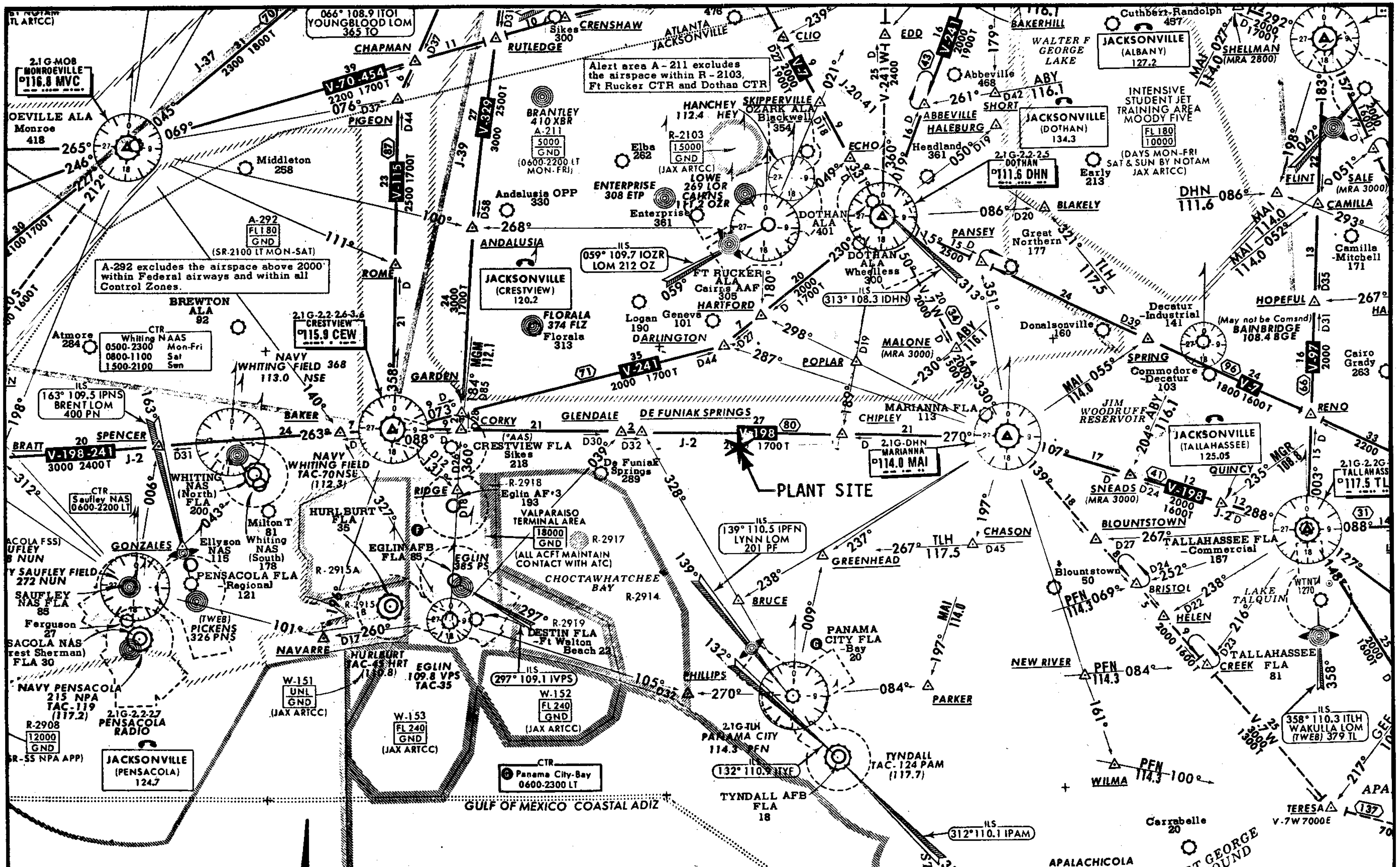
AGRICULTURE/FORESTRY/RURAL RESIDENTIAL

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

EXISTING LAND USE

FIGURE 2.2-2



CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

✱ PLANT SITE

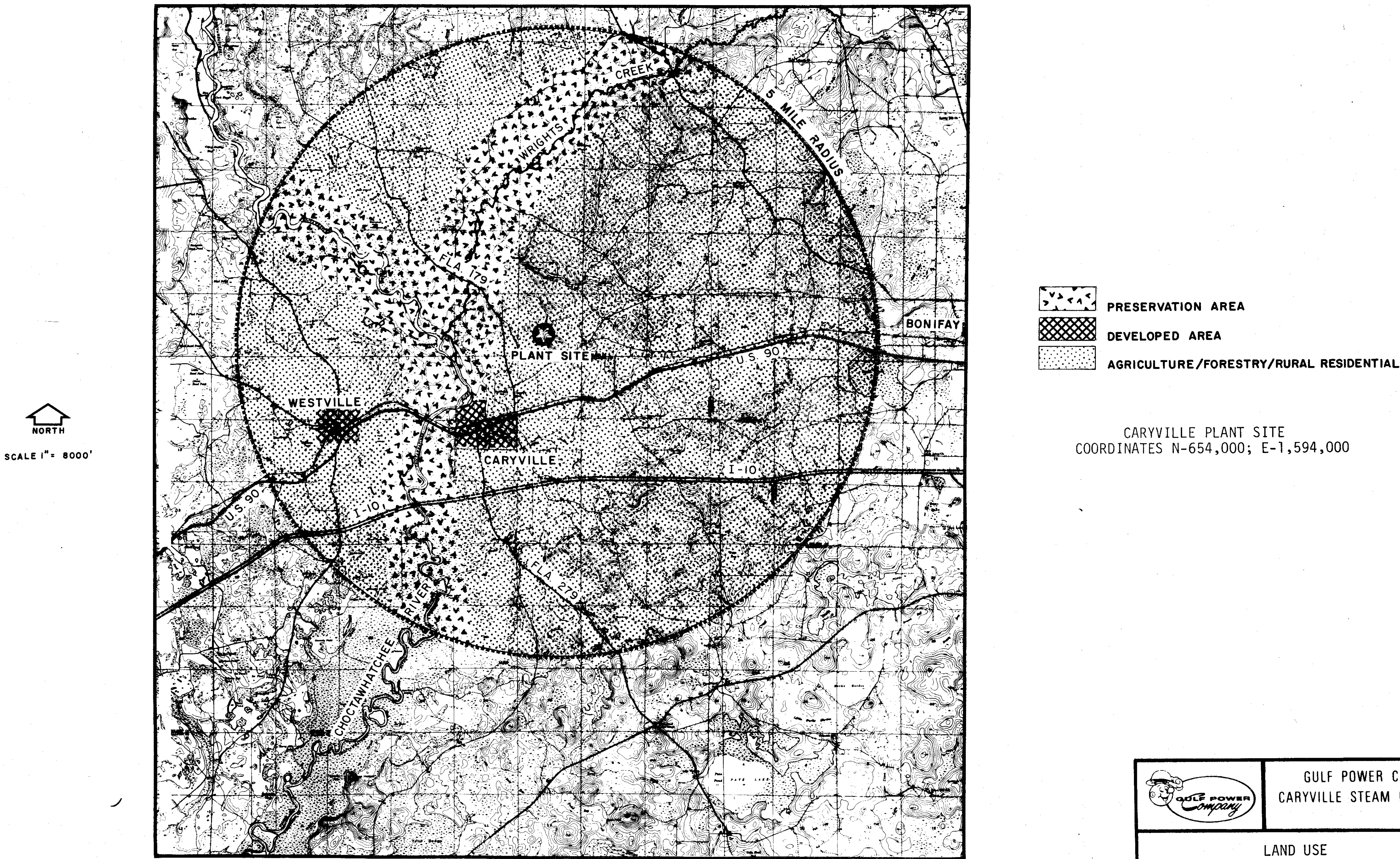
N

GULF POWER COMPANY

GULF POWER CO.
CARYVILLE STEAM PLANT

MAIN EAST-WEST AIR ROUTES RELATIVE TO PROPOSED PLANT SITE

FIGURE 2.2-3

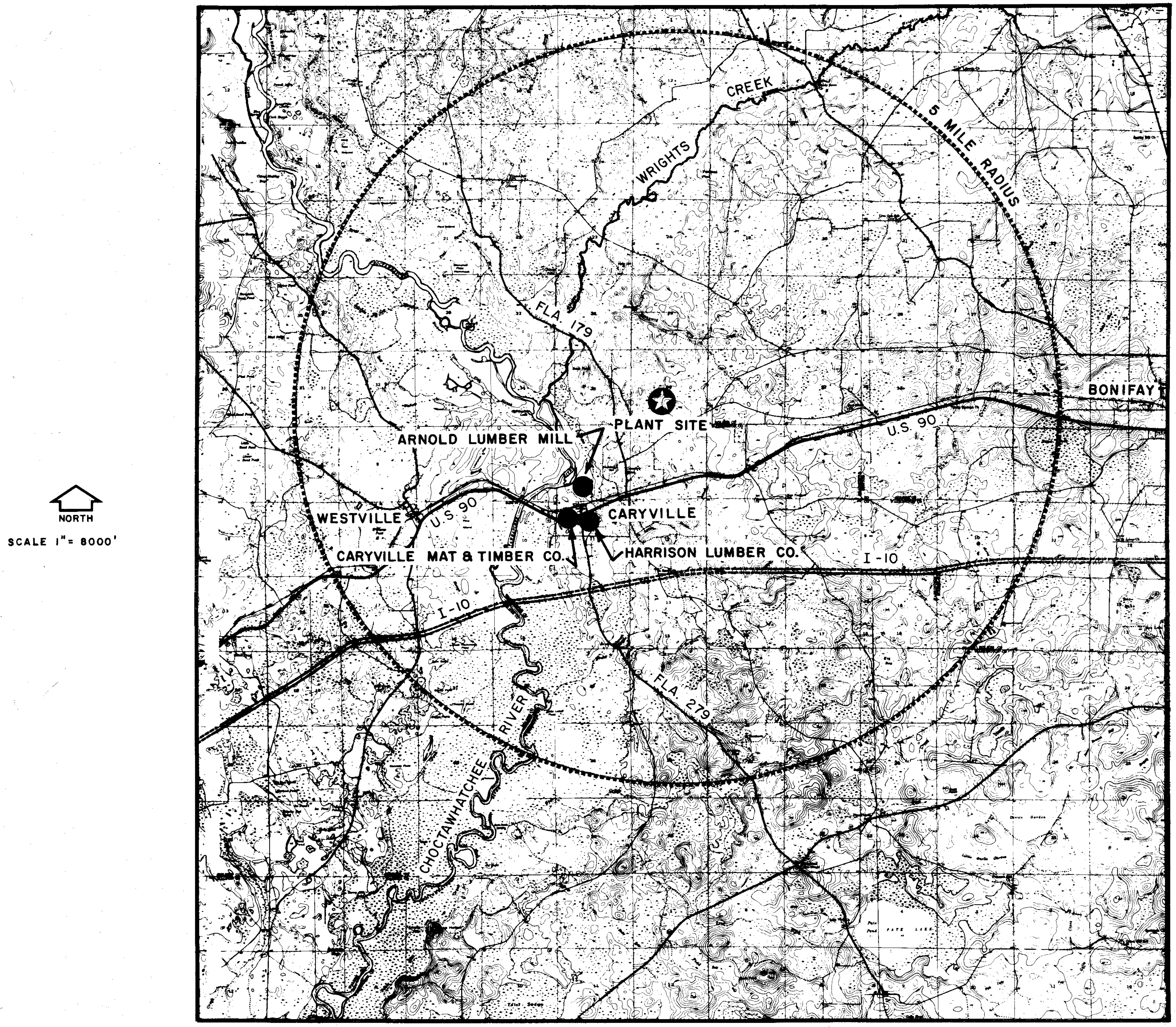


CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

LAND USE

FIGURE 2.2-4



● INDUSTRIAL SITE

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

LOCATION OF INDUSTRIES
NEAR THE PLANT SITE

FIGURE 2.2-5

2.3

2.3 Regional Historic, Scenic, Cultural, and Natural Landmarks

2.3.1 Landmarks

According to Mr. E. W. Carswell, Editor, Washington County News (Florida), and other local citizens, no significant historic, cultural, or natural landmarks exist in the area. However, portions of Hathaway Mill, a gristmill first opened in the late 1800's and in operation until about 1959, are to be found to the northwest of the proposed plant site. No sites in the five-mile radius area are listed in the National Register of Historic Places; the National Registry of Natural Landmarks; or on the historical identification maps maintained by the State of Florida Bureau of Historic Sites and Properties, Division of Archives, History, and Records Management. No unusual or unique scenic site or vista is located within the five-mile radius.

2.3.2 Archaeological Significance

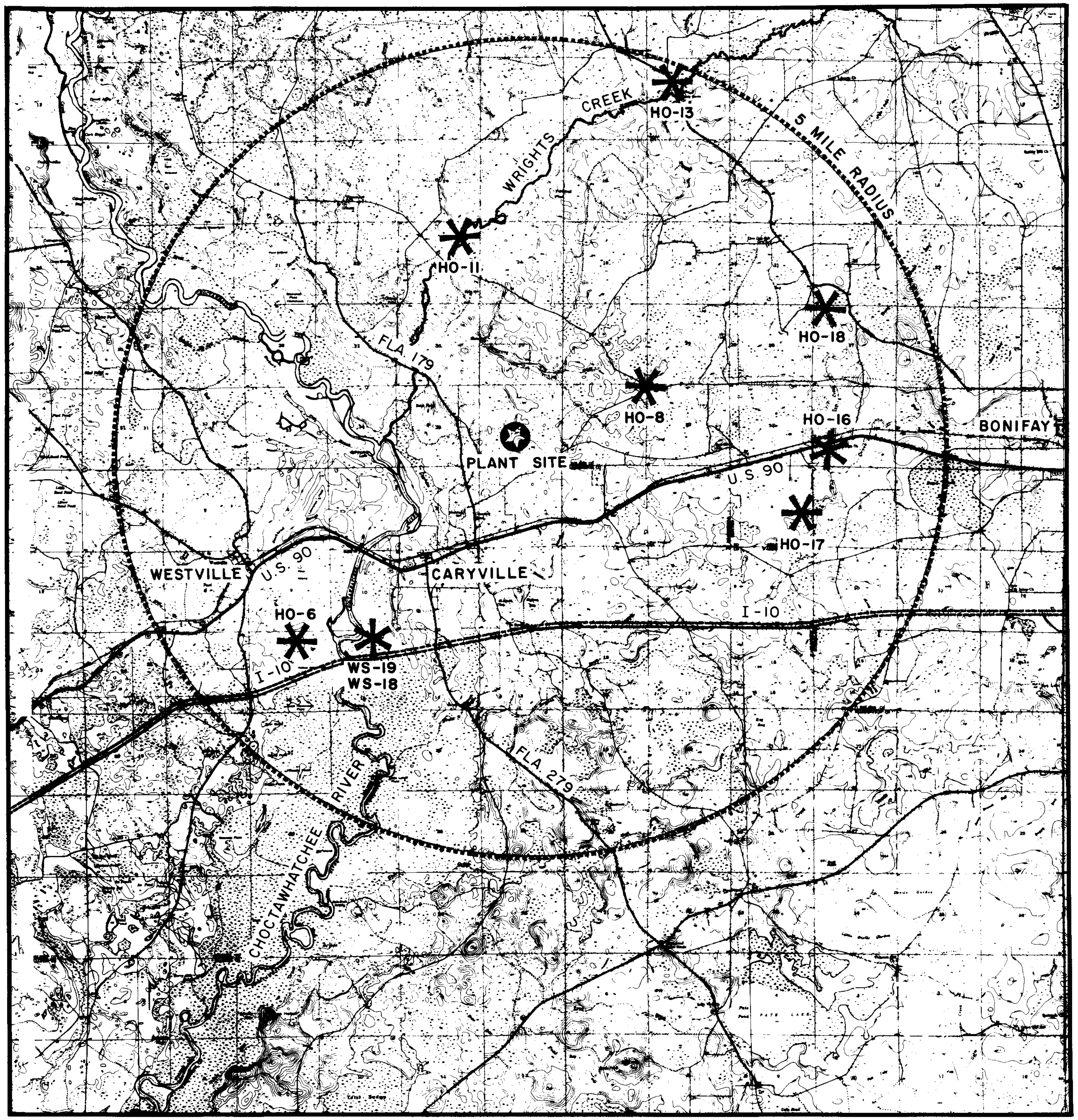
Figure 2.3-1 shows various archaeological sites within the five-mile radius area identified by the State of Florida Bureau of Historic Sites and Properties, Division of Archives, History, and Records Management. The number adjacent to each site corresponds to the State of Florida's listing. The sites shown represent only an initial identification of archaeological sites in the area by the State of Florida. A survey is currently being conducted by the Division of Archives, History, and Records Management to ensure a complete listing. Gulf will develop and carry out specific preservation or excavation plans as warranted on the basis of the survey.

2.3.3 Archaeological Sites Along Transmission Line Rights-Of-Way

Figure 2.3-2 shows the location of archaeological sites adjacent to the proposed transmission line rights-of-way. These are sites identified by the State of Florida Bureau of Historic Sites and Properties, Division of Archives, History, and Records Management. The sites shown represent only an initial State of Florida identification of archaeological or historic sites. A more detailed archaeological and historical survey of the transmission line rights-of-way is currently being conducted by the Division of Archives, History, and Records Management.

2.3.4 Archaeological and Historical Survey

For a detailed discussion of an archaeological and historical survey of the proposed power plant site, refer to Section 1 of Appendix A. 3



NORTH

SCALE 1" = 8000'

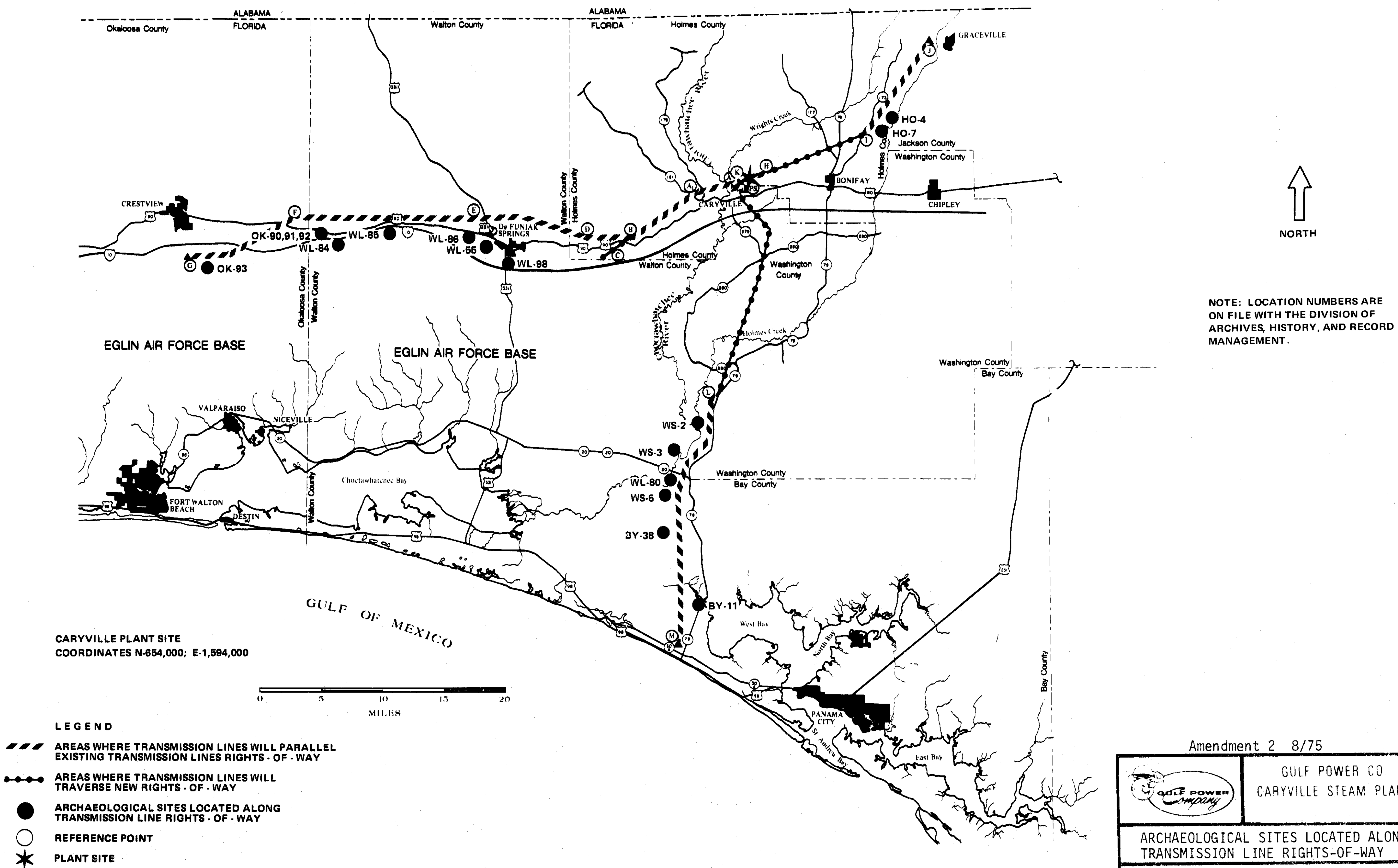
NOTE: LOCATION NUMBERS ARE ON FILE WITH THE DIVISION OF ARCHIVES, HISTORY, AND RECORD MANAGEMENT

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

ARCHAEOLOGICAL SITES

FIGURE 2.3-1



Amendment 2 8/75

GULF POWER CO
CARYVILLE STEAM PLANT

ARCHAEOLOGICAL SITES LOCATED ALONG TRANSMISSION LINE RIGHTS-OF-WAY

FIGURE 2.3-2

2.4

2.4 Geology

2.4.1 Major Geological Aspects of Site

The Caryville site is in the Coastal Plain, a geologic region including all of Florida and extending along the coast as far north as New York and westward through Texas. The area near the Choctawhatchee River is a part of the River Valley Lowlands and contiguous areas are included in the Marianna Lowlands. (See figure 2.4-1.) The flat and gently rolling terrain is directly underlain by floodplain deposits of the Choctawhatchee River and by discontinuous, dissected remnants of terrace deposits which were formed parallel to the present coastline.

rolling terrain

2.4.1.1 Topography - Landforms in the area are a combination of typical karstic terrain features and of those features expected on flood plain deposits and ancient terrace surfaces. Surficial sand, clay, and gravel deposits blanket most of the area and mask underlying beds of limestone. Marshes occupy most of the flat surfaces and apparently exist because of the occurrences of massive and lenticular beds of clay and clayey sand within the surficial deposits. The downward movement of surface water is partially restricted by the clay content of the sediments. Water-filled sinkholes, formed as a result of the solution and collapse of limestone, occur parallel to Florida Highway No. 179, west of the planned generating facilities.

Sand, clay over limestone

2.4.1.1.1 Topographic Relief - Topographic relief at the Caryville site is approximately 80 feet. Elevations range from about 45 feet along the Choctawhatchee River to about 125 feet at the plant site.

2.4.1.1.2 Plant Site Drainage - Drainage of the plant area occurs in part by surface runoff to Little Dram Branch, Hathaway Mill Creek, Wrights Creek, and the Choctawhatchee River, and in part by internal drainage through sinkholes in the surrounding countryside.

2.4.1.2 Sinkholes and Ponds - The sinkholes and ponds in the Caryville area occur mainly between elevations of 55 to 75 feet. In the upland areas, the ancient karst features have now all been dissected by drainage and destroyed (1). However, unfilled depressions occur near the plant site at elevations up to 110 feet. The sinkholes and ponds are mostly located near streams where the alluvial deposits overlying the limestone of the Crystal River Formation are probably less than 50 feet thick. The available geologic information indicates that the alluvial materials thicken eastward from the floodplains of the Choctawhatchee River and Wrights Creek.

2.4.1.2.1 Aerial Photography - Examinations of the site have been made using aerial photography and no indications of active subsidence have been observed. Aerial photography for the Caryville topographic sheet was done in 1947 and 1974. Field examinations and subsequent studies of remote sensing imagery indicate that essentially no new karst

features have formed since 1947. The relative sizes of the ponds also seem to have remained constant during this 27-year time period.

Small ponds are visible on aerial photographs and on remote sensing images within areas which are shown as marshes on the topographic sheet. Some of these small ponds are probably wet weather phenomena and are probably the result of clay lenses in the terrace deposits that prevent downward movement of surface waters. Small ponds of this nature containing large hardwood and pine trees greater than 12 inches in diameter are particularly noticeable in the northern and central parts of Ash Disposal Area "A". (See figure 3.1-2.) Marshy areas underlain by terrace deposits similar to these at Caryville are characteristic of other parts of the Gulf and Atlantic coastal plains where limestone is many hundreds of feet beneath the surface.

2.4.1.2.2 Florida Aquifer - The Caryville site is in the area of recharge of the Floridan Aquifer. In northwest Florida, the recharge area of the Floridan Aquifer is estimated to be 2,100 square miles. Plant facilities to be constructed at Caryville will occupy about 0.06 percent of the total recharge area.

Some of the large water-filled ponds lacking hardwoods and pines are probably subtle karstic sinkhole features. In some, a direct connection could exist with the Floridan Aquifer. In other ponds, although the connection may be poor, some of the water seeping downward from the ephemeral ponds eventually reaches the Aquifer. Gulf is therefore carefully evaluating these features as a part of hydrogeologic studies, as described in subsection 2.5.1.1, "Sinks and Ponds."

2.4.1.3 Regional Structure - As shown in figure 2.4-2, Caryville is located on the western flank of the Chattahoochee arch, a broad anticlinal structure of low relief trending northeast-southwest; this arch is reported to crest in Holmes, Washington, and Jackson Counties, Florida (2). As reported in the literature (2, 3, 4), uplift of the arch causes limestone of late Eocene age to occur near the surface in an area where Miocene and younger stratigraphic units would normally be exposed. (See figure 2.4-3.) Formations in the Caryville area strike N 70° to 75° W and dip southwest from 15 to 20 feet per mile. 2

Considerable relief occurs on the top of the limestone as can be noted on the sample logs and drillers logs given in Section 2 of Appendix B. Severe weathering took place and considerable amounts of limestone were removed by erosion prior to deposition of the floodplain and alluvial terrace deposits. Solution weathering of the limestone by ground water is continuing even now, but presents no problem to the plant siting.

2.4.1.4 Stratigraphy - Study of drill cutting samples from observation wells at the Caryville site, figure 2.4-4, has resulted in the identification 2

of the following stratigraphic units. These units, from oldest to youngest, are: the Tuscahoma Sand and Hatchetigbee Formation of early Eocene age; the Williston Formation and Crystal River Formation, that in this area constitute the Ocala Group of late Eocene age; the Marianna Limestone of Oligocene age; and alluvial floodplain and terrace deposits of Quaternary age. Alluvial terrace deposits are not included on the geologic map of Florida, figure 2.4-5, but details of these deposits are shown on the geologic map of Holmes and Washington Counties, figure 2.4-6. East-west and north-south stratigraphic units in the Caryville area are included as figures 2.4-6a and 2.4-10.

2.4.1.4.1 Tuscahoma Sand - One hundred fifty feet of the Tuscahoma Sand were penetrated in potable water supply test well No. 1. (See figure 2.4-6b.) The Tuscahoma consists mainly of medium-gray, silty, micaceous, carbonaceous clay with thin interbeds of very fine to fine, subangular, glauconitic, quartzose sand.

2.4.1.4.2 Hatchetigbee Formation - The Hatchetigbee Formation overlies the Tuscahoma Sand and in the water supply test well No. 1 is about 95 feet thick. The Bashi Marl Member, a distinctive bed of sandy impure fossiliferous limestone about 10 feet thick at the base of the Hatchetigbee, separates the two formations. The Hatchetigbee above the Bashi is composed mainly of medium-gray, silty, micaceous, carbonaceous 2
clay with thin interbeds of very fine to fine, subangular, glauconitic, quartzose sand.

2.4.1.4.3 Claiborne Group - Overlying the Hatchetigbee Formation is the Claiborne Group of middle Eocene age. To the north in Alabama, the Claiborne Group is subdivided into the Tallahatta and Lisbon Formations, but the characteristics used to differentiate the two formations are not distinct in the Caryville area. The Claiborne Group is about 630 feet thick in the potable water supply test well No. 1. (See figure 2.4-6a.) Boring samples from wells drilled in the Caryville area indicate mostly fine to coarse quartzose sand, clayey sand, sandy limestone, and clay. A thin bed of yellowish-gray sandy limestone and coarse grained, green-tinted quartzose sand were selected as the top of the Claiborne in the Caryville area. Oysters and echinoids occur abundantly as fossils in the Claiborne and glauconite in varying proportions as the principal accessory mineral. The Claiborne Group is the primary source of municipal ground-water supplies in the Caryville area. The Claiborne Group strikes N 80°W in the eastern part of the area and N 70° to 75°W in the Caryville area. The dip is southwest from 15 to 20 feet per mile.

2.4.1.4.4 Williston Formation - The Williston Formation, at the base of the Ocala Group in the Caryville area, ranges in thickness from 70 feet in the northern part of the area to 100 feet in the southern part. The Williston consists mainly of very fine-grained glauconitic, sandy, dolomite, dolomitic limestone, and fine to coarse quartzose sand. Coquinoidal limestone occurs in varying amounts in the formation and is

distinctive in apperance because of the miliolid foraminifera content and the glauconite in the limestone is generally altered by weathering to shades of yellow and pale-orange. Very fine dolomite occurs as a constituent of the quartz sand in the formation. The crystals along with the sandy dolomite were probably formed after the formation was deposited by crystallization from ground water. The Williston is somewhat more resistant to weathering than the coquinoidal limestone that occurs in the overlying Crystal River Formation. The Williston underlies alluvial and terrace deposits in the area planned for construction of the generating facilities and Ash Disposal Area "A."

2.4.1.4.5 Crystal River Formation - The Crystal River Formation at the top of the Ocala Group is partially exposed northwest of the Caryville site. The Crystal River is exposed, although less than 10 feet, along Wrights Creek in the Ne of the NW of sec. 26, T. 5 N., R 16 W. (elevation 54 feet), and in the Nw of the Nw of sec. 35, T. 5 N., R. 16 W. (elevation 51 feet) (1). These outcrops are reported to be exposed at times of low water. The formation ranges in color from white to yellowish-gray, is very fine-grained, and dense in part. Generally, however, it is a massive coquinoidal limestone consisting of the complete and fragmentary tests of forminiferans and megafossils bound together with sparry calcite cement. Limestone beds in the lower part of the Crystal River are sandy and glauconitic. From 10 to 25 feet of medium to coarse, 2
sparsely glauconitic, quartzose sand separates the Crystal River from the underlying Williston Formation. The upper surface of the Crystal River is highly weathered and unevenly eroded. One hundred thirty feet of the formation were penetrated in Observation Well 24-1. (See Section 1 of Appendix B.) The Crystal River Formation is estimated to be about 180 feet thick in the Caryville vicinity. The rock ranges from soft to hard with small irregular well-indurated recrystallized lenses in the more weathered zones. The rock is reported to be nearly pure calcium carbonate in places and contains less than one percent impurities (3).

2.4.1.4.6 Marianna Limestone - The Marianna Limestone of Oligocene age unconformably overlies the Crystal River Formation. Four feet of the Marianna is exposed northwest of the plant site, one quarter of a mile west of Hathaway Mill, in the NW of the SE of sec. 26, T. 5 N., R. 16 W. (elevation 62 feet) (1). Limestone boulders of the Marianna are exposed on the hillslope on the southside of Hathaway Mill Creek. The boulders occur near the southeast corner of sec. 25, T. 5 N., R. 16 W., or about 400 feet northwest of Observation well No. 7, figure 2.4-4, (elevation 80 feet). The Marianna varies in color from white to yellowish-gray and is partly a soft chalky- to fine- grained limestone and is partly porous coquinoidal limestone composed of bryozoans, shelled invertebrates, and foraminiferans bound together with sparry calcite cement. The formation is about 95 percent calcium carbonate (3). The thickness of the formation ranges from a few feet to as much as 40 feet in Holmes and Washington Counties (1).

Only a few feet of the Marianna occurs in the vicinity of the Caryville site. Lithologically, the Crystal River and Marianna are very similar and sample descriptions of observation wells in the Caryville area that penetrate the Crystal River near land surface may also include some Marianna. Eight feet of the Marianna Limestone were penetrated in Observation Well No. 7 and were identified by the occurrence of fossil species typical of the Oligocene and the Marianna.

2.4.1.4.7 Quaternary Alluvium and Soils - Alluvial floodplain and terrace deposits unconformably overlie the limestone in the Caryville area. Floodplain deposits of clay, sand, and gravel occur immediately adjacent to and in the beds of the streams in the area. The somewhat older alluvial terrace deposits are exposed at higher elevations and consist of pale yellowish-orange to moderate-red fine to very coarse-grained quartzose argillaceous sand that is gravelly in places. Massive and lenticular clay beds and beds of sandy clay also occur within the terrace deposits. The gravels are mainly fine rounded pebbles of quartz and quartzite. The alluvial floodplain and terrace deposits are similar in nature and are described in the sample logs as a single undifferentiated unit termed Quaternary alluvium. The alluvial deposits are described may also include unrecognized Miocene stratigraphic units that are not defined in reports of the area. Alluvial deposits range in thickness from about 20 feet to 310 feet. The thickness of alluvial deposits 2
overlying limestone is shown in figures 2.4-7 and -8.

Four depositional alluvial terraces which occur along the Choctawhatchee River have been mapped (1). The terraces are separated by escarpments and are similar in origin to the present flood plain. Each level represents a period of valley cutting. The levels recognized are a 10- to 20-foot surface, 30- to 50-foot surface, 60- to 100-foot surface, and a 145- to 165-foot surface (1). Most of the Caryville site is located on highly disseceted remnants of the three lowest alluvial terraces, figure 2.4-6.

Clay beds occurring at the observation well sites should also occur in the substrata in the areas planned for ash disposal, detention ponds, and coal storage. Test borings within Ash Disposal Area "A" were made to verify the extent of clay beds.

Soils in the plant area are relatively thin, mainly sandy, and low in organic content. Top soil thicknesses in test borings range from 0.3 foot to 3.0 feet and average 1.0 foot or less. Fine-size quartz pebble gravels also occur locally in the upper soil layers.

2.4.1.5 Geologic Structure - Rocks in the area generally strike N 70° to N 80°W and dip gently to the southwest from 15 to 20 feet per mile. The structural contour map of the area drawn on the top of the Claiborne Group shows that the rate of dip increases slightly towards 2
the coast, figure 2.4-6c.

2.4.1.6 Remote Sensing Studies - Because of the extensive cover of alluvial terrace deposits, only limited information concerning the bedrock limestone geology of the area could be obtained by conventional field methods. Gulf therefore employed remote sensing techniques to aid in the study of the Caryville site. It was hoped that remotely sensed data could be added to this data base. Such information in a carbonate terrane is known to be helpful in locating soil moisture anomalies, subsurface voids, areas of potential collapse, and zones of fracturing (5, 6, 7, 8).

To provide the desired additional data, Gulf conducted studies using the Caryville 7 and 1/2-minute topographic quadrangle map, infrared photography, a thermal infrared mosaic and ERTS-1 (Earth Resource Technology Satellite) imagery. The studies showed a number of alignments, fracture traces, and lineaments suggestive of fracturing which may be related to subsurface karstic development in the underlying limestone; however, the results of the studies showed no evidence of collapse within the alluvial terrace deposits in the immediate area of the plant site.

2.4.1.6.1 Procedures - The ponds, swampy undrained depressions, and shallow dry depressions that dot the landscape of the Caryville area are related to solution development in the limestones that underlie the thin veneer of alluvial terrace deposits in the area. Even a casual examination of maps, photographs, and images of the area reveals the rectilinear character of many of the ponds and swamps which suggests control by factures. The orientation of these surface features was measured directly from the Caryville 7 and 1/2-minute quadrangle. This technique was used before visiting the Caryville area and before receiving photographic data. (See figures 2.4-9 and -10.)

A 35 square-mile area surrounding the plant site was studied. This area is bounded on the northwest by the NW/cor., sec. 16, T. 5 N., R. 16 W.; on the northeast by the NE/cor., sec. 18, T. 5 N., R. 15 W.; on the southeast by the SE1/4 of sec. 18, T. 4 N., R. 15 W.; and on the southwest by the SW1/4 of sec. 16, T. 4 N., R. 16 W. The orientation of each lake and depression area (hachured contours) shown within the study area was measured and placed into one of three categories: (a) unidirectional, (b) bidirectional, or (c) equidimensional. Most of the ponds and undrained depressions in the area demonstrated a single direction of elongation (unidirectional); a number were essentially round in outline (equidimensional); and a few exhibited to axes of elongation (bidirectional). One hundred sixteen orientations occurred within the 146 recorded features; no orientation value was assigned to equidimensional features. The orientation

data of the unidirectional and bidirectional features were plotted at 10° intervals on a rose diagram for analysis and cmparison. (See figure 2.4-9.)

The color infrared photography of the Caryville area evaluated is at a scale of approximately 1:48,000. This was studied for subtle differences in vegetative vigor suggestive of variations in soil moisture content which could represent subsurface geologic or hydrologic conditions. The color infrared photography, figure 2.4-10, was much more useful in delineating the boundaries of swamps than the 7 and 1/2-minute quadrangle owing to the difference in the spectral signatures of the lower swampy areas (purple) and the higher relatively dry areas (red). Initial analysis revealed a rectilinear character of many of the ponds, swamps, drainages, and zones of high soil moisture. Such short straight segments on aerial photographs have been called "fracture traces" provided they are less than one mile in length (9).

Fracture traces, consisting of straight segments of ponds, swamps, drainages, and zones of high moisture content, were plotted on a clear overlay superimposed on one of the color infrared transparencies. This procedure was carried out under stereoscopic view. The spectral signature difference, together with relative topographic control provided by stereo viewing, aided in the interpretation of the fracture traces. An area of approximately 7.3 square miles in the vicinity of the plant site was evaluated and the locations of 243 separate fracture traces were plotted. (See figure 2.4-10.) Their orientations were plotted at 10° intervals on a rose diagram for analysis and comparison. (See figure 2.4-11.)

Black and white prints of color infrared photographs were used to plot long linear alignments which were not possible to delineate on the transparencies. These alignments were difficult to see through conventional viewing; therefore, rather than viewing the print with the eye essentially perpendicular to the picture, the photographs were viewed with the eye at a low angle. This technique allows delineation of subtle long-linear features which were transferred to a clear overlay. Such features that are longer than one mile in length are termed "lineaments" (9). (The term "lineament" is applied to naturally occurring linear features delineated from aerial or space images and consists of topographic, vegetative, or soil tonal alignments that are at least partially continuous for distances greater than one mile (10).) Lineaments have been variously termed "linears," "lineations," or "linear features" by others, but these all refer to the same phenomena. On photography or imagery, lineaments are expressed as narrow elongate dark and/or light patches that are aligned along a straight or gently curved line. The cause or causes for lineaments are sometimes known, but most often are unknown. Because very few lineaments have been located on the ground and studied in detail, it is often difficult to define the nature of the elements that make them up. It has been the experience of geologists, however,

that they represent one or a combination of the following surface phenomena: aligned offsets along several adjacent streams, straight stream segments, alignment of gaps or saddles of several adjacent ridges, alignment of adjacent ridge terminations, soil tonal differences, soil moisture differences, and land-use patterns. The latter phenomenon can only be called a true lineament when the land-use pattern enhances a naturally occurring surface feature. In such cases, the linear feature is generally expressed beyond the limits of cultural influence. Such surface features may be the direct result of structural control, i.e., joints, faults, other types of brittle fracture phenomena, and/or structural axes. In other cases they may represent geologic units, lithologic horizons, mineral bandings, unconformities, or rock boundaries. Gulf studied an area of approximately nine square miles in the vicinity of the plant site and plotted the locations of 47 major lineament traces. (See figures 2.4-12 and -13.) Their orientations are plotted at a 10° interval on a rose diagram for analysis and comparison. (See figure 2.4-14.)

The thermal infrared mosaic of the Caryville area evaluated is at a scale of approximately 1:12,000. Thermal signatures for differential soil moisture in the area showed very subtle changes along linear alignments. These were plotted as lineaments. An area of 4.7 square miles in the vicinity of the plant site was evaluated and 137 lineament traces were located. Their orientations were plotted at a 10° interval on a rose diagram for analysis and comparison. (See figure 2.4-15.)

Data collected by ERTS-1 were used to evaluate the regional lineament orientations in Walton, Holmes, and Washington Counties, Florida. Lineaments were plotted on a band 5 (red spectral band) image (ERTS E-1085-15503-5) recorded at about 10:00 a.m. October 16, 1972, by ERTS-1. The image used is 115 miles on a side and is at a scale of approximately 1:1,000,000. Lineaments so delineated were drawn on a clear overlay. One hundred sixteen separate regional lineaments were plotted for the three-county area. (See figure 2.4-16.) Their orientations are measured, recorded, and plotted on a 10° interval rose diagram. (See figure 2.4-17.)

2.4.1.6.2 Discussion - None of the data analyzed exhibited annular spectral signatures which would suggest evidence of incipient collapse within the alluvial terrace deposits in the vicinity of the proposed plant site.

The alignment of ponds and undrained depressions on topographic maps; the rectilinear character of ponds, swamps, drainages, and zones of high soil moisture of the color infrared photographs; and the lineaments of the color infrared photographs, thermal mosaic, and ERTS-1 imagery of the area apparently reflect the regional patterns of fractures that cut the underlying limestone.

Analyses of the linear features from these many data sources show that several directions seem to recur. (See figures 2.4-9, -11, -14, -15, and -17.) Perhaps the most common orientation lies between N40° and

70°W, generally averaging approximately N60°W. The color infrared lineaments, figure 2.4-14, and the thermal infrared lineaments, figure 2.4-15, show excellent correlation for this direction, and fracture trace data, figure 2.4-11, are also closely similar. The lineaments delineated on ERTS-1 imagery, figure 2.4-17, show this orientation to be of regional significance also. The regional lineaments measured in northern Florida (11) also show a strong high in the vicinity of N50°-60°W. (See figure 2.4-18.) N48°W (132°) is the characteristic strike of the northern Florida lineaments (11).

Other recurring orientations of considerable importance are those lying between N30° and 60°E and generally averaging approximately N45°E. The pond and undrained depression alignments, figure 2.4-9, the color infrared lineaments, figure 2.4-14, and ERTS-1 lineaments, figure 2.4-17, show excellent correlation for this direction. The thermal infrared data, figure 2.4-15, and the fracture trace data, figure 2.4-11, however, show somewhat poorer correlation, but still fall within the broad range. Again, the excellent correlation of this direction with the ERTS-1 lineaments suggest regional significance. This fact is borne out by an analysis of the regional lineaments of northern Florida which show a marked high, averaging N48°E (12). (See figure 2.4-18.)

Another orientation, east to west, is somewhat less important. All of the data analyzed, with the exception of the lineaments derived from the color infrared data, figure 2.4-14, show this direction to be of moderate importance; other data show it to be insignificant (11). (See figure 2.4-18.)

Peaks in the vicinity of north-south are generally either low or missing in most of the data. A notable exception is the ERTS-1 data. (See figure 2.4-17.) It is quite possible that part of the reason for this peak is due to the plotting of lineaments along cultural boundaries.

The two most prominent orientations discussed above appear to have regional significance and are very likely related to the regional fracture pattern. The fact that ponds, swamps, undrained depressions, drainages, and zones of high soil moisture exhibit straight segments which are similar in orientation to these regional directions very strongly suggests that the lineaments are lines along which solution in the limestones has occurred. The black and white print of the color infrared photograph, figure 2.4-12, and a thermal infrared mosaic, both show the relationship of the lineaments to the plant site area. Several lineaments cut the plant site itself and many traverse the ash disposal areas.

Under certain circumstances (such as repetitive violent earthquakes or prolonged drastic fluctuations in the water table), such fracture-related lineaments could represent a potential hazard to the plant site and ash disposal area; however, earthquake epicenters have never been recorded in the Florida panhandle or the adjacent parts of southeastern

Alabama and southwestern Georgia (13), and drastic water table fluctuations are not likely in this area since it is an active recharge area.

Initially, this study (paragraph two in subsection 2.4.1.6.1) was undertaken with the possibility of lineament related hazards in mind. At that time, it was known that beneath the veneer of unconsolidated materials, the area was underlain by limestone. It was also known that the numerous ponds, swamps, and undrained depressions in the area were suggestive of a karstic terrain. The fact that the alignments of straight segments of ponds, swamps, undrained depressions, and drainages show preferred orientations and that they match local and regional lineaments suggests that the lineaments represent fractures which have controlled depression formation. The development of these surface features along with solution of the underlying limestones probably took place at an earlier period in geologic time when the water table was much lower. Solution activity is greatest near the water table. Test drilling in the vicinity of the plant site and in the ash disposal area has shown that the limestone is at considerable depth throughout most of the area and well below the present water table. Because of this current situation, little or no solution along the earlier formed solution network in the limestone should be taking place. As a result of this low level or induced absence of solution in the underlying limestones, the overlying unconsolidated materials are, as well, stable and unlikely to be prone to collapse and subsequent swamp, pond, and undrained depression formation. This condition of near-equilibrium should persist in the area unless some condition (man-induced or natural) causes a marked lowering of the water table. Lineaments across the plant site area should, therefore, be of no particular concern.

Beneath the overburden exists a highly irregular, karstic, limestone surface ranging in depth below land surface from a few feet to over two hundred feet. In some places, the upper surface of the limestone is separated from the overburden-shallow aquifer by impermeable clay; in other places, the limestone is directly overlain by permeable sand. Test drilling in the disposal area shows the limestone surface has a relief of about 15 feet. Therefore, for the area of the disposal site, there is potential hydrological connection between the overburden, or shallow aquifer, and the underlying limestone or deeper aquifer. 2

During the pumping tests on the deep potable water supply well No. 2, as water was drawn down in the pumped well, it affected the water level in the limestone aquifer (deep aquifer) as well as the water level in the shallow well in the overburden.

The water table map for the area, dated January 6, 1975, figure 2.5-17, shows that the general gradient and direction of movement of water for Ash Disposal Area "A" is toward the west.

From the pumping test on the shallow aquifer, transmissibility and storage coefficients were computed and the underflow determined as approximately 12,000 gallons per day per mile width of the aquifer from the Ash Disposal Area "A."

A Fence diagram of Ash Disposal Area "A" is shown in figure 2.4-19. The information was obtained from drillings and test borings in Ash Disposal Area "A" as contained in Sections 2 and 3, respectively, of Appendix B. 2

2.4.2 References

(1) Vernon, R. O., "Geology of Holmes and Washington Counties, Florida." Florida Geol. Survey Bull. 21, 1942.

(2) Puri, H. S. and R. O. Vernon, "Summary of the geology of Florida and guidebook to the classic exposures." Florida Geol. Survey, Spec. Pub. No. 5, 1964.

(3) Reves, W. D., "The limestone resources of Washington, Holmes, and Jackson Counties, Florida." Florida Geol. Survey Bull. 42, 1961.

(4) Chen, C. S. "The regional lithostratigraphic analysis of Paleocene and Eocene rocks of Florida." Florida Geol. Survey Bull. 45, 1965. (Referenced in title block of figure 2.4-2.)

(5) Powell, W. J., C. W. Copeland, and J. A. Drahovzal. "Delineation of linear features and application to reservoir engineering using Apollo 9 multispectral photography." Alabama Geol. Survey Inf. Series 41, 1970.

(6) Newton, J. G. and L. W. Hyde. "Sinkhole problem in and near Robert's Industrial Subdivision, Birmingham, Alabama - a reconnaissance." Alabama Geol. Survey Circ. 68, 1971.

(7) Newton, J. G., C. W. Copeland, and W. L. Scarbrough. "Sinkhole problem along proposed route of Interstate Highway 459 near Greenwood, Alabama." Alabama Geol. Survey, Circ. 83, 1973.

(8) Warren, W. M. and C. C. Wielchowsky. "Aerial remote sensing of carbonate terranes in Shelby County, Alabama." Alabama Geol. Survey Rep. Series 26, p. 14, 1973.

(9) Lattman, L. H. "Technique of mapping geologic fracture traces and lineaments on aerial photographs." Photogramm. Eng., Vol. 24, No. 4, pp. 568-576, 1958.

(10) Ibid., p. 569.

(11) Vernon, R. O. "Geology of Citrus and Levy Counties, Florida." Florida Geol. Survey Bull. 33, 1951.

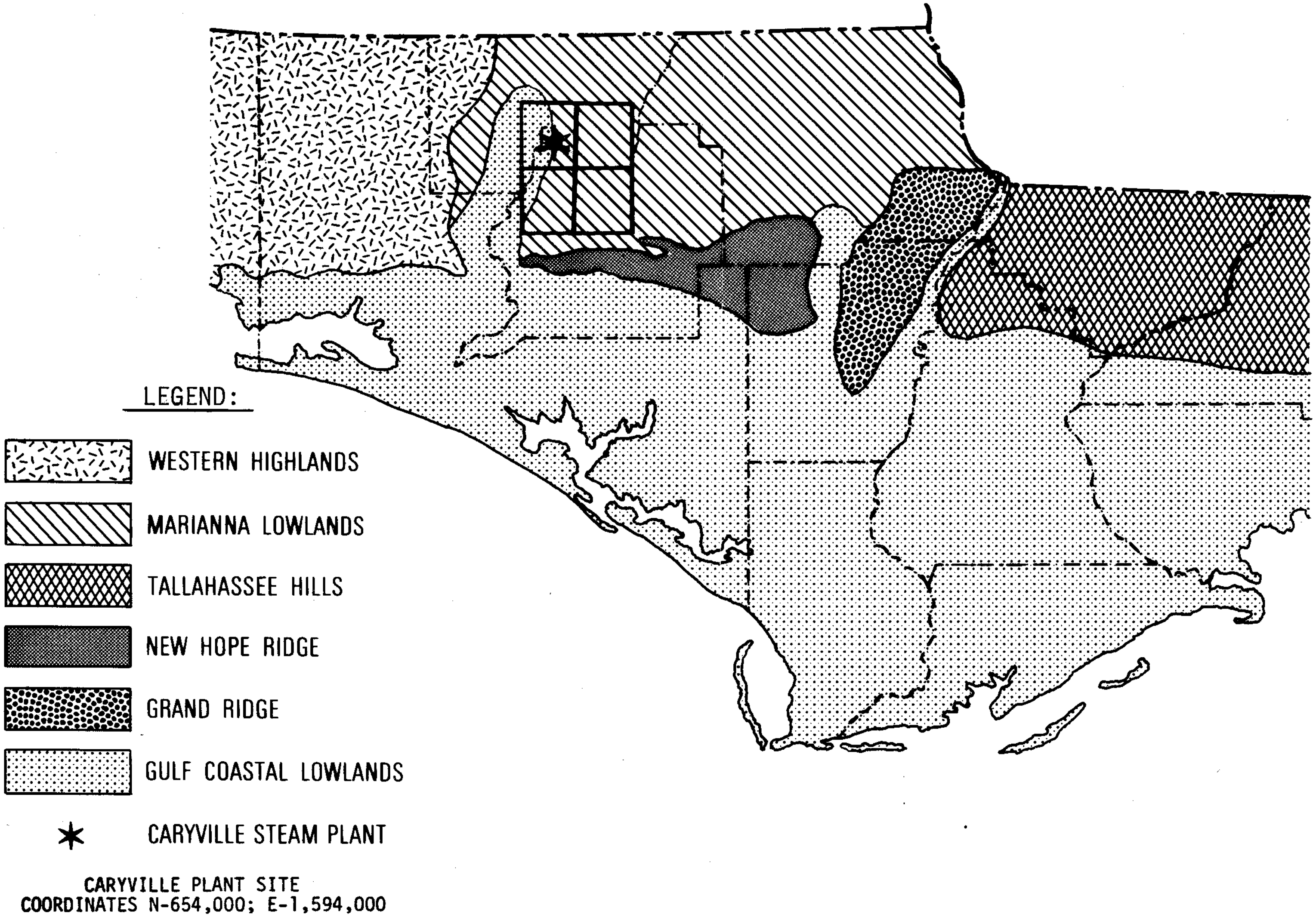
(12) Gay, S. P. "Pervasive orthogonal fracturing in the earth's continental crust." Tech. Pub. No. 2, Am. Stereo Map Co., Salt Lake City, 1973.

(13) Eppley, R. A. Earthquake History of the United States, Part 1, Stronger Earthquakes of the United States (Exclusive of California and Western Nevada), U. S. Dept. of Commerce, Environmental Science Services Administration, Coast and Geodetic Survey, 1965.

(14) Cohee, G. V. Tectonic map of the United States exclusive of Alaska and Hawaii, U. S. Geol. Survey and Am. Assoc. Petroleum Geologists, 1962. (Referenced in title block of figure 2.4-2.)

(15) Pressler, E. D. "Geology and occurrence of oil in Florida." Am. Assoc. Petroleum Geologists Bull. Vol. 31, pp. 1851-1862, 1947. (Referenced in title block of figure 2.4-2.)

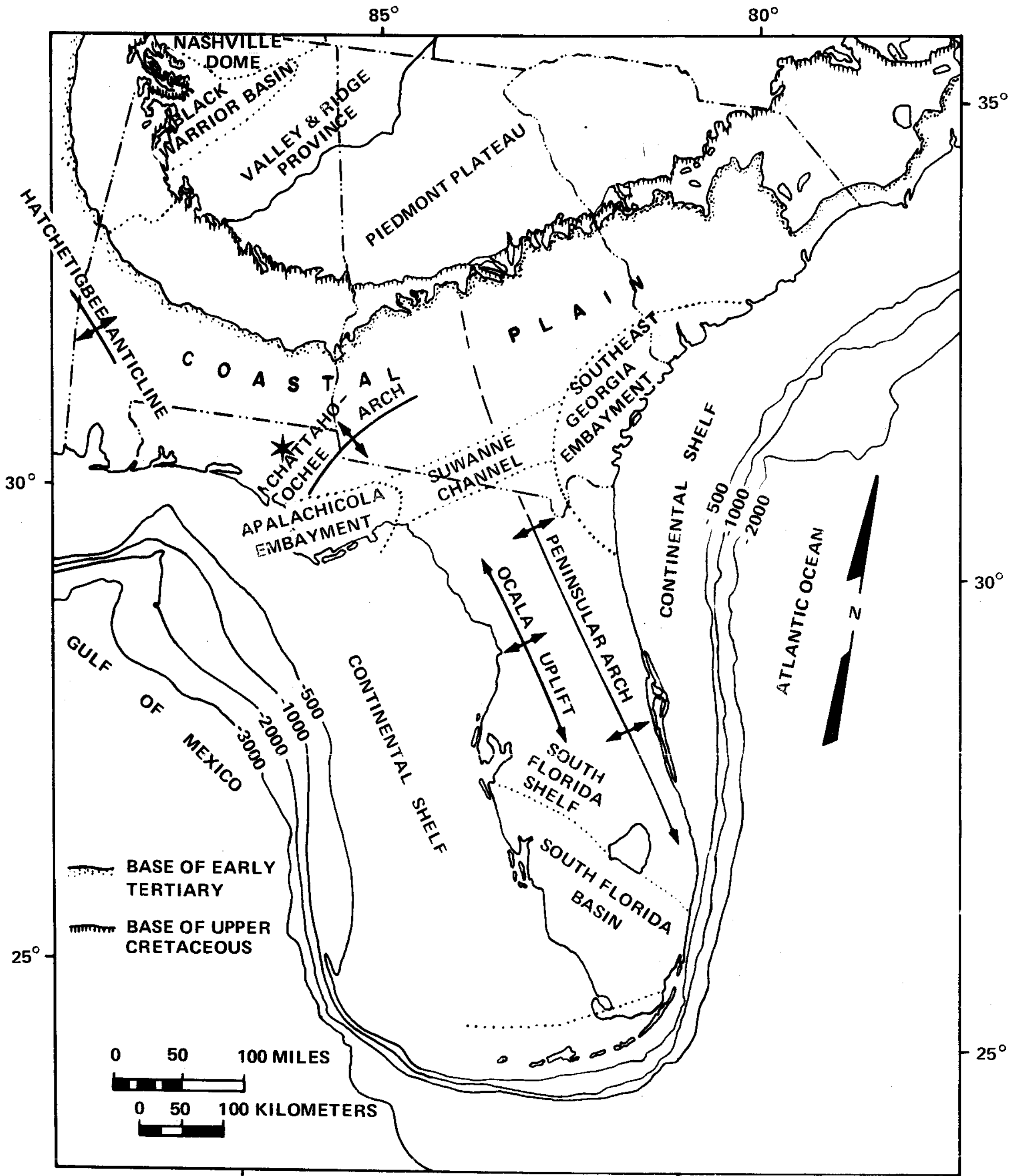
(16) Vernon, R. O. and H. S. Puri. "Geologic map of Florida." Florida Geol. Survey Map Series No. 18, scale 30 miles to 1 inch, 1965. (Referenced in title block of figure 2.4-5.)



GULF POWER CO.
CARYVILLE STEAM PLANT

PHYSIOGRAPHIC SUBDIVISIONS OF NORTHWEST FLORIDA

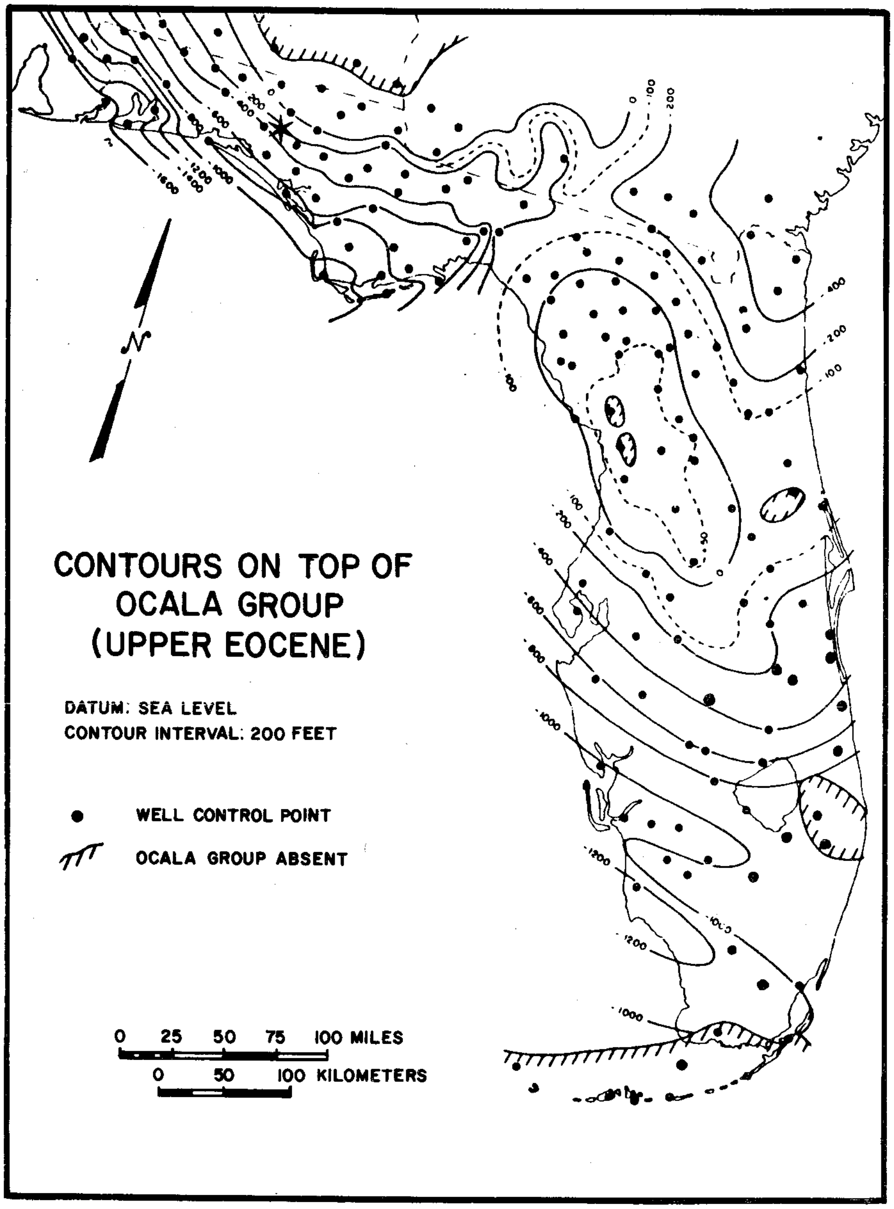
FIGURE 2.4-1



✱ CARYVILLE STEAM PLANT
CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

AMENDMENT 2 8/75

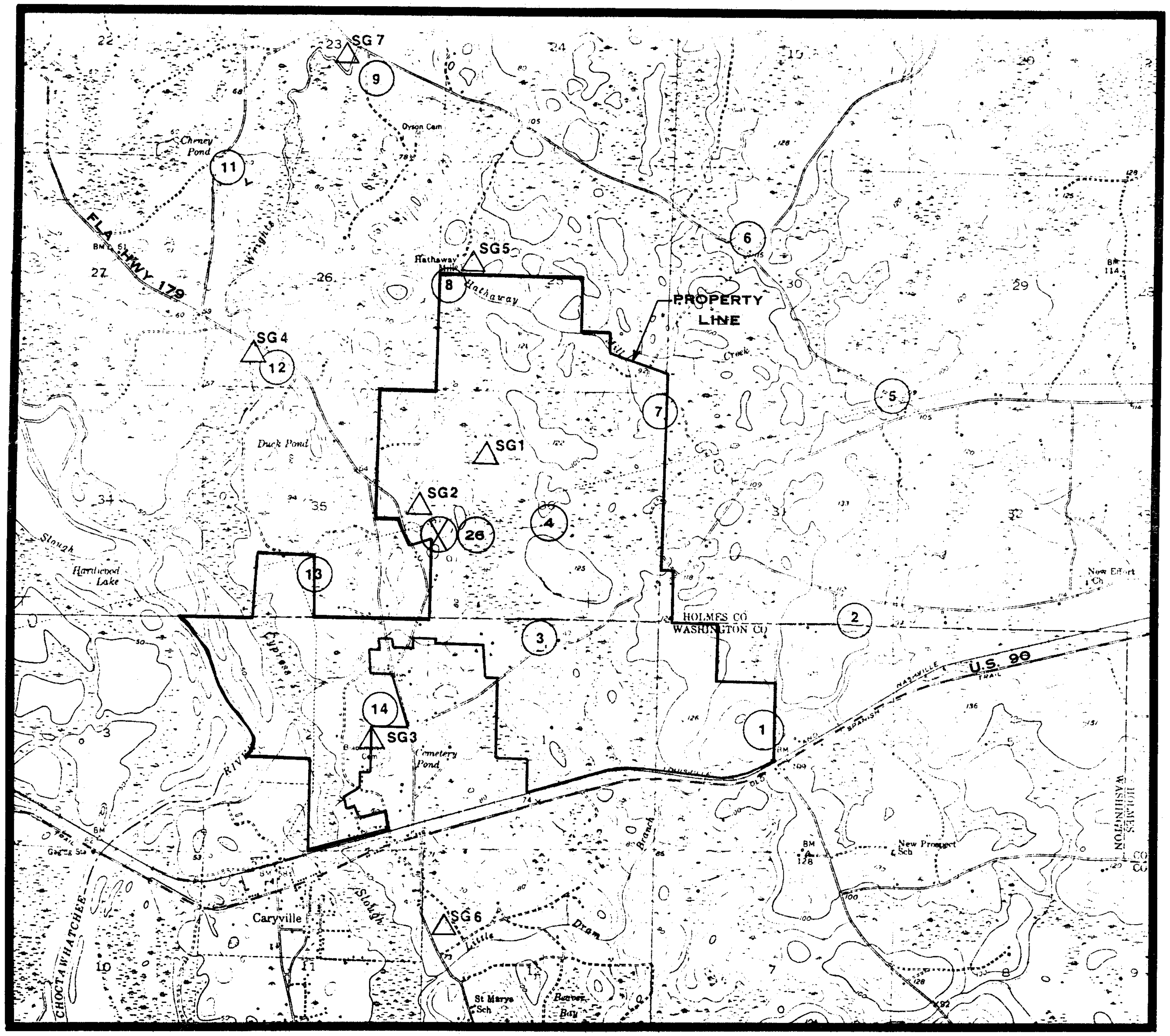
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	MAJOR STRUCTURAL FEATURES OF SOUTH-EASTERN COASTAL PLAIN (MODIFIED FROM REFERENCES 4, 14, 15) FIGURE 2.4-2



✱ CARYVILLE STEAM PLANT

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	STRUCTURE MAP OF FLORIDA SHOWING CONTOURS ON TOP OF UPPER EOCENE (FROM REFERENCE 4)
		FIGURE 2.4-3



LEGEND:

- OBSERVATION WELLS
- STAFF GAUGES
- POTABLE WATER SUPPLY WELL NO. 2

SG-1 - POND
SG-2
SG-3
SG-4 - WRIGHTS CREEK
SG-5 - HATHAWAY MILL CREEK
SG-6 - LITTLE DRAM BRANCH
SG-7 - WRIGHTS CREEK

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

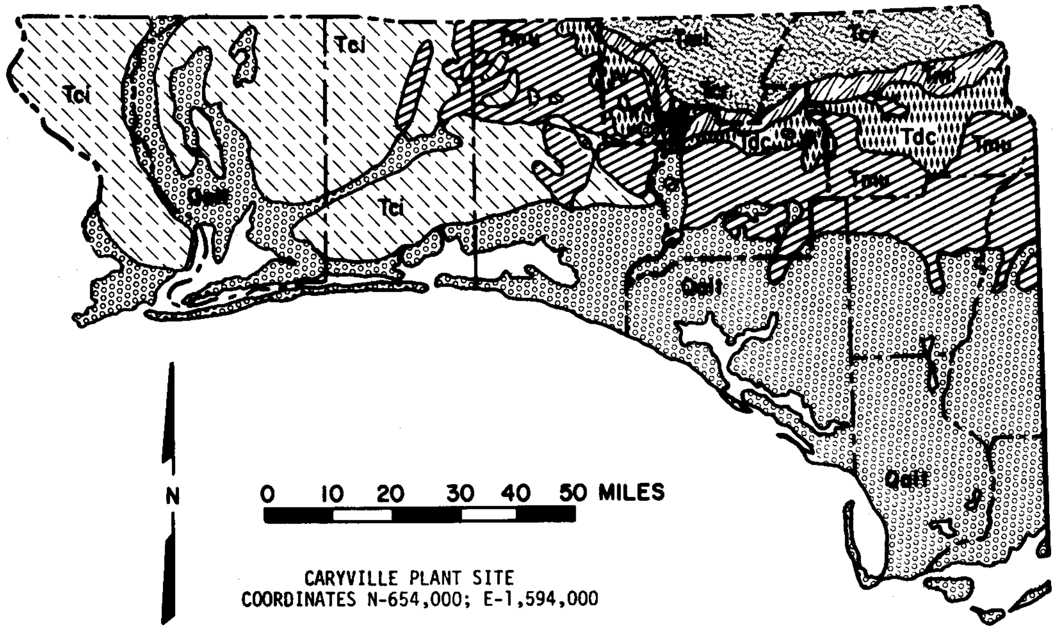
NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

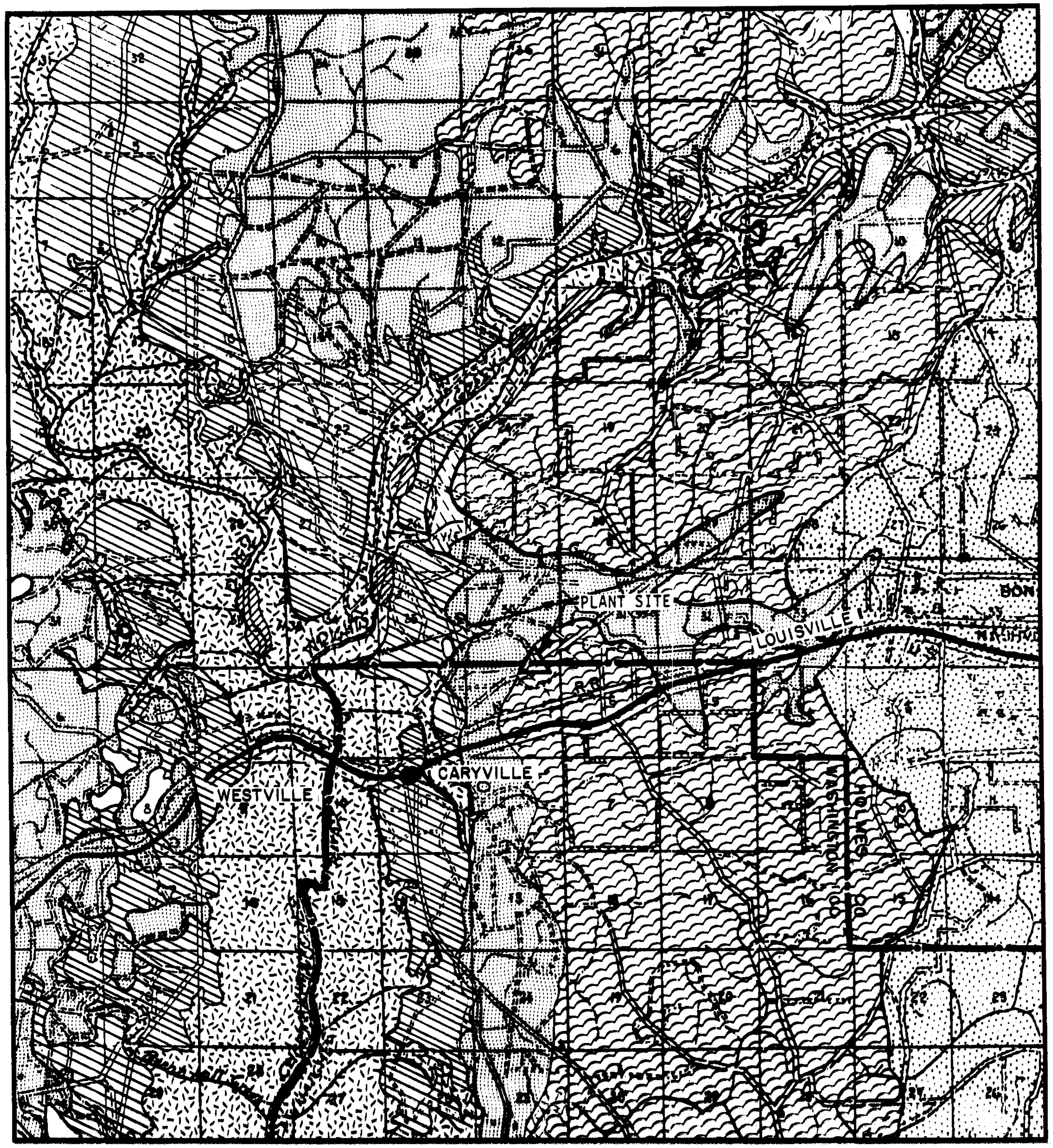
LOCATIONS OF OBSERVATION WELLS AND STAFF GAGES NEAR THE PLANT SITE

FIGURE 2.4-4



	Qalt	Alluvial and Marine Terrace Deposits (Holocene and Pleistocene)
	Tci	Citronelle Formation (Pliocene)
	Tmu	Miocene, Undifferentiated
	Tdc	Duncan Church Beds (Oligocene)
	Tml	Marianna Limestone (Oligocene)
	Tcr	Crystal River Formation (Eocene)
✶		Caryville Steam Plant

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	GEOLOGIC MAP OF THE NORTHWEST PANHANDLE OF FLORIDA (MODIFIED FROM REFERENCE 16)
		FIGURE 2.4-5



N

EXPLANATION

Quaternary	Holocene	Alluvium	
	Pliocene ? and Pleistocene	10 to 20 foot	Alluvial Terrace Deposit
		30 to 50 foot	
		60 to 100 foot	
		145 to 165 foot	
	Oligocene	Marianna Limestone	
	Eocene	Crystal River Formation (OCALA GROUP)	

SCALE
MILES
1 ½ 0 1 2 3

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

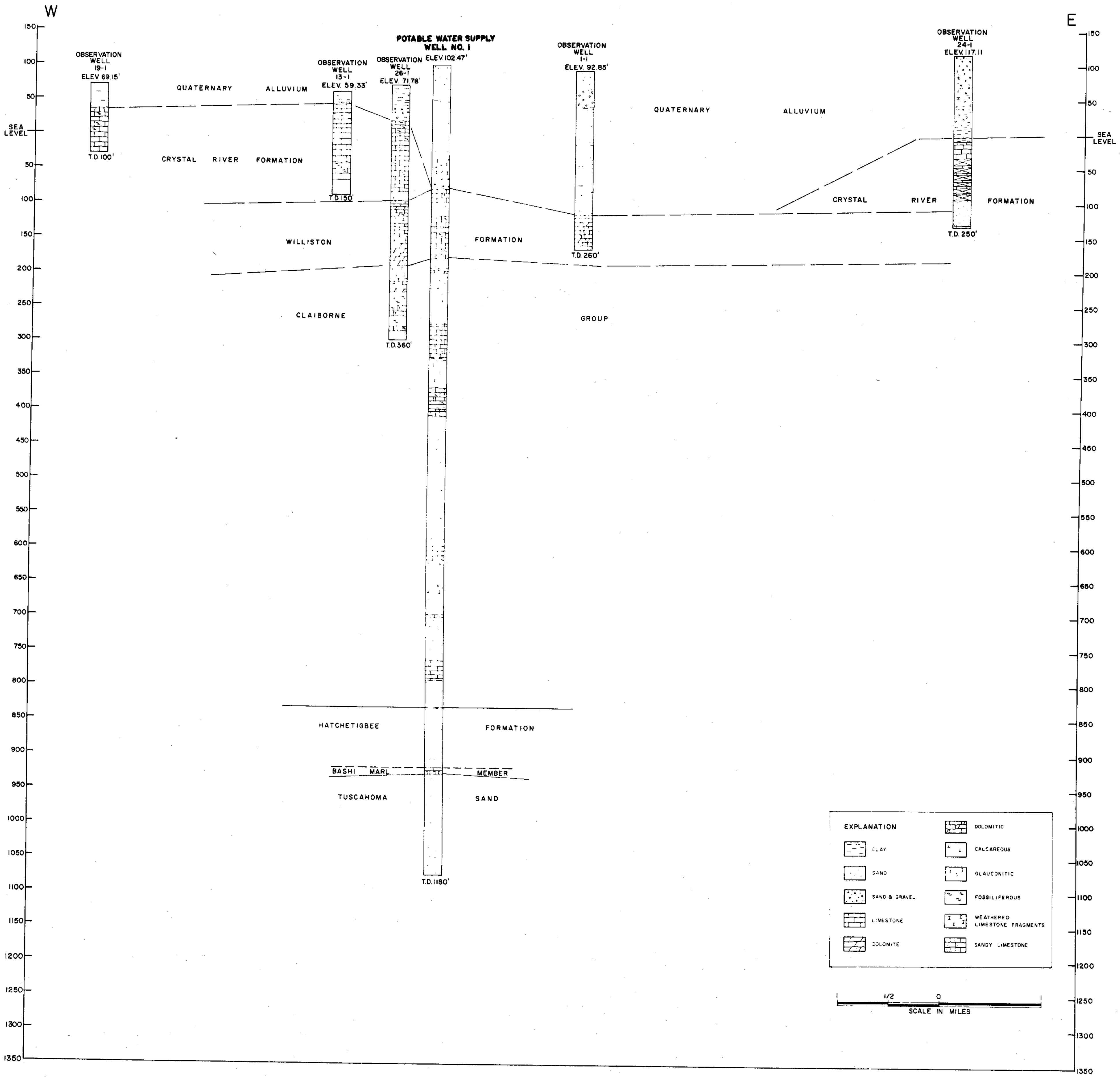
Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

GEOLOGIC MAP OF PARTS OF HOLMES AND WASHINGTON COUNTIES, FLORIDA (MODIFIED FROM REFERENCE 1)

FIGURE 2.4-6

Image Quality
As you review the next group of images, Please note that the original documents
were of poor quality.



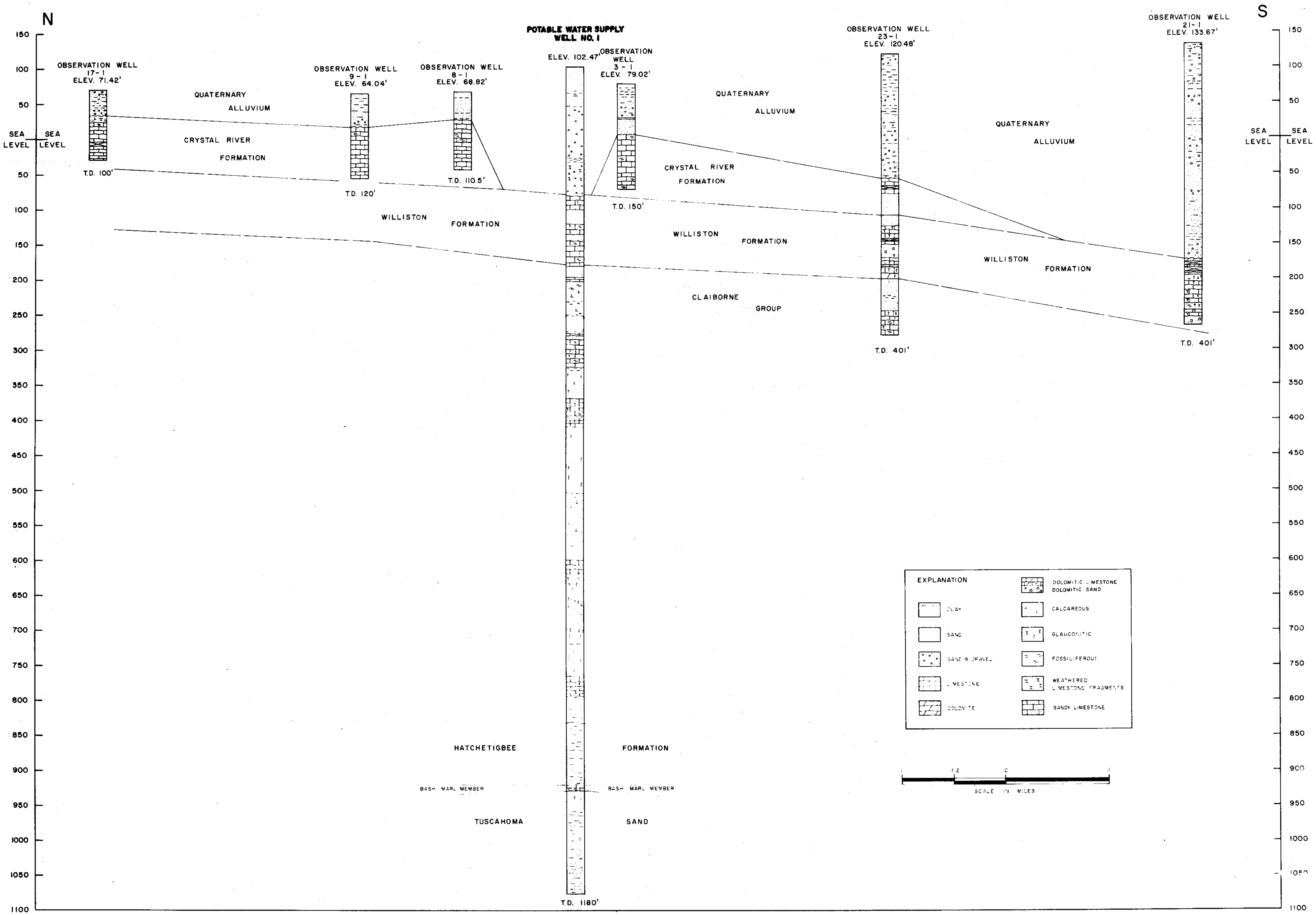
NOTE: LINE OF SECTION IS SHOWN ON STRUCTURAL CONTOUR MAP, FIGURE 2.4-6c.

AMENDMENT 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

EAST-WEST STRATIGRAPHIC CROSS SECTION

FIGURE 2.4-6a



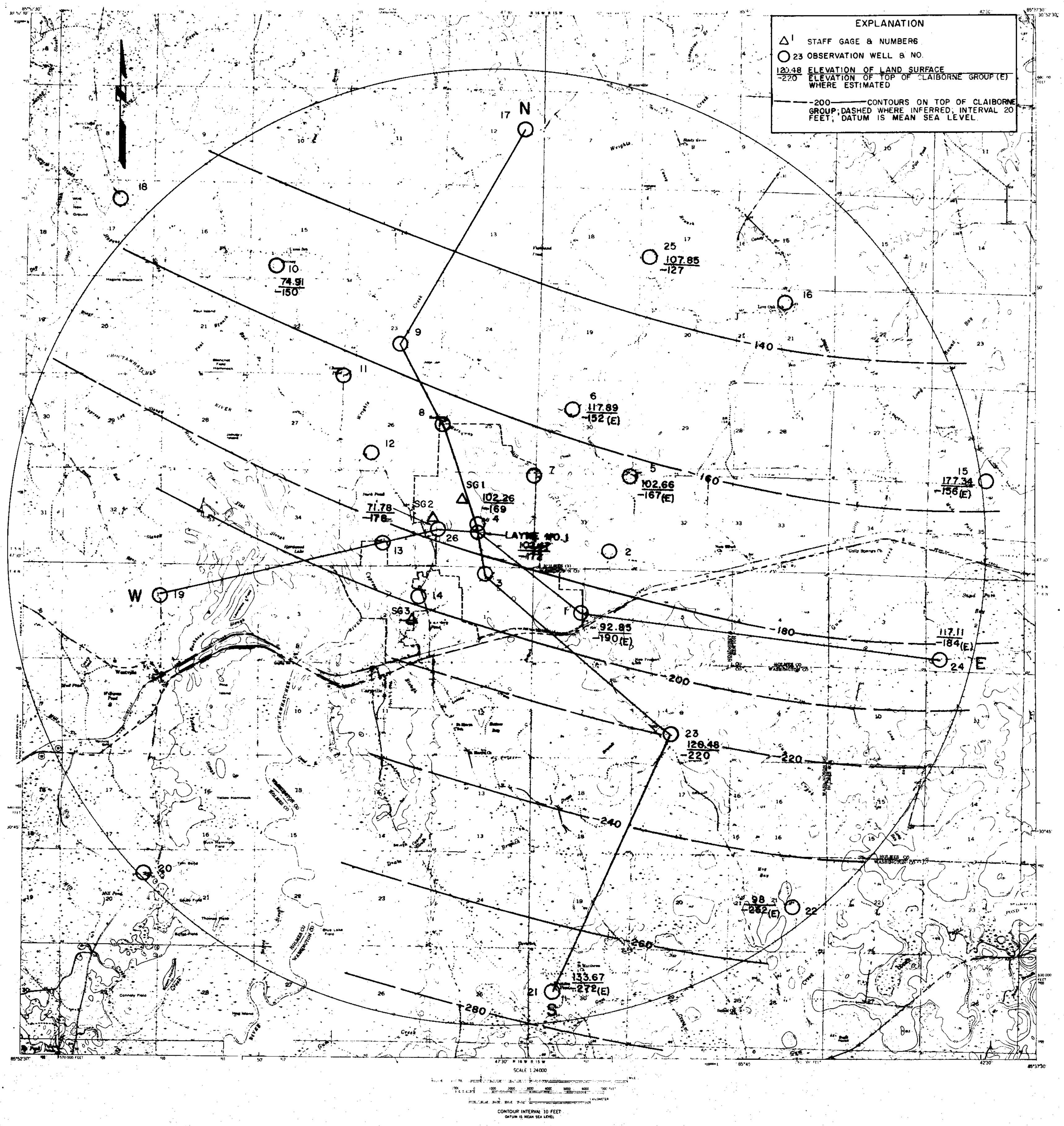
NOTE: LINE OF SECTION IS SHOWN ON STRUCTURAL CONTOUR MAP, FIGURE 2.4-6c.

AMENDMENT 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

NORTH-SOUTH STRATIGRAPHIC CROSS SECTION

FIGURE 2.4-6b



CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

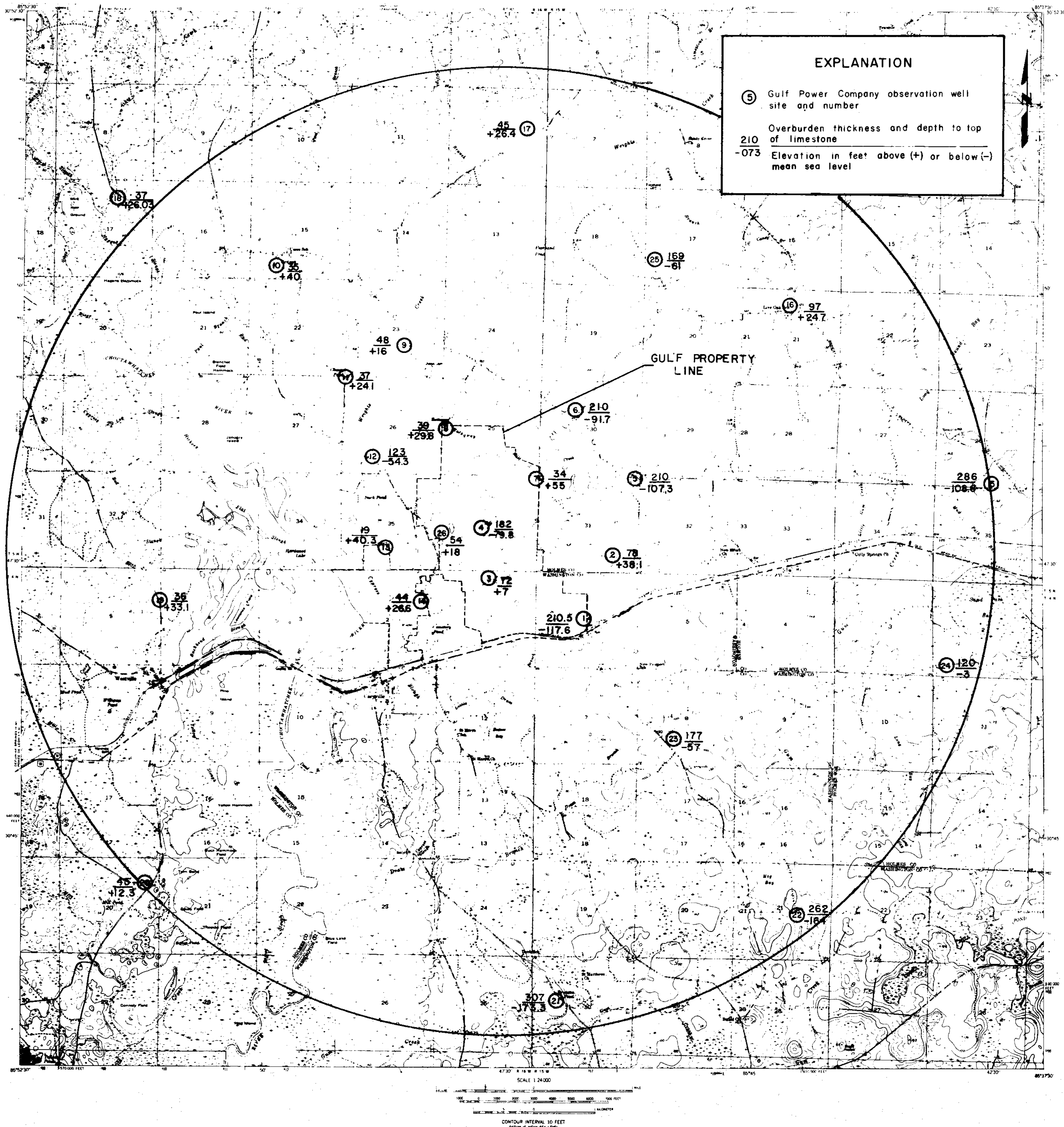
NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

AMENDMENT 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

STRUCTURE CONTOUR MAP SHOWING CONFIGURATION OF TOP OF CLAIBORNE GROUP

FIGURE 2.4-6c



CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

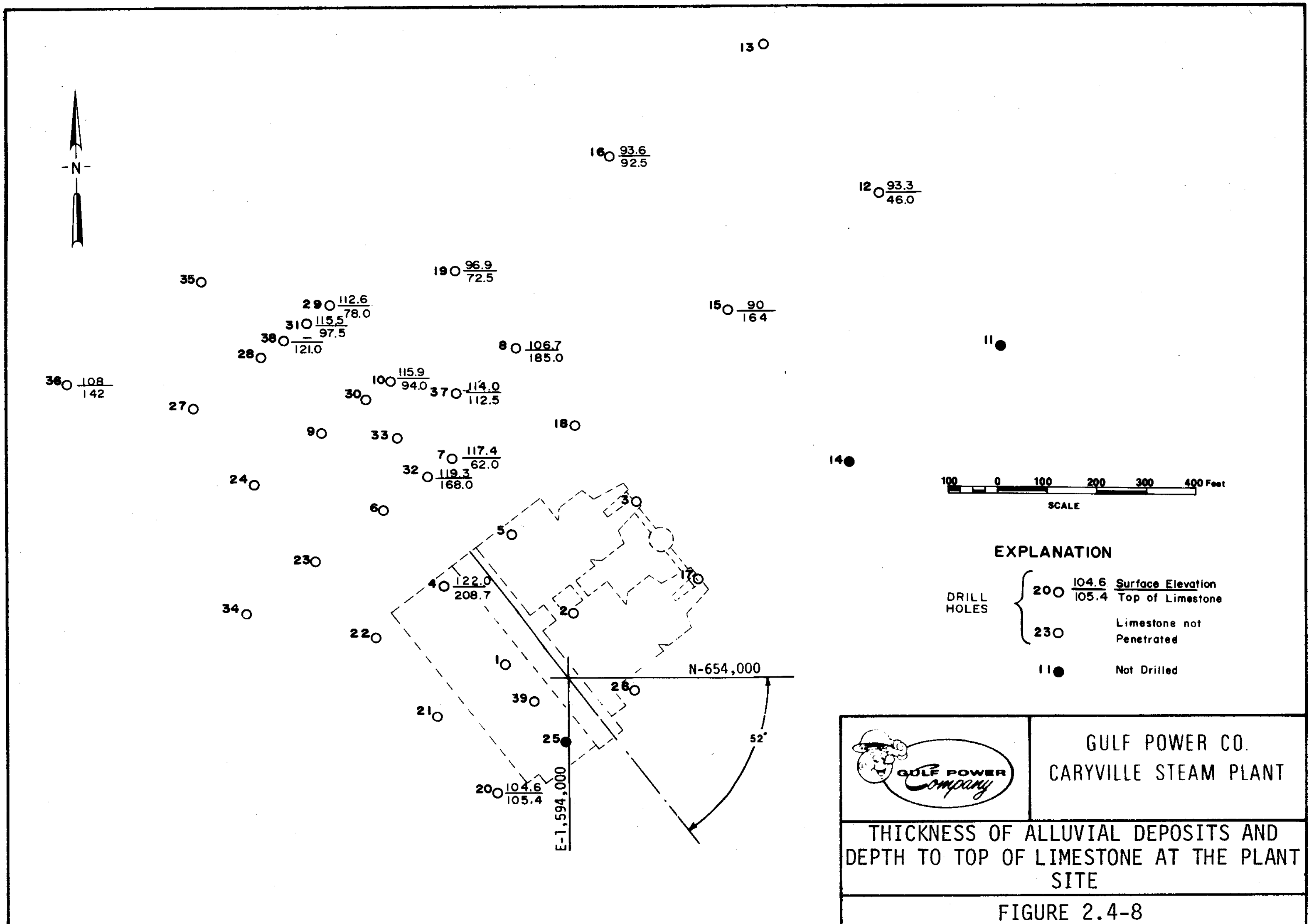
NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

AMENDMENT 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

THICKNESS OF ALLUVIAL DEPOSITS AND DEPTH TO TOP OF LIMESTONE IN CARYVILLE AREA

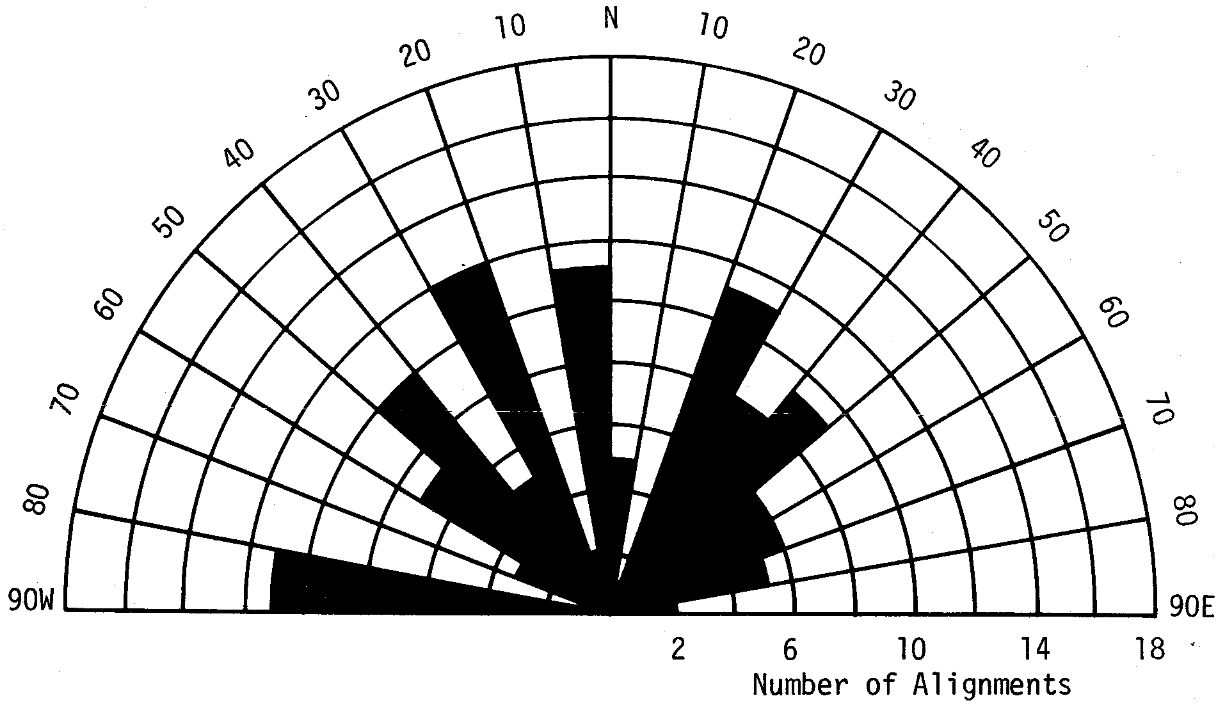
FIGURE 2.4-7



GULF POWER CO.
CARYVILLE STEAM PLANT

THICKNESS OF ALLUVIAL DEPOSITS AND DEPTH TO TOP OF LIMESTONE AT THE PLANT SITE

FIGURE 2.4-8



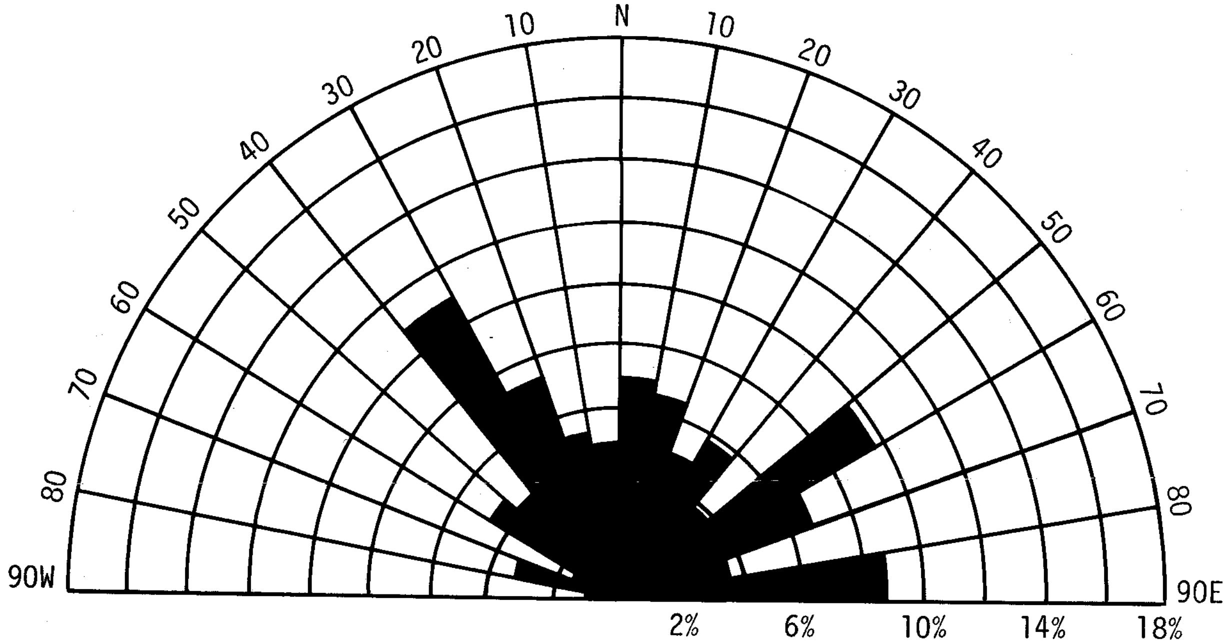
Gulf Power Company	GULF POWER CO. CARYVILLE STEAM PLANT	POND AND UNDRAINED DEPRESSION ORIENTATIONS ON THE CARYVILLE 7 AND 1/2-MINUTE QUADRANGLE
		FIGURE 2.4-9

N

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

Amendment 1 6/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	PHOTO OF THE COLOR INFRARED OF THE CARYVILLE AREA SHOWING FRACTURE TRACES
		FIGURE 2.4-10



GULF POWER CO.
CARYVILLE STEAM PLANT

FRACTURE TRACE ORIENTATIONS DERIVED FROM COLOR INFRARED PHOTOGRAPHY OF THE PROPOSED CARYVILLE SITE

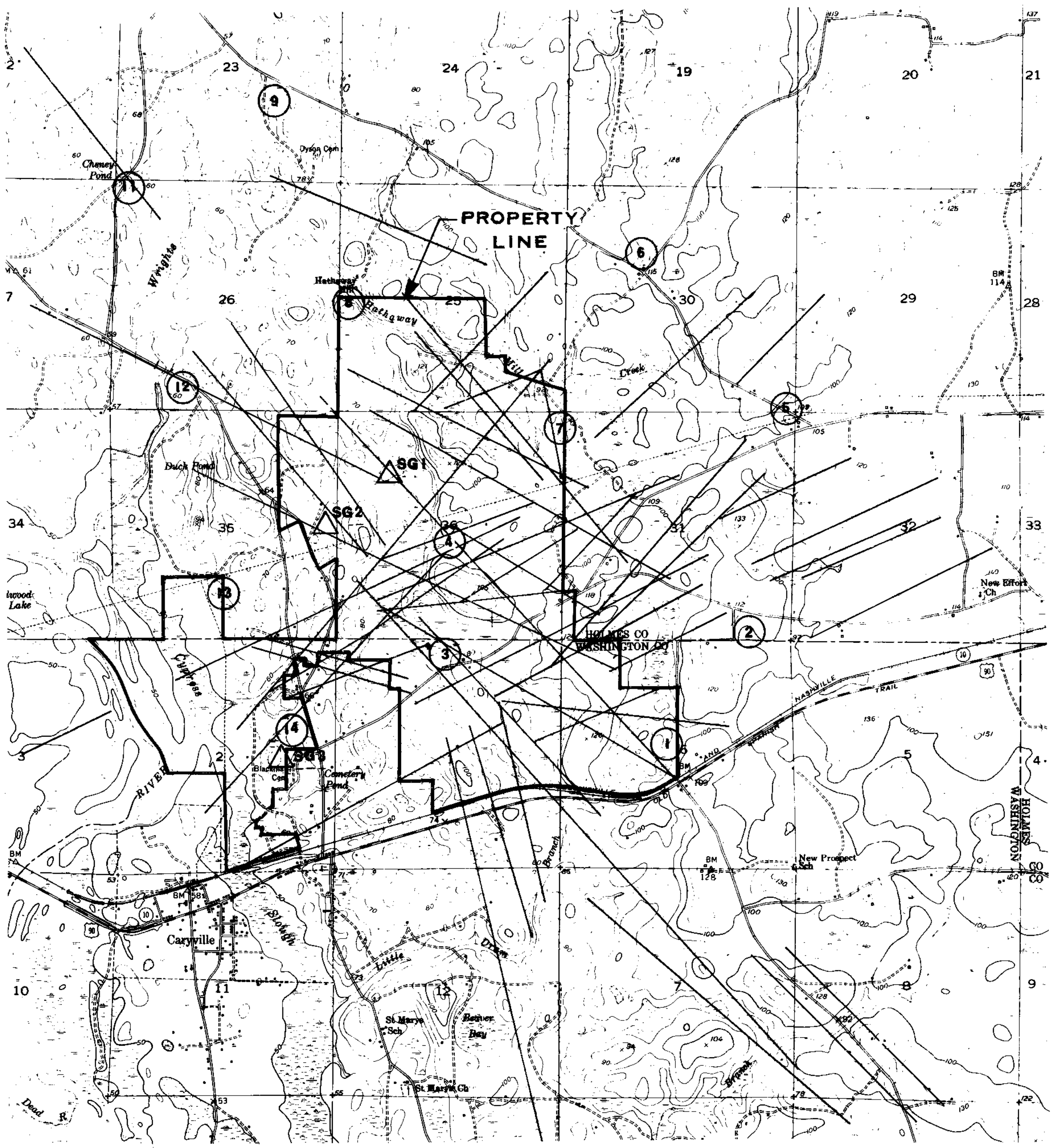
FIGURE 2.4-11

N

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

Amendment 1 6/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	PHOTO OF THE COLOR INFRARED OF THE CARYVILLE AREA SHOWING LINEAMENTS FIGURE 2.4-12



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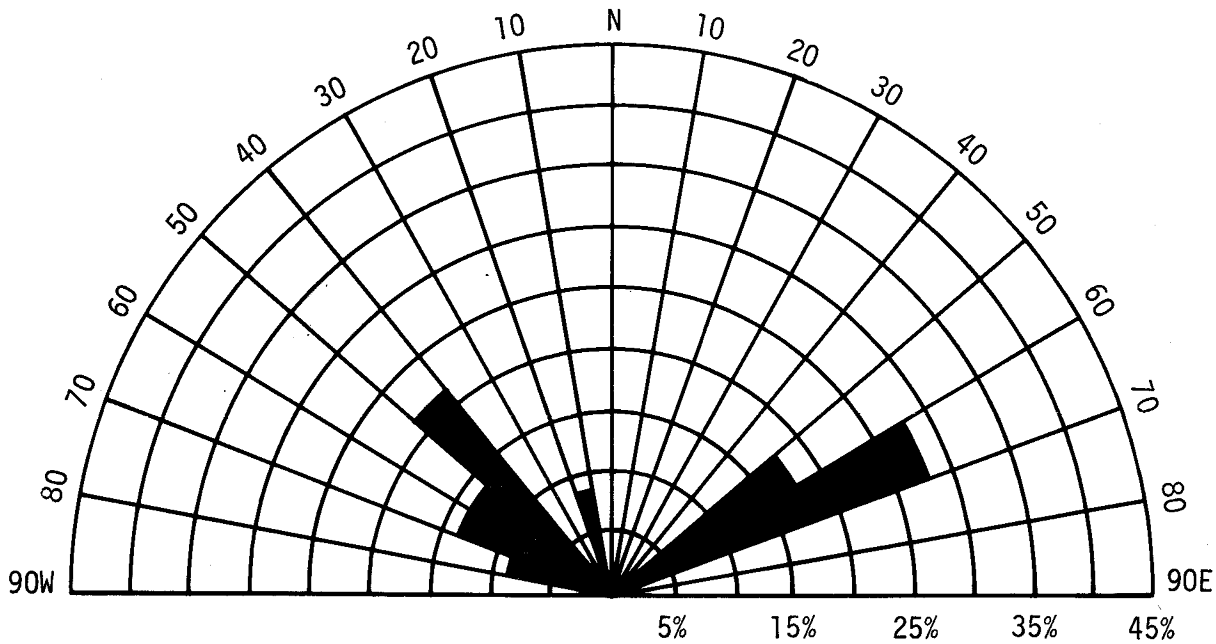
NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

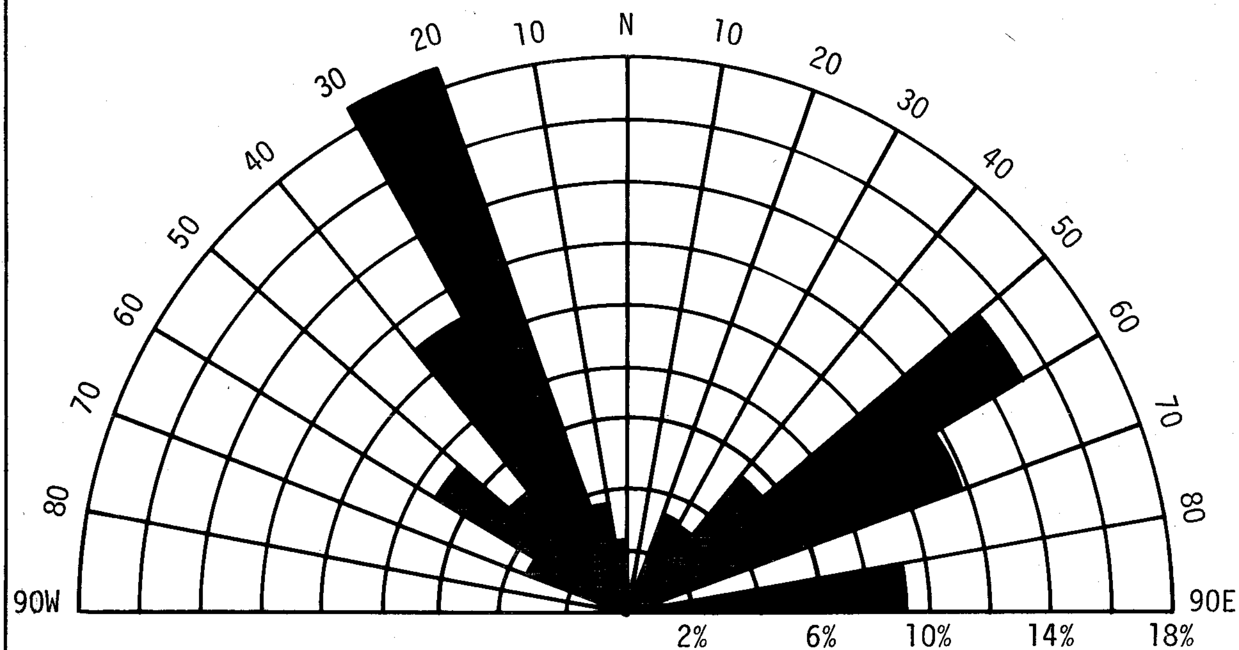
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	LINEAMENTS OF INFRARED PHOTO ON A TOPOGRAPHIC QUADRANGLE SHEET (NUMBERED CIRCLES ARE OBSERVATION WELL LOCATIONS)
		FIGURE 2.4-13



GULF POWER CO.
CARYVILLE STEAM PLANT

LINEAMENT ORIENTATIONS FROM BLACK AND WHITE PRINT OF A COLOR INFRARED PHOTOGRAPH

FIGURE 2.4-14



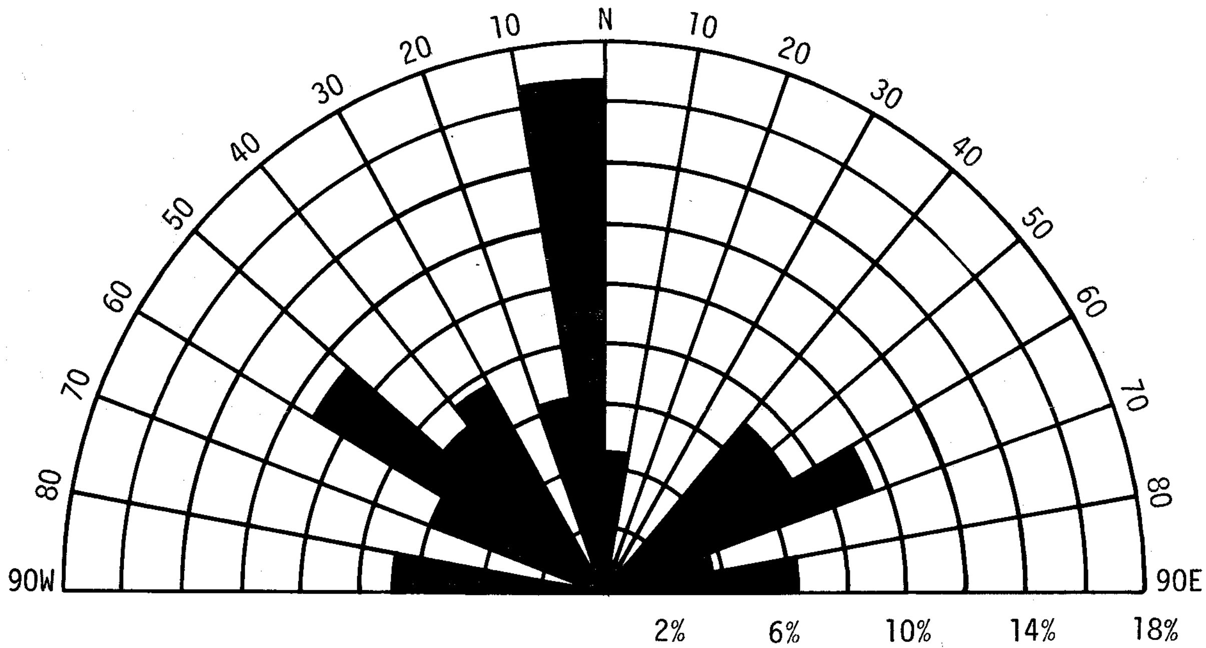
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	LINEAMENT ORIENTATIONS DERIVED FROM THERMAL INFRARED MOSAIC OF THE PROPOSED CARYVILLE SITE
		FIGURE 2.4-15

N

CARYVILLE PLANT SITE
COORDINATES N-654,000: E-1,594,000

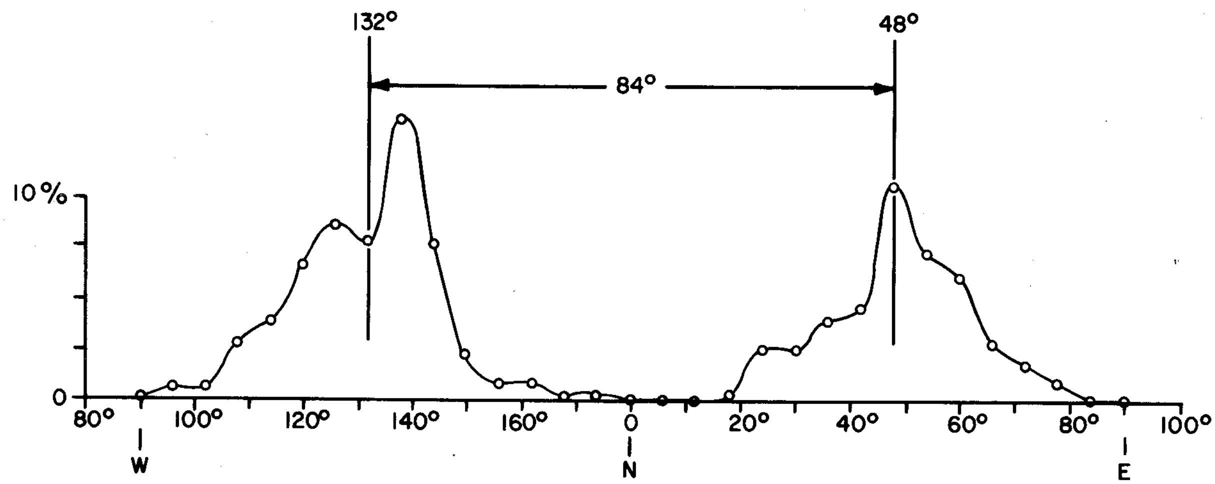
Amendment 2 8/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS-1) BAND 5 IMAGE (E-1085-15503-5) OF NW FLORIDA REGIONAL LINEAMENTS
		FIGURE 2.4-16

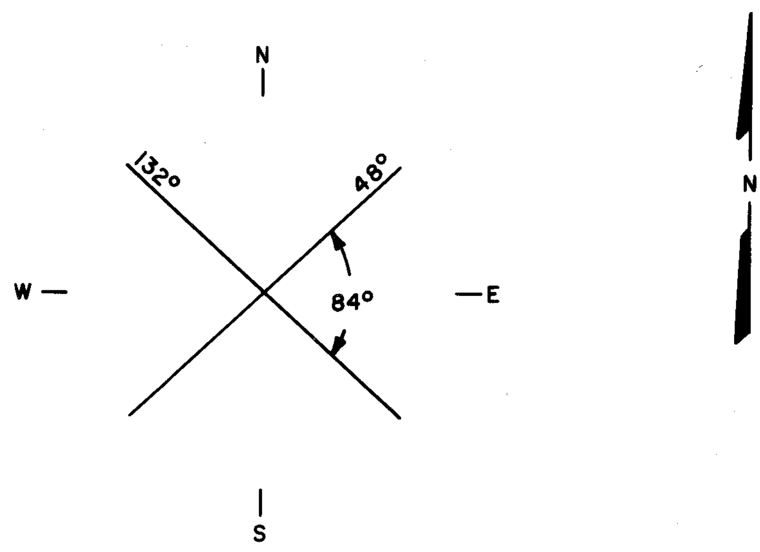


NOTE: ORIENTATIONS DELINEATED FROM ERTS-1
RED BAND IMAGERY (E-1085-15503-5)

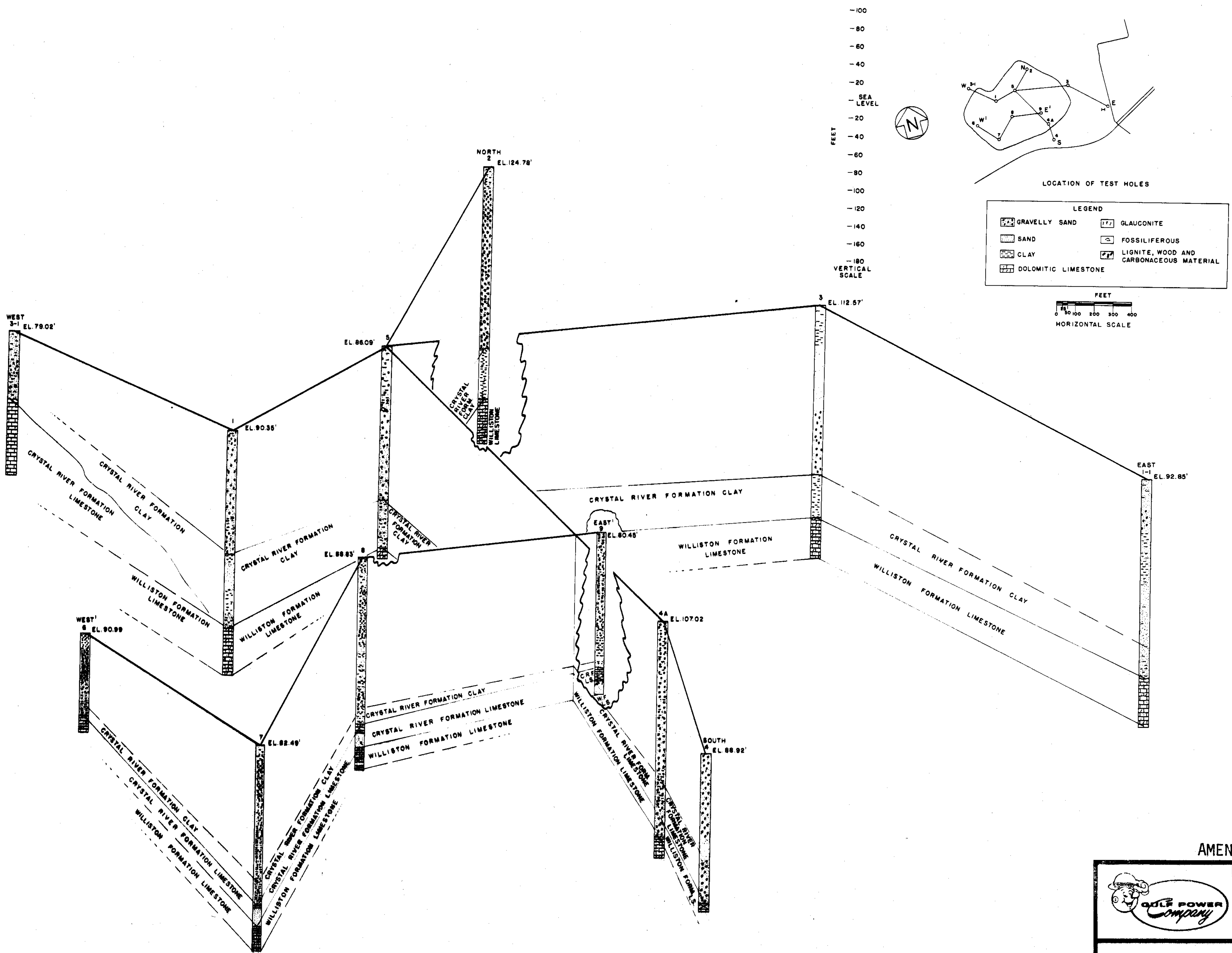
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	LINEAMENT ORIENTATIONS FOR PARTS OF WALTON, HOLMES, AND WASHINGTON COUNTIES, FLORIDA FIGURE 2.4-17



6° INTERVAL, NOT AVERAGED



GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	SUMMARY OF ORIENTATION OF 360 AIRPHOTO LINEARS IN NORTHERN FLORIDA (AFTER REFERENCES 11, 12)
		FIGURE 2.4-18



AMENDMENT 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

FENCE DIAGRAM ASH DISPOSAL AREA "A"

FIGURE 2.4-19

2.5 Hydrology

The hydrologic cycle is the continuous circulation of moisture and water on the earth. This cycle has neither a beginning nor an end, although its concept begins with ocean waters because they cover about three-fourths of the earth's surface. Radiation from the sun evaporates ocean water into the atmosphere where the vapor collects to form clouds. Under certain conditions, the cloud moisture condenses and falls back to earth in various forms or precipitation such as rain, hail, sleet, or snow. The precipitation that falls on the earth is the source of essentially all our fresh water supply. We depend upon this precipitation to recharge the quantity that is used from lakes, streams, and underground sources. As the precipitation falls on the land surface, two movements take place: (a) part of the water soaks into the ground, and (b) part runs off over the surface and into streams. The water that goes into the ground moves downward until it enters a ground-water reservoir. At the same time part of the water moves in the ground-water reservoir and reaches lower elevations, another part moves onto the surface as springs and seeps which help maintain the flow of streams in dry periods. The streams that carry both surface- and ground-water supplies eventually discharge to the oceans which completes and starts the cycle anew. The forces involved in this cycle are gravity, radiation, molecular attraction, and capillary action. A schematic diagram of the hydrologic cycle is shown in figure 2.5-1.

2.5.1 Ground Water

In general, the atmospheric and geological systems through which water moves in the Choctawhatchee River basin are similar to most river basins in Florida. Like most other basins, (a) rainfall is the source of all the water even though some falls outside the basin and moves underground into the basin, (b) the surface materials are highly porous, unconsolidated sands, (c) the basin is underlain by the artesian Floridan Aquifer, and (d) water leaves the basin by streamflow, evaporation, transpiration, underground flow to the ocean and other basins, and by consumption.

2.5.1.1 Sinks and Ponds - To monitor water level fluctuations and establish the relationship and influence of rainfall on the shallow aquifer, Gulf has placed staff gages in three selected ponds in the plant site area, figure 2.4-4. Gulf monitors these gages monthly to relate rainfall to ground-water and surface-water fluctuations. This monitoring data will provide information needed for establishing seasonal trends. Hydrographs for two of the ponds are presented in Section 1 of Appendix C. Data collection from the third pond was not possible until June, 1975, the hydrograph for which will be included in a subsequent amendment to this Site Certification Application. 2

Gulf has completed the drilling of the 52 wells in the observation well network. (See figure 2.4-7 for locations.) During the week of October 28 to November 1, 1974, Gulf installed a continuous water level recorder in Observation Wells 14-1 and 14-2 near the meteorological station. Tentative plans call for continuous recording devices to be installed in observation wells to be located approximately 200 feet from the plant's water supply wells. Continuous water level recorders have been installed in the wells at Observation Well site 21. Illustrations showing water levels recorded in the observation wells are included as figures 2.5-2 and -3. Data from the observation wells are summarized in table 2.5-1 and hydrographs are included in Section 1 of Appendix C.

Gulf began a comprehensive ground water monitoring program in June, 1975 which will continue monthly through July, 1976. (Refer to subsection 6.4.1, "Methods and Procedure for Ground Water Data Collection.") The purpose of the program is to obtain background data on ground water quality and quantity prior to plant operation.

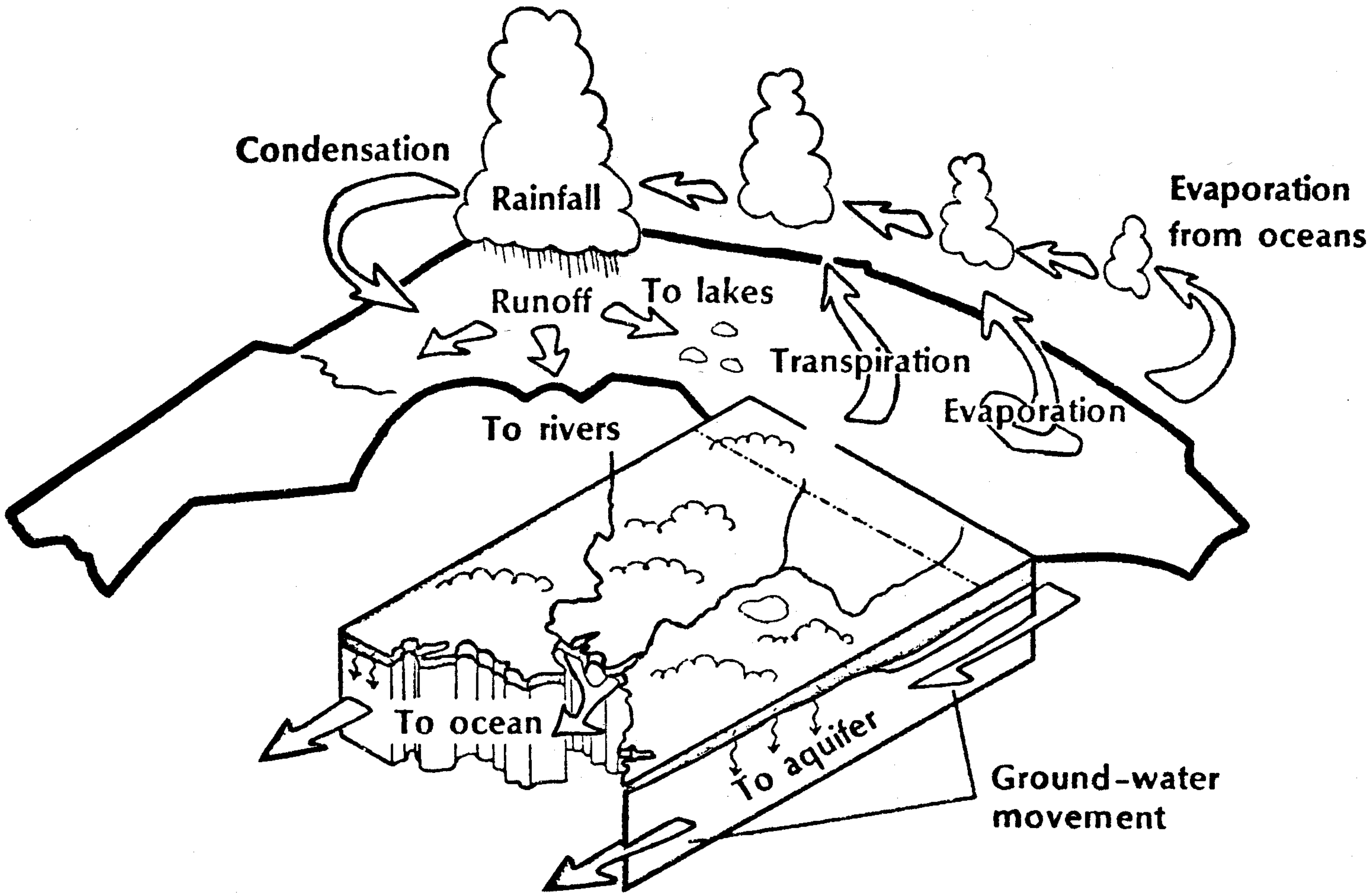
All 52 observation wells were sampled and chemically analyzed in June, 1975. However, since changes in ground water quality are generally very slow, only selected wells will be sampled for complete monthly water quality chemical analysis for the remainder of the monitoring period.

From a study of geological and hydrological information for the observation wells and a careful analysis of the detailed water quality analysis from the June, 1975 samples, the following wells were selected to be sampled for complete monthly chemical analysis: 2

A. Wells 3-1 and 3-2
B. Wells 4-1 and 4-2
C. Wells 10-1 and 10-2
D. Wells 14-1 and 14-2
E. Wells 19-1 and 19-2
F. Wells 22-1 and 22-2
G. Wells 24-1 and 24-2
H. Wells 26-1 and 26-2

Selection of the above wells is based on one or more of the following criteria:

1. The ability to monitor the hydrogeological conditions in the water bearing formation
2. A network's representation of the recharge area of the Floridan Aquifer (where overburden is thin)
3. A network's representation of the overburden where it is thick and hydrologically less well connected to the Floridan Aquifer
4. A network's representation of the overburden and Floridan Aquifer outside the general area of influence of the plant site



GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	HYDROLOGIC CYCLE FIGURE 2.5-1

5. A network's representation of the plant site area
6. A network's representation of the area between the plant site and Caryville
7. A network's representation of "up dip" and "down dip" structural conditions to the plant site
8. A network's representation of the east and west sides of the Choctawhatchee River

The water level of observation wells which do not have water level recorders installed will be measured on a monthly basis. The wells not chosen for a complete chemical analysis will be field checked for the following parameters on a monthly basis: 2

A. temperature
B. chlorides
C. specific conductance
D. total hardness
E. pH

Ground water of the Caryville region may be divided into two categories: (a) artesian water, which occurs in an extensive limestone system known as the Floridan Aquifer, and (b) that found in several shallow formations of relatively small areal extent. The Floridan Aquifer, as the artesian aquifer is called, underlies the Caryville site just as it does almost all of Florida, the coastal area of Georgia, and the southernmost parts of South Carolina and Alabama. It consists of a series of limestone beds having a combined thickness of several thousand feet throughout most of Florida (1). At some places, the aquifer is exposed at the surface, but throughout much of the state its top is several hundred feet beneath the surface. This artesian water is replenished by rain in areas where the limestone aquifer lies at the surface and where it is covered only by pervious material. Figure 2.5-4 shows that the proposed Caryville site is located in one such region of recharge. In the Caryville area, almost all the rainfall is offered to the aquifer with some of the water being rejected when the aquifer becomes full. Within this area, the water that falls as rain is stored over long periods of time. The recoverable volume of water stored in the Floridan Aquifer is known to be very large.

Field work carried out in the vicinity of the Caryville site shows that there are two possible types of recharge processes.

A. In one, the aquifer is exposed at the land surface or is covered only with a porous sand through which water may infiltrate to the aquifer quite readily. (See figures 2.5-5 and -6A.) In such an area, a large percentage of the rainfall is available to the aquifer. (Where the aquifer is not full, it accepts the water offered to it, leaving little or none to run off in streams.)

B. In the second type of recharge, the aquifer is overlain by a blanket or relatively impervious material that tends to confine the aquifer and effectively prevent recharge. Thus, it is only where the blanket is breached that appreciable quantities of water can reach the aquifer.

In some areas, the blanket of impervious material is perforated with sinkholes; these are formed as the walls of limestone caverns gradually dissolve and eventually collapse. These sinkholes are the avenues through which water finds its way down into the artesian aquifer (1). (See figure 2.5-6B.) Ordinarily, they are not open holes but are floored with sand which allows water to slowly filter through to the underlying limestone. Thus, the rate of recharge is limited by the number of sinkholes and by the permeability of the sand and other material the sinkholes contain. In this case, the recharge is limited neither by the amount of rainfall nor by the capacity of the aquifer to receive water, but rather only by the rate at which water may seep through the material in the sinkhole.

Gulf made depth and temperature surveys the week of December 9 to 13, 1974, of five sink ponds located along Florida Highway No. 179 west of the plant site. (See figure 2.5-7.) Maximum depths of the ponds range from 1.8 feet below land surface in pond No. 6 to 7.6 feet below land surface in pond No. 4. Temperature surveys indicate the ponds are not directly connected to the underlying limestone. It appears from these data that the bottoms of the ponds are plugged with relatively impermeable material. Thus, although the ponds may be a source of recharge to the shallow-water table aquifer, they are not a potential source of rapid recharge to the limestone aquifer.

The general direction in which the water moves within the aquifer has been determined by mapping the height at which water stands in many wells. The result is the map shown in figure 2.5-8 which represents approximately the height to which the artesian water will rise at any given place. Generally, recharge occurs in areas where the water stands high and discharge occurs where it stands low. The water moves laterally from the areas of recharge towards areas of discharge, generally at right angles to the lines shown on the map.

The network of observation wells monitored by the Northwest Florida Water Management District (NFWMD) is also shown in figure 2.5-9. Records of water levels for each of five representative observation wells from the U. S. Geological Survey, Tallahassee, Florida, are given in tables 2.5-2 through -6. The following tabular data give the highest, lowest, and average of the high and low readings at each well:

Well No.	*Highest (Date)	*Lowest (Date)	*End of 1972
30	70.58 (5/64)	64.51 (11/72)	64.51
31	78.7 (3/64)	72.17 (1/69)	75.91

32	81.7 (1/65)	62.68 (1/66)	77.7
33	92.04 (5/64)	83.24 (7/61)	84.14
37	63.97 (12/35)	45.99 (11/52)	47.71

*elevation in feet above mean sea level

Hydrographs of the above five representative observation wells are shown in figures 2.5-10 through -16.

The results from a well inventory within a five-mile radius of the site are presented in table 2.5-6a. A description of the bases for the inventory is included in subsection 6.4.1, "Methods and Procedures for Ground-Water Data Collection."

The configuration of the water table in the shallow aquifer is shown by contours in figures 2.5-17 and -17a; the configuration of the potentiometric surface in the Floridan Aquifer is shown by contours in figures 2.5-18 and -18a. The maps show that the flow of water is toward the Choctawhatchee River, roughly perpendicular to the contours shown on the maps. Figures 2.5-17 and -18 represent water levels in December, 1974/January, 1975 when recharge was at a minimum. Figures 2.5-17a and -18a represent water levels during a period of maximum recharge from April 11 to April 25, 1975. 2

In roughly the eastern one-half of the 5-mile radius area, the Floridan Aquifer and water table aquifer are distinct and respond independently to the various factors that cause water level fluctuations. In parts of the plant site area, and to the west along the flood plains of the Choctawhatchee River and Wrights Creek, the alluvial deposits are relatively thin and there is close hydrologic connection of the Floridan and water table aquifers. Near the streams and whree the alluvial deposits overlying limestone bedrock are thin, the Floridan Aquifer receives rapid recharge from the alluvium. The areas of close hydrologic connection of the aquifers are shown by the water levels on figures 2.5-17, -17a, -18, and -18a. The hydrographs of the deep and shallow wells show where the aquifers respond alike and where there are major differences in response to recharge. These hydrographs are included in Section 1 of Appendix C.

2.5.1.2 Quantity of Water - Gulf's initial ground-water requirements will be for plant service use, boiler make-up, and use for human consumption. To provide water for these requirements, Gulf will ~~drill a well~~ prior to beginning plant operation. As the ~~plant is expanded~~, ~~additional wells will be drilled.~~ Because the shallow aquifer is not continuous and only small yields can be obtained from individual wells, water for potable use will be developed from the Floridan Aquifer. (Refer to subsection 3.3.1.1, "Well Water.") 2

2.5.1.3 Quality of Water - The results of chemical analyses of a water sample (shown as milligrams per liter (MG/L) as $CaCO_3$) from potable water supply test well No. 2 of the Floridan Aquifer shown in figure 2.5-18 are as follows (2):

Results of Analysis	MG/L as $CaCO_3$
Calcium (Ca)	117.5
Magnesium (Mg)	31.2
Sodium (Na)	3.7
Potassium (K)	1.2
Bicarbonates (HCO_3)	148.1
Sulfate (SO_4)	1.3
Chlorides (Cl)	4.2
pH	7.6
Total Iron (as Fe)	0.47
Dissolved Silica (as SiO_2)	12.0
Free Carbon Dioxide (as CO_2)	7.8

2

The results of the chemical analyses of samples taken from other wells during the monitoring period will be included in a subsequent amendment to this Site Certification Application.

2.5.1.4 Springs and Sinkholes - Many springs and sinkholes occur throughout Florida. The minimum, maximum, and average flows in cubic feet per second (CFS) from seven representative springs in the Caryville area are as follows:

Spring No.	Maximum Flow (CFS)	Minimum Flow (CFS)	Average Flow (CFS)	Period of Record
1 Morrison	121	54.9	109.03	1942 to 1972
2 Jackson Springs			*2	1972
3 Ponce de Leon Spring	20.7	6.92	16.13	1942 to 1972
4 Vortex Blue Spring	---	---	*6.92	1972
5 Beckton Springs	49.5	33.2	41.35	1942 to 1972
7 Cypress Springs	85	75.3	80.15	1942 to 1972

8 Blue Spring	44.4	32.45	38.45	1942 to 1972

* One measurement only.

The occurrence of sinkholes in Caryville area is described in section 2.4, "Geology," and in subsection 2.5.1 above. The locations of springs discharging from the Floridan Aquifer in Northwest Florida are shown in figure 2.5-19.

2.5.1.5 Effects of Construction - Since the area to be occupied by the plant facilities represents only a few hundredths of one percent of the total area recharged by the Floridan Aquifer, plant construction is expected to have no adverse effects on the quantity and quality of ground water at the proposed site or within a five-mile radius of the site.

2.5.1.6 Effects of Plant Operation - Effluents from operation of the plant will have no adverse effects on the quantity or quality of ground-water at the proposed site. The only ground-water used will be for service water at the plant. Sewage effluent will be treated to meet the requirements of the Florida Department of Pollution Control. (Refer to section 3.6, "Sanitary and Other Wastes' Systems.") Ashes will be stored for an initial period in a properly designed disposal area which will minimize seepage into the ground water. This will allow Gulf time to obtain data on any ash pond leachate. 2

2.5.1.7 Proposed Plant Ground-Water Use and Competition for Ground-Water Supply - Production wells will develop water from the highly permeable Floridan Aquifer, and little competition for ground-water supply is anticipated.

A pumping test was carried out at the potable water supply test well No. 2 during March 20-26, 1975. The pumped (production) well, referred to as potable water supply test well No. 2, was drilled as part of an exploration program. Observation wells 26-1 and 26-2 were drilled at a distance of 200 feet from the pumped well for use in the test to obtain the information needed to determine the coefficients of transmissibility and storage of the artesian aquifer that underlies the proposed plant site. The locations of the wells are shown on figure 2.4-4, and the details of well construction are shown on figure 2.5-19a. The potable water supply test well No. 2 and Observation Well 26-1 were completed in the lower part of the Ocala Group (Williston Formation) and the upper part of the Claiborne Group. 2

The test consisted of pumping potable water supply test well No. 2 at a uniform rate of 402 gallons per minute (GPM) for a period of three days and observing the amount and rate of decline in water levels in Layne No. 2 well, the two wells at site 26, and observation wells at five sites from 2,000 to 5,000 feet away. After pumping ceased, the amount and rate of recovery in water levels in potable water supply test well No. 2 and the two nearby observation wells were observed for a period of three days. A summary of the drilling statistics, such as location, elevation, total depth, etc., are included in table 2.5-6b.

The results of the pumping test were analyzed by the Theis nonequilibrium formula described in Section 1 of Appendix F. The average coefficient of transmissibility (gallons per day per foot) was 96,000 and the average coefficient of storage was 4.4 x 104. Water levels in the Floridan Aquifer in observation wells at sites 3, 4, 12, 13, and 14 were measured hourly throughout the test and were not affected by the test pumping. 2

The specific capacity of the production well, after 72 hours of pumping during the test, was computed to be about 2.1 gallons per minute per foot of drawdown. Based on the average coefficient of transmissibility and coefficient of storage determined from the pumping test on potable water supply test well No. 2, the minimum specific capacity of a properly developed well at the plant site is estimated to be about 15 to 20 GPM per foot of drawdown.

The test results indicate that 3,000 GPM of water can be supplied from properly constructed and spaced wells in the Claiborne and Ocala Groups, and that this water supply can be developed without appreciably affecting water levels beyond the boundary of the plant site.

2.5.1.8 Ground-Water Parameters and Effects of Construction and Plant Effluents - Although ground-water supplies in the vicinity of the Caryville plant site are not expected to be affected by construction or by plant effluents, the monitoring program described in subsection 6.4.1, "Potential Effects of the Chemical and/or Physical Condition of Local Ground Water during the Site Preparation and Construction," will detect any ground-water parameters that may be affected by construction and plant effluents.

2.5.1.9 Effect of Seasonal Fluctuations - Hydrographs of water level records from selected wells are included as figures 2.5-10 through -16 and in Section 1 of Appendix C. 2

A fluctuation of the water level in a well indicates that the ground-water reservoir is adjusting to changes in storage because of variations in recharge and discharge. When recharge exceeds discharge, water levels in wells rise and when discharge exceeds recharge, water levels decline. A knowledge of these fluctuations is necessary to determine water-level trends and changes in ground-water storage. Other factors

that affect water levels, e.g., changes in atmospheric pressure, earthquakes, earth and ocean tides, and changes in surface loading, generally have only a temporary effect and change only slightly the actual quantity of water stored in the ground-water reservoir.

The water levels in wells in the Caryville area fluctuate seasonally in response to changes in precipitation and corresponding changes in the rates of recharge. The highest water levels generally occur in April or May, following the period of maximum precipitation. Lowest water levels generally occur in December or January, following the period of minimum precipitation.

2.5.2 Surface Water

The proposed Caryville site is located on the line between Holmes and Washington Counties immediately east of the Choctawhatchee River at river mile 65.0. The site and environs within a five-mile radius of the site are contained in the Choctawhatchee drainage basin. Drainage south of the plant site is provided by the small Gum Creek and by Little Gum Creek both of which flow south and eventually go west to the Choctawhatchee River. Several low bayous are a part of this system. In the immediate area of the site, drainage is northwest to Wrights Creek via Hathaway Mill Creek and southeast via Little Dram Branch. Several small ponds (10 acres and less) exist immediately west of the site. Further west a number of small creeks, branches, and sloughs drain east into the Choctawhatchee River.

The major stream in the site environ is the Choctawhatchee River. (See figure 2.5-20.) The Choctawhatchee River has its origin near the town of Clayton in Barbour County, Alabama. The river extends about 160 miles to its mouth at the east end of Choctawhatchee Bay. The largest tributary is the Pea River which begins in Pike and Barbour Counties, Alabama, and extends about 130 miles to its mouth in the Choctawhatchee River at river mile 91.7 or approximately 26 miles upstream of the Caryville site.

Flow data for the Choctawhatchee River are available from a 42 year period of record at the U.S.G.S. Gaging Stations at the U. S. Highway No. 90 bridge approximately one mile below the Caryville site at river mile 64.0, and a 44 year period of record from the U.S.G.S. gage at Bruce, Florida, river mile 20.7. The average flow at the Caryville gage is 5,292 cubic feet per second (CFS). This represents the run-off from a 3,499 square mile drainage area. The average flow at the Bruce, Florida, gage is 6,981 CFS from a drainage area of 4,384 square miles. Avg Flow

Historical flow records for the Caryville gage are summarized in table 2.5-7. Statistics from these flows are shown in figures 2.5-21 through - 39. Other relevant records of flow and water quality (3) are contained in Section 2 of Appendix C. 2

The average flow velocity by the site is two feet per second and can vary for low and flood flows from one foot per second to six feet per second. Maximum discharge of record is 60,100 CFS and occurred in April, 1960. Minimum daily flow recorded is 604 CFS and occurred in September, 1968. Based on floodmarks, the maximum stage of the river in 1929 was about El. 66 feet mean sea level with an estimated flow of 206,000 CFS. Ground elevation on the site ranges from El. 45 to El. 125 with most of the area approximately El. 70. The average stage of the 2
river is at El. 46.

There are no major users of surface water downstream between the site and the Gulf of Mexico nor within five miles upstream. The town of Caryville obtains water from wells. There are no known future demands for large quantities of water in this vicinity, except for Gulf's proposed plant.

The Choctawhatchee River is the major supplier of fresh water to the Choctawhatchee Bay. As stated previously, the average flow near Bruce, Florida, is 6,981 CFS. This represents flow from a drainage area of 4,384 square miles. In addition to the fresh water supplied by the Choctawhatchee River, it is estimated that an additional 950 CFS would be supplied from approximately 560 square miles of other drainage areas surrounding the Bay. Streams included in this area are Garnier, Toms, Turkey, Swift, Ricky, Mullett, Basin, Alaqua, Fourmile, Lafayette, and Black Creeks. The average fresh water supply to Choctawhatchee Bay from surface water sources would be in excess of 7,900 CFS.

Water from the river will be used mainly for make-up water in the cooling system. The approximate withdrawal for one 500 MW unit, at full load, will be 6,549 GPM (14 CFS), for 1,000 MW installed capacity, at full load, 13,098 GPM (29 CFS), and for 3,000 MW installed capacity, at full load, 39,294 GPM (88 CFS), as shown in table 3.4-6.

The consumptive use of water by the Caryville steam plant will be through the process of evaporation from the natural draft cooling towers. The estimated maximum evaporation for the 3,000 megawatt installation will be 25,980 GPM or approximately 57 CFS. This consumptive use is less than one percent of the average fresh water supply to the Choctawhatchee Bay.

Water in the Choctawhatchee River is usually soft, colored, and slightly acidic. Some high turbidity occurs after heavy rainfall. Total dissolved solids are low as indicated by specific conductance values, usually well below 100 micromhos per centimeter. Daily temperature extremes for the period 1962 to 1969 were 4°C and 32°C (39°F and 89°F). The water is classified as Class III, Recreation - Propagation and Management of Fish and Wildlife, as designated in Chapter 17-3, Florida Administrative Code. Representative river temperatures and chemical analyses are 2
available for review (4). These records show that pollutant levels in 2

the Choctawhatchee River are below the limits specified in Chapter 17-3, Florida Administrative Code.

Gulf will install and monitor flow by continuous recording devices along the Choctawhatchee River (at the Caryville gaging station), Wrights Creek (Sec. 23, T.5N, R.16W), and Hathaway Mill Creek (SW1/4, NW1/4, Sec. 25, T.5N, R.16W). In addition, Gulf will monitor by staff gages the relative water levels on Little Dram Branch and on a natural drainage 2
course west of the plant site proper. Records of the physical and chemical parameters obtained during the monitoring program will be included in a subsequent amendment to this Site Certification Application.

2.5.3 References

(1) Stringfield, V. T. "Artesian waters in the Florida peninsula." U. S. Geol. Survey, Water-Supply Paper 773-C, pp. 114-195, 1936.

(2) Orlando Laboratories, Inc., Orlando Florida, 32806.

(3) "Water Resources Data for Florida." United Stated Geological Survey, Part 1, Volume 1, Annual Publication.

(4) "Water Resources Data for Florida." United States Geological Survey, Water Quality Records, Part 2, Annual Publication. 2

TABLE 2.5-1

SUMMARY OF OBSERVATION WELLS

Well No.	Total Depth (In Feet)	Elevation Measuring Point (M. P.)[1]	Location[2]	Top of Limestone[3]	Cavities[4]	Casing	Screen[5]	Drill Fluid Circulation Loss Depth (In Feet)[6]
1-1	260	94.10	1,598,558.767 E. 650,753.092 N.	210.5		211 feet of 6 inch steel		250 to 260
1-2	52	94.18	1,598,562.101 E. 650,763.080 N.			53 feet of 4 inch polyvinyl chloride (p.v.c.)	42 to 52	
2-1	220	117.49	1,600,089.519 E. 654,096.285 N.	78		91 feet of 6 inch steel 118 feet of 4 inch steel		78 to 220
2-2	75	117.80	1,600,082.356 E. 654,097.628 N.			76 feet of 4 inch p.v.c.	65 to 75	
3-1	150	80.70	1,593,403.638 E. 652,883.327 N.	72	73-75	78 feet of 4 inch steel		145 to 150
3-2	42	80.68	1,593,406.744 E. 652,863.463 N.		(10/22/74)	43 feet of 4 inch p.v.c.	32 to 42	
4-1	350	103.13	1,593,576.431 E. 656,261.133 N.	182		192 feet of 6 inch steel		
4-2	70	103.28	1,593,568.420 E. 656,283.445 N.			70 feet of 4 inch p.v.c.	60 to 70	
5-1	265	103.84	1,601,257.886 E. 658,513.785 N.	212	(11/14/74)	215 feet of 4 inch steel		251 to 260
5-2	51	104.44	1,601,246.760 E. 658,491.813 N.		(11/14/74)	51 feet of 4 inch p.v.c.	40 to 50	
6-1	265	119.34	1,598,253.401 E 662,108.679 N.	212		215 feet of 4 inch steel		

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TABLE 2.5-1 (Continued)

Well No.	Total Depth (In Feet)	Elevation Measuring Point (M. P.)[1]	Location[2]	Top of Limestone[3]	Cavities[4]	Casing	Screen[5]	Drill Fluid Circulation Loss Depth (In Feet)[6]
6-2	40	118.94	1,598,271.256 E. 662,090.007 N.			41 feet of 4 inch p.v.c.	30 to 40	
7-1	151	90.34	1,596,124.007 E. 658,642.349 N.	35	132-135	35 feet of 6 inch steel		43
7-2	25	90.89	1,596,138.631 E. 658,620.427 N.			26 feet of 4 inch p.v.c.	15 to 25	
8-1	110.5	69.69	1,591,029.797 E. 661,495.471 N.	39		60 feet of 4 inch steel		39; 50; 77
8-2	25	70.26	1,591,004.274 E. 661,486.273 N.			25 feet of 4 inch p.v.c.	15 to 25	
9-1	120	65.01	1,589,118.106 E. 666,062.104 N.	48		83 feet of 4 inch steel		51-70; 89; 110-120
9-2	40	65.17	1,589,124.831 E. 666,085.210 N.	36		36 feet of 4 inch p.v.c.	26 to 36	
10-1	301	75.99	1,582,099.698 E. 670,560.638 N.	35	97-98	59 feet of 4 inch steel		97
10-2	21	76.93	1,582,108.417 E. 670,583.957 N.			20 feet of 4 inch p.v.c.	10 to 20	
11-1	107	61.68	1,585,928.044 E. 664,190.741 N.	37		42 feet of 4 inch steel		37
11-2	30	62.83	1,585,937.130 E. 664,211.534 N.			29 feet of 4 inch p.v.c.	18 to 28	
12-1	190	69.48	1,587,269.331 E. 659,470.175 N.	123	(11/14/74)	128 feet of 4 inch steel		188
12-2	60	68.15	1,587,251.811 E. 659,485.863 N.		(11/14/74)	61 feet of 4 inch p.v.c.	50 to 60	
13-1	150	60.59	1,587,766.710 E. 654,614.966 N.	19	32-40	26 feet of 6 inch steel 54 feet of 4 inch steel		22; 129

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TABLE 2.5-1 (Continued)

Well No.	Total Depth (In Feet)	Elevation Measuring Point (M. P.)[1]	Location[2]	Top of Limestone[3]	Cavities[4]	Casing	Screen[5]	Drill Fluid Circulation Loss Depth (In Feet)[6]
13-2	18	60.87	1,587,763.886 E. 654,638.712 N.			19 feet of 4 inch p.v.c.	13 to 18	
14-1	100	71.39	1,589,661.261 E. 651,525.676 N.	40		47 feet of 6 inch steel		42
14-2	32	71.70	1,589,686 251 E. 651,522.330 N.			32 feet of 6 inch p.v.c.	21 to 31	
15-1	330	178.04	1,620,357.641 E. 657,806.039 N.	286		250 feet of 4 inch steel 84 feet of 2.5 inch steel set to 290 feet		309
15-2	63	178.23	1,620,356.394 E. 657,781.505 N.			64 feet of 4 inch p.v.c.	53 to 63	
16-1	180	122.87	1,609,922.509 E. 668,130.942 N.	97		107 feet of 6 inch steel		97; 117-168 (50%); 168-180 (90%)
16-2	44	122.11	1,609,929.357 E. 668,155.324 N.			44 feet of 4 inch p.v.c.	33 to 43	
17-1	100	72.17	1,595,469.698 E. 677,460.044 N.	45	75 to 80	50 feet of 4 inch steel		41; 75; 81-100
17-2	25	73.65	1,595,445.773 E. 677,458.290 N.			26 feet of 4 inch p.v.c.	19 to 25	
18-1	100	63.89	1,573,499.464 E. 674,032.737 N.	37		42 feet of 4 inch steel		37
18-2	26	64.13	1,573,514.162 E. 674,052.472 N.			27 feet of 4 inch p.v.c.	16 to 26	
19-1	100	70.25	1,575,890.167 E. 652,058.888 N.	36		37 feet of 4 inch steel		36

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CSP-ER-2

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TABLE 2.5-1 (Continued)

Well No.	Total Depth (In Feet)	Elevation Measuring Point (M. P.)[1]	Location[2]	Top of Limestone[3]	Cavities[4]	Casing	Screen[5]	Drill Fluid Circulation Loss of Depth (In Feet)[6]
19-2	20	70.83	1,575,881.132 E. 652,082.134 N.			22 feet of 4 inch p.v.c.	10 to 20	
20-1	100	58.33	1,575,244.691 E. 636,268.559 N.	45		50 feet of 4 inch steel	45; 98	
20-2	30	58.86	1,575,221.804 E. 636,267.453 N.			30 feet of 4 inch p.v.c.	20 to 30	
21-1	401	134.48	1,596,692.497 E. 629,974.717 N.	307		202 feet of 6 inch steel 107 feet of 4 inch steel		306; 311.5
21-2	110.5	136.47	1,596,677.297 E. 629,986.284 N.			112 feet of 6 inch p.v.c.	95.5 to 110.5	
22-1	320	99.50	1,609,533.366 E. 634,280.478 N.	262		264.5 feet of 4 inch steel		
22-2	40	99.96	1,609,527.197 E. 634,303.925 N.			42 feet of 4 inch p.v.c.	30 to 40	
23-1	401	121.18	1,603,337.617 E. 644,261.975 N.	177	188-192 264-266	233 feet of 4 inch steel		177; 245-258; 258-260; 323-330
23-2	63	120.62	1,603,343.458 E. 644,286.459 N.			63 feet of 4 inch p.v.c.	52 to 62	
24-1	250	118.37	1,617,383.701 E. 648,059.643 N.	136		156 feet of 4 inch steel		129-131; 144; 235-240
24-2	61	118.43	1,617,387.335 E. 648,083.082 N.			62 feet of 4 inch p.v.c.	50 to 60	
25-1	300	108.66	1,602,118.389 E. 670,306.146 N.	169		170 feet of 4 inch steel		
25-2	43	108.66	1,602,139.729 E. 670,294.393 N.			43 feet of 4 inch p.v.c.	33 to 43	
26-1	364	72.00	1,590,810.784 E. 655,575.701 N.	54	99-105 120	160 feet of 6 inch steel 85 feet of 4 inch steel 198 feet of 2.5 inch steel	260 to 281 and 310 to 331	86; 93; 120
26-2	50	71.35	1,590,818.542 E. 655,599.019 N.			51 feet of 6 inch p.v.c.	40 to 50	

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Explanation for Table 2.5-1: Summary of Observation Wells

1 Elevation Measuring Point at top of casing in feet above mean sea level
2 Location is expressed in terms of Florida Grid Coordinates
3 Top of Limestone in feet below land surface
4 Cavities in feet below land surface
5 Screen wrapped around slots in casing and placed below surface at depth indicated
6 Drill Fluid Circulation Loss depth in feet

TABLE 2.5-2

WATER LEVELS IN NORTHWEST FLORIDA OBSERVATION WELL NO. 37

FORM 9-148

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No. ________

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Washington

STATE Florida

304632N0854851.1 Local number 4. Town of Caryville. Drilled public-supply artesian well in Floridan aquifer, diam 4 in, reported depth 785 ft. Lsd 62.97 ft above msl. MP top of casing, 1.00 ft above lsd.

Highest water level 0.00 Dec. 12 1935; lowest -17.98 Nov. 23 1952
Records available 1935, 1946- Water level below land-surface datum

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1974							
Jan 7	-9.80						
Mar. 6	9.64						

GPO 938799

TABLE 2.5-2 (Continued)

WATER LEVELS IN NORTHWEST FLORIDA OBSERVATION WELL NO. 37

FORM 9-148

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No. ______

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Washington

STATE Florida

304632N0854851.1. Local number 4. Town of Caryville. NE1/4NW1/4 sec. 11, T.4 N. R. 16 W. Drilled public-supply artesian well in Floridan aquifer, diam 4 in, reported depth 785 ft. Lsd 62.97 ft above msl. MP top of casing, 1.00 ft above lsd.

Highest water level 0.00 Dec. 12, 19 35; lowest -17.98 Nov. 23, 19 52
Records available 1935, 1946- Water level below land-surface datum

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1969		1971		1973			
Jan. 6	-15.59	Jan. 13	-10.48	Jan. 9	-8.92		
Mar. 3	13.50	Mar. 9	8.24	Mar. 7	10.14		
May 5	11.76	May 5	10.44	May 3	8.36		
July 8	13.26	July 6	11.93	July 10	11.05		
Sept. 2	11.35	Sept. 15	11.84	Sept. 5	12.08		
Nov. 4	-12.80	Nov. 8	-13.42	Oct. 30	-12.20		
1970		1972					
Jan. 5	-12.03	Jan. 6	-11.49				
Mar. 3	9.96	Mar. 2	11.00				
May 4	10.73	May 5	11.95				
June 22	10.95	July 14	12.96				
Aug. 31	11.45	Sept. 5	15.42				
Nov. 3	-12.68	Nov. 7	-16.26				

GPO 935799

TABLE 2.5-2 (Continued)

WATER LEVELS IN NORTHWEST FLORIDA OBSERVATION WELL NO. 37

FORM 9-146

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No. ______

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Washington

STATE Florida

304632N0854851.1. Local number 4. Town of Caryville. NE1/4NW1/4 sec. 11, T. 4 N., R. 16 W. Drilled public-supply artesian well in Floridan aquifer, diam 4 in, reported depth 785 ft. Lsd 62.97 ft above msl. MP top of casing, 1.00 ft above lsd.

Highest water level 0.00 Dec. 12, 1935 ; lowest -17.98 Nov. 23, 1952
Records available 1935, 1946-1968 Water level below land-surface datum

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1964		1966		1968			
Jan. 8	-10.48	Jan. 6	-12.00	Jan. 8	-10.15		
Mar. 4	12.46	Mar. 9	6.80	Mar. 1	11.50		
May 6	7.20	Apr. 28	11.35	May 7	12.50		
July 6	11.60	July 5	12.68	July 1	14.75		
Sept. 8	10.76	Sept. 12	14.00	Sept. 3	15.99		
Nov. 3	-10.89	Oct. 31	-14.95	Nov. 4	-17.10		
1965		1967					
Jan. 4	-8.60	Jan. 3	-12.20				
Mar. 3	9.08	Mar. 6	10.55				
May 3	10.25	May 1	12.75				
July 6	12.10	July 10	13.43				
Sept. 8	12.85	Sept. 5	12.76				
Nov. 1	-12.53	Nov. 6	-11.10				

TABLE 2.5-2 (Continued)

WATER LEVELS AND ARTESIAN PRESSURES IN NORTHWEST FLORIDA
OBSERVATION WELL NO. 37

FORM 9-148

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No. ______

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Washington

STATE Florida

304632N0854851.1 FORMERLY 4

4. Town of Caryville. NE1/4NW1/4 sec. 11, T. 4 N., R. 16 W. Drilled public-supply artesian well in Floridan aquifer, diam 4 in, reported depth 785 ft. Lsd 62.97 ft above msl. MP top of casing, 1.00 ft above lsd.

Highest water level 0.00 Dec. 12, 19 74 ; lowest -17.98 Nov. 23, 19 52
Records available 1935, 1946-63 Water level below land-surface datum

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1959		1961		1963			
Feb. 6	-12.45	Jan. 13	-14.16	Jan. 9	-14.38		
Mar. 20	9.35	Mar. 10	10.25	Mar. 6	10.67		
May 8	11.49	Apr. 19	7.50	Apr. 24	12.31		
June 19	11.67	June 9	12.06	June 19	14.05		
Aug. 21	11.55	July 12	11.37	Aug. 26	12.50		
Sept. 25	12.08	Sept. 1	11.45	Oct. 25	-12.58		
Nov. 6	10.02	Oct. 19	12.90				
Dec. 18	-11.39	Nov. 30	-13.98				
1960		1962					
Jan. 29	-11.00	Jan. 11	-9.71				
Mar. 25	10.25	Mar. 2	9.12				
May 12	10.24	Apr. 19	9.49				
July 2	12.76	June 4	12.26				
Aug. 12	13.11	Aug. 2	13.86				
Sept. 23	14.85	Sept. 19	15.18				
Nov. 11	14.55	Nov. 9	-15.85				
Dec. 16	-14.72						

GPO 935789

TABLE 2.5-2 (Continued)

WATER LEVELS AND ARTESIAN PRESSURES IN NORTHWEST FLORIDA OBSERVATION WELL NO. 37

FORM 9-148

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No. ______

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Washington

STATE Florida

4. Town of Caryville. NW1/4SW1/4 sec. 11, T. 4 N., R. 16 W. Drilled public-supply artesian well in Floridan aquifer, diameter 4 inches, reported depth 785 feet. Land-surface datum is about 58 feet above msl. MP top of casing, 1.00 ft above lsd.

Highest water level 0.00 Dec. 12 1935; lowest -17.98 Nov. 23, 1952
Records available 1935, 1946-58 Water level below land-surface datum

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1956		1958		1959			
Feb. 3	-15.68	Jan. 7	-13.51	Dec. 18	-11.39		
Mar. 12	12.34	Feb. 12	12.65				
April 23	12.09	Mar. 28	10.32				
July 23	15.59	May 12	11.44				
Sept. 4	14.95	June 24	12.66				
Oct. 11	11.34	Aug. 5	11.78				
Nov. 27	-13.67	Sept. 23	11.61				
1957		Nov. 4	13.77				
Jan. 15	-11.85	Dec. 17	-14.96				
Feb. 28	12.69	1959					
Apr. 12	11.02	Feb. 6	-12.45				
May 27	11.60	Mar. 20	9.35				
July 1	13.70	May 8	11.49				
Aug. 12	13.66	June 19	11.67				
Oct. 8	12.24	Aug. 21	11.55				
Nov. 20	13.43	Sept. 25	12.08				
		Nov. 6	10.02				

GPO 935799

TABLE 2.5-2 (Continued)

WATER LEVELS AND ARTESIAN PRESSURES IN NORTHWEST FLORIDA OBSERVATION WELL NO. 37

FORM 9-148

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No. ______

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Washington 4

STATE Florida

4. Town of Caryville. SW1/4SW1/4 sec. 2, T. 4 N., R. 16 W. Drilled public-supply artesian well in Floridan aquifer, diameter 4 inches, reported depth 785 feet. Land-surface datum is about 58 feet above msl.

Highest water level -7.80 April 17, 1947; lowest -17.98 Nov. 28, 1952
Records available 1946-1955 Water level below land-surface datum

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1951		1953		1955			
Jan. 2	-13.64	Feb. 14	-11.25	Jan. 11	-16.99		
Feb. 19	13.09	Mar. 29	11.20	Feb. 21			
Apr. 2	10.91	May 12	9.47	Apr. 4	15.24		
May 28	12.64	June 19	15.10	May 16	13.07		
July 10	14.18	Aug. 1	14.83	June 28	12.61		
Sept. 4	15.26	Sept. 12	13.55	Aug. 16	12.33		
Oct. 16	16.00	Oct. 24	11.94	Sept. 27	13.97		
Dec. 4	-14.78	Dec. 10	- 8.76	Nov. 7	15.49		
1952		1954		Dec. 19	-16.20		
Jan. 28	-15.00	Jan. 15	-11.37				
Mar. 18	14.05	Feb. 27	13.29				
Apr. 23	11.13	Apr. 10	11.22				
June 7	12.29	May 21	15.09				
July 20	14.35	July 11	14.63				
Aug. 26	14.30	26	15.05				
Oct. 14	16.86	Sept. 7	16.41				
Nov. 23	-17.98	Oct. 18	17.60				
		Nov. 29	-17.58				

GPO 935799

TABLE 2.5-3

WATER LEVELS IN NORTHWEST FLORIDA OBSERVATION WELL NO. 33

FORM 9-148

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No.

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Holmes

STATE Florida

305202N0854529.1. Local number 052-545-2. Richard Hand. SW1/4NW1/4SE1/4 sec. 5, T. 5 N., R. 15 W. Drilled domestic artesian well in Floridan aquifer, diam 6 in, reported depth 300 ft. Lsd 73.44 ft above msl. MP top of coupling, 1.00 ft above lsd.

Highest water level +17.6 May 6, 1964; lowest +8.8 July 17, 1961
Records available 1961- Water level above lsd

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1961		1963		1967		1973	
July 17	+ 8.8	Jan. 9	+10.6	Jan. 3	+12.3		
Sept. 28	11.4	Mar. 6	12.9	May 1	+10.0		
Oct. 19	13.9	Apr. 24	11.8	1968			
Nov. 30	+12.4	June 19	11.2	Jan. 8	+14.6		
		Aug. 26	13.0	May 7	+12.0		
1962		Oct. 25	+12.6	1969			
Jan. 11	+14.9	1964		Jan. 6	+ 9.6		
Mar. 2	13.8	Jan. 8	+14.6	May 5	+11.4		
Apr. 19	15.8	Mar. 4	16.4	1970			
June 4	13.8	May 6	17.6	May 4	+11.0		
Aug. 2	10.0	July 6	+15.2	June 22	+13.2		
Sept. 19	11.8	1965		1971			
Nov. 9	+10.7	Jan. 4	+14.6	Jan. 13	+10.1		
		May 3	+16.7	May 5	+12.1		
		1966		1972			
		Jan. 6	+13.6	Jan. 11	+9.6		
		Apr. 28	14.5	May 5	+9.7		
		July 5	+13.0				

TABLE 2.5-4

WATER LEVELS IN NORTHWEST FLORIDA OBSERVATION WELL NO. 32

FORM 9-140

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No. ____________

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Holmes

STATE Florida

305119N0855619.1. Local number 051-556-1. Florida Forest Service. Prosperity Tower. NW1/4NE1/4SE1/4 sec. 9, T. 5 N., R. 17 W. Drilled unused artesian well in Floridan aquifer, diam 3 in, depth 260 ft, Lsd 285.68 ft above msl. MP top of coupling, at lsd.

Highest water level -203.98 Jan. 4, 19 65 ; lowest -223.00 Jan. 11, 19 66

Records available 1961- Water level below lsd

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1961		1963		1967		1972	
July 12	-206.52	Jan. 9	-208.50	May 1	-206.96	Jan. 11	-207.66
Sept. 28	211.20	Mar. 6	208.43	1968		May 5	-207.98
Oct. 27	206.17	Apr. 24	214.60	Jan. 8	-207.20	1973	
Nov. 30	-207.69	June 19	209.10	May 7	206.55	Jan. 9	-209.65
		Aug. 26	209.30	Nov. 4	-208.95	May 9	206.77
1962		Oct. 25	-209.24	1969		1974	
Mar. 2	-206.14	1964		Jan. 6	-209.60	Mar. 6	207.30
Apr. 19	204.80	Jan. 8	-208.96	Mar. 3	210.00		
June 4	205.76	Mar. 4	207.00	May 5	209.85		
Aug. 2	205.90	May 6	205.20	June 24	209.76		
Sept. 19	209.20	July 6	-204.15	July 22	210.00		
Nov. 9	-207.67	1965		Aug. 21	-209.77		
		Jan. 4	-203.98	1970			
		May 3	-204.68	Jan. 5	-209.10		
		1966		May 4	-207.35		
		Jan. 11	-223.00	1971			
		Apr. 28	204.75	Jan. 14	-207.58		
		July 8	-204.95	May 5	-205.53		

GPO 938789

TABLE 2.5-5

WATER LEVELS IN NORTHWEST FLORIDA OBSERVATION WELL NO. 31

FORM 9-148

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No. ______

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Holmes

STATE Florida

305014N0854837.1. Local number 050-548-1. Glynn Cooper. NW1/4SW1/4SE1/4 sec. 14, T. 5 N., R. 16 W. Drilled unused artesian well in Floridan aquifer, diam 6 in. Lsd 71.5 ft above msl. MP top of ell, 1.50 ft above lsd.

Highest water level +5.7 March 4, 1964; lowest -0.83 Jan. 6, 1969
Records available 1961- Water level above and below lsd

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1961		1963		1967		1973	
July 17	+3.5	Jan. 9	-0.17	Jan. 3	+2.60	Jan. 9	+1.68
Sept. 28	3.9	Mar. 6	+1.98	May 1	+3.10	May 3	4.30
Oct. 19	3.5	Apr. 24	1.90	1968		1974	
Nov. 30	+2.9	June 19	1.40	Jan. 8	+3.90	Jan. 7	3.25
		Aug. 26	2.90	May 7	+3.45		
1962		Oct. 25	+2.50	1969			
Jan. 11	+3.40	1964		Jan. 6	-0.83		
Mar. 2	4.60	Jan. 8	+3.3	May 5	+1.30		
Apr. 19	5.10	Mar. 4	5.7	1970			
June 4	3.90	May 6	5.5	Jan. 5	+1.60		
Aug. 2	2.9	July 6	+4.30	May 4	+3.60		
Sept. 19	1.4	1965		1971			
Nov. 9	+0.24	Jan. 4	+5.30	Jan. 13	+2.71		
		May 3	+5.20	May 5	+4.16		
		1966		1972			
		Jan. 6	+3.40	Jan. 11	+2.2		
		Apr. 28	4.90	May 5	+2.91		
		July 5	+3.90				

GPO 935799

TABLE 2.5-6

WATER LEVELS IN NORTHWEST FLORIDA OBSERVATION WELL NO. 30

FORM 9-148

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No. ______

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Holmes

STATE Florida

304322N0855614.1. Local number 4. Mrs. Dan Hughes. Ponce de Leon. Drilled public-supply artesian well in Floridan aquifer, diam 6 in, reported depth 187 ft. Lsd 62.18 ft above msl. MP top of 6-by 4-in reducing tee, 1.50 ft above lsd.

Highest water level +6.90 May 6 1964; lowest +0.83 November 7 1972
Records available 1938, 1947- Water level above land-surface datum

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1974							
Jan. 7	+2.02						
March 6	1.99						

GPO 838789

TABLE 2.5-6 (Continued)

WATER LEVELS IN NORTHWEST FLORIDA OBSERVATION WELL NO. 30

FORM 9-148

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

Report Page No. ____
GROUND WATER BRANCH

COUNTY Holmes

STATE Florida

304322N0855614.1. Local number 4. Mrs. Dan Hughes. Ponce de Leon. NE1/4SE1/4 sec. 28, T. 4 N., R. 17 W. Drilled public-supply artesian well in Floridan aquifer, diam 6 in, reported depth 187 ft. Lsd 62.18 ft above msl. MP top of 6-by 4-in reducing tee, 1.50 ft above lsd.

Highest water level +6.90 May 6 1964; lowest +0.83 November 7 1972
Records available 1938, 1947- Water level above land-surface datum

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1969		1971		1973			
Jan. 6	+2.34	Jan. 14	+3.70	Jan. 9	+3.62		
Mar. 3	2.40	Mar. 9	4.83	Mar. 7	3.16		
May 5	2.65	May 5	3.72	May 9	4.74		
June 24	2.40	July 6	3.88	July 10	2.94		
July 8	1.92	Sept. 15	3.14	Sept. 5	2.60		
22	2.35	Nov. 8	+2.56	Oct. 30	+1.57		
Aug. 21	4.28	1972					
Sept. 2	4.15	Jan. 6	+3.62				
Nov. 4	+2.85	Mar. 2	3.34				
1970		May 5	2.68				
Jan. 5	+2.91	July 14	3.60				
Mar. 3	4.27	Sept. 14	1.19				
May 4	3.78	Nov. 7	+0.83				
June 22	3.50						
Aug. 31	3.30						
Nov. 3	+3.46						

TABLE 2.5-6 (Continued)

WATER LEVELS IN NORTHWEST FLORIDA OBSERVATION WELL NO. 30

FORM 9-148

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No.

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Holmes

STATE Florida

304322N0855614.1. Local number 4. Mrs. Dan Hughes. Ponce de Leon. NE1/4SE1/4 sec. 28, T. 4 N., R. 17 W. Drilled public-supply artesian well in Floridan aquifer, diam 6 in, reported depth 187 ft. Lsd 62.18 ft above msl. MP top of 6-by 4-in reducing tee, 1.50 ft above lsd.

Highest water level +6.90 May 6, 1964; lowest +1.00 Jan. 11, 1955

Records available 1938, 1947-1968 Water level above land-surface datum

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1964		1966		1968			
Jan. 8	+6.05	Jan. 11	+3.90	Jan. 8	+5.40		
Mar. 4	6.60	Mar. 9	6.61	Feb. 27	4.40		
May 6	6.90	Apr. 28	4.06	May 7	3.50		
July 6	5.10	July 8	3.10	July 1	2.33		
Sept. 8	4.50	Sept. 12	3.80	Aug. 21	2.05		
Nov. 3	+4.70	Oct. 31	+3.30	Sept. 3	1.88		
1965		1967		Oct. 1	1.52		
Jan. 4	+5.70	Jan. 3	+5.5	Nov. 4	+1.38		
Mar. 3	6.35	Mar. 6	4.5				
July 6	4.00	May 1	3.20				
Sept. 8	3.70	July 10	2.72				
Nov. 1	+3.50	Sept. 5	3.35				
		Nov. 6	+4.68				

GPO 938798

TABLE 2.5-6 (Continued)

WATER LEVELS AND ARTESIAN PRESSURES IN NORTHWEST FLORIDA
OBSERVATION WELL NO. 30

FORM 9-448

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No. ____________

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Holmes

STATE Florida

4. Mrs. D. Hughes. Ponce de Leon. NE1/4SE1/4 sec. 28, T. 4 N., R. 17 W. Drilled public-supply artesian well in Florida aquifer, diam 6 in, reported depth 187 ft. Lsd 62.18 ft above msl. MP top of 6-by 4-in reducing tee, 1.50 ft above lsd.

Highest water level +5.72, Nov. 30 19 48; lowest +1.00 Jan. 11, 19 55
Records available 1938, 1947-63 Water level above land-surface datum

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1959		1961		1963			
Feb. 6	+3.30	Jan. 13	+2.80	Jan. 9	+2.08		
Mar. 20	4.70	Mar. 10	3.35	Mar. 6	3.50		
May 8	3.51	Apr. 19	4.70	Apr. 24	2.70		
June 19	4.60	June 9	3.10	June 19	2.80		
Aug. 21	4.10	July 12	3.30	Aug. 26	3.90		
Sept. 25	4.10	Sept. 1	5.30	Oct. 25	+3.60		
Nov. 6	5.50	Oct. 19	2.70				
Dec. 18	+4.80	Nov. 30	+2.70				
1960		1962					
Jan. 29	+4.70	Jan. 11	+5.00				
Mar. 25	4.90	Mar. 2	4.70				
May 12	4.92	Apr. 19	4.80				
July 2	3.48	June 4	3.60				
Aug. 12	3.00	Aug. 2	2.70				
Sept. 23	3.10	Sept. 19	2.15				
Nov. 11	2.40	Nov. 9	+1.90				
Dec. 16	+2.90						

GPO 838799

TABLE 2.5-6 (Continued)

WATER LEVELS AND ARTESIAN PRESSURES IN NORTHWEST FLORIDA
OBSERVATION WELL NO. 30

FORM 9-146

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Report Page No. ______

WATER RESOURCES DIVISION

GROUND WATER BRANCH

COUNTY Holmes

STATE Florida

4. Mrs. D. Hughes. NE1/4SE1/4 sec. 28, T. 4 N., R. 17 W. Ponce de Leon. Drilled public-supply artesian well in Florida aquifer, diameter 6 inches, reported depth 187 feet. Land-surface datum is about 64 feet above msl. MP top of 6-in x 4-in reducing tee, 1.50 feet above lsd.

Highest water level +5.72 Nov. 30 1948; lowest +1.00 Jan. 11 1955
Records available 1938, 1947-58 Water level

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1956		1958		1959			
Feb. 3	+1.40	Jan. 7	+4.05	Dec. 18	+4.80		
Mar. 12	+3.93	Feb. 12	4.97				
April 23	+2.45	Mar. 28	4.5				
June 12	+1.82	May 12	4.10				
July 23	+3.05	June 24	5.20				
Sept. 4	+2.37	Aug. 5	3.35				
Oct. 11	+3.44	Sept. 23	3.30				
Nov. 27	+2.43	Nov. 4	2.10				
1957		Dec. 17	+2.06				
Jan. 15	+2.35	1959					
Feb. 28	+1.94	Feb. 6	+3.30				
Apr. 12	+2.90	Mar. 20	4.70				
May 27	+2.60	May 8	3.51				
July 1	+3.80	June 19	4.60				
Aug. 12	+2.35	Aug. 21	4.10				
Oct. 8	+3.80	Sept. 25	4.10				
Nov. 20	+3.60	Nov. 6	5.50				

GPO 935789

TABLE 2.5-6 (Continued)

WATER LEVELS AND ARTESIAN PRESSURES IN NORTHWEST FLORIDA
OBSERVATION WELL NO. 30

FORM 9-148

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

Report Page No. ____
GROUND WATER BRANCH

COUNTY Holmes 4

STATE Florida

4. Mrs. D. Hughes. Ponce de Leon. SW1/4NE1/4 sec. 27, T. 3 N., R. 17W. Drilled public-supply artesian well in Floridan aquifer, diameter 6 inches, reported depth 187 feet. Land-surface datum is about 64 feet above msl.

Highest water level +5.72 November 30 19 48 ; lowest +1.90 Jan. 11 19 55
Records available 1947-55 Water level above land-surface datum.

Date	Water level	Date	Water level	Date	Water level	Date	Water level
1951		1953		1955			
Jan. 2	+2.59	Feb. 14	+3.35	Jan. 11	+1.00		
Feb. 19	+2.64	Mar. 29	+3.26	Feb. 21	+1.86		
Apr. 2	+3.58	May. 4	+3.73	Apr. 4	+1.71		
May 28	+2.42	June 19	+3.68	May 16	+1.85		
July 10	+2.02	Aug. 1	+2.83	June 28	+1.50		
Sept. 4	+1.87	Sept. 12	+2.33	Aug. 16	+2.21		
Oct. 16	+1.82	Oct. 24	+2.68	Sept. 27	+1.85		
Dec. 4	+2.46	Dec. 10	+5.01	Nov. 7	+1.55		
1952		1954		Dec. 19	+1.24		
Jan. 28	+2.73	Jan. 15	+4.80				
Apr. 23	+2.97	Feb. 27	+4.03				
July 19	+1.79	Apr. 10	+3.60				
Aug. 26	+1.95	May 21	+2.80				
Oct. 14	+1.91	July 11	+2.86				
Nov. 23	+1.72	26	+2.23				
		Sept. 7	+1.75				
		Oct. 18	+1.40				
		Nov. 19	below +1.1				

GPO 938789

TABLE 2.5-6a

LIST OF WATER WELLS IN THE VICINITY OF CARYVILLE

Well No.	Location	Depth of Well (In Feet)	Diameter (In Inches)	Casing (In Feet)	Use	Remarks
1	NW1/4SE1/4SW1/4 Section 12 T5N - R16W	44	02	40	DOM[1]	
2	SE NE NW 5 - 15 - 8	140	03	--	IND[2]	
3	SW NW SE 5 - 15 - 8	190 to 200	04	--	MUN[3]	Lane & Bowler deep well turbine, 3 inch outlet
4	SE1/4SE1/4SE1/4 Section 16 T5N - R16W	12	02	12	DOM	This well never dry in 46 years
5	SE1/4SE1/4SE1/4 Section 16 T5N - R16W	14	02	14	DOM	Owner reports never dry in 46 years
6	SW SW SE 5 - 16 - 16	--	04	--	DOM	Second house from corner, trailer in between, 1 inch hose to trailer
7	SE1/4NW1/4SW1/4 Section 15 T5N - R16W	--	02	--	DOM	
8	SE1/4NW1/4SE1/4 Section 15 T5N - R16W	20	01	20	DOM	

2

TABLE 2.5-6a (Continued)

Well No.	Location	Depth of Well (In Feet)	Diameter (In Inches)	Casing (In Feet)	Use	Remarks
9	SE1/4SE1/4NW1/4 Section 14 T5N - R16W	55	02	40	DOM	
10	SE1/4SE1/4NW1/4 Section 14 T5N - R16W	40	02	--	DOM	
11	NW SW SE 5 - 16 - 14	500+	06	500+	UNUSED[4]	U.S. Geological Survey Observation well, has been flowing, dry now
12	SW SW SE 5 - 16 - 14	575	06	575	DOM	
13	SE1/4NE1/4SW1/4 Section 17 T5N - R15W	265	02	--	DOM	
14	SE1/4SE1/4NW1/4 Section 16 T5N - R15W	50	02	50	DOM	
15	NE1/4NE1/4SW1/4 Section 16 T5N - R15W	265	02	250	DOM	
16	SW1/4NW1/4NE1/4 Section 21 T5N - R15W	265	02	250	DOM	Information obtained from relative of former owner

TABLE 2.5-6a (Continued)

Well No.	Location	Depth of Well (In Feet)	Diameter (In Inches)	Casing (In Feet)	Use	Remarks
17	NE1/4SE1/4NW1/4 Section 21 T5N - R15W	265	02	245	DOM	
18	NW1/4NW1/4NW1/4 Section 20 T5N - R15W	--	02	--	DOM	
19	SE1/4NE1/4SE1/4 Section 23 T5N - R16W	--	02	--	DOM	
20	NW NE NW 5 - 16 - 15	130	04	96	DOM	
21	NW NE NW 5 - 16 - 15	--	02	--	DOM	
22	NW1/4NW1/4SW1/4 Section 22 T5N - R16W	96	03	--	DOM	
23	NW SW NW 5 - 16 - 26	120	04	100	DOM	Pump 1,700 gallons per hour
24	NE1/4SW1/4SE1/4 Section 26 T5N - R16N	76	02	74	DOM	
25	NW1/4SE1/4NW1/4 Section 30 T5N - R15W	300	04	--	DOM	

TABLE 2.5-6a (Continued)

Well No.	Location	Depth of Well (In Feet)	Diameter (In Inches)	Casing (In Feet)	Use	Remarks
26	SW1/4NW1/4SE1/4 Section 21 T5N - R15W	320	02	260	DOM	
27	SE1/4SE1/4SW1/4 Section 26 T5N - R15W	350	03	--	DOM	
28	NW1/4NE1/4NW1/4 Section 35 T5N - R15W	487	04	--	DOM	Owner reports drinking water quality very poor
29	NE SE NW 5 - 15 - 27	140	02	113	DOM	Capacity 240 gallons per minute
30	NW1/4NW1/4NE1/4 Section 34 T5N - R15W	380	02	--	DOM	
31	NE NW NE 5 - 15 - 32	369	02	340	DOM	
32	NE1/4NE1/4NE1/4 Section 31 T5N - R15W	--	02	--	DOM	
33	NW NE SW 5 - 15 - 31	40	40	--	DOM	
34	NE SW SW 5 - 15 - 31	264	03	--	DOM	

2

TABLE 2.5-6a (Continued)

Well No.	Location	Depth of Well (In Feet)	Diameter (In Inches)	Casing (in Feet)	Use	Remarks
35	SE1/4NE1/4SW1/4 Section 31 T5N - R15W	--	03	--	DOM	
36	NW1/4SW1/4SW1/4 Section 36 T5N - R16N	--	03	--	DOM	
37	SE1/4SE1/4SE1/4 Section 35 T5N - R16N	100	02	--	DOM	
38	SE1/4NE1/4SE1/4 Section 35 T5N - R16N	--	02	--	DOM	
39	SW1/4NE1/4SE1/4 Section 35 T5N - R16N	140	02	42	DOM	
40	NW1/4NE1/4SE1/4 Section 35 T5N - R16N	100	03	65	DOM	
41	NW1/4NE1/4SE1/4 Section 35 T5N - R16N	120	03	65	DOM	
42	SE1/4SE1/4NE1/4 Section 35 T5N - R16N	200	04	--	DOM	

2

TABLE 2.5-6a (Continued)

Well No.	Location	Depth of Well (In Feet)	Diameter (In Inches)	Casing (In Feet)	Use	Remarks
43	NW1/4SE1/4NE1/4 Section 35 T5N - R16N	--	02	--	DOM	
44	NE1/4SW1/4NE1/4 Section 35 T5N - R16N	60	04	42	DOM	Second well on property; this well used to fill fish pond
45	NW1/4SW1/4NW1/4 Section 35 T5N - R16N	82	02	63	DOM	
46	NW1/4SW1/4NW1/4 Section 35 T5N - R16N	67	02	38	DOM	
47	NE1/4NW1/4NE1/4 Section 35 T5N - R16N	--	02	--	DOM	
48	NE1/4NW1/4NE1/4 Section 35 T5N - R16N	110	04	58	COM[5]	
49	NW1/4SW1/4NE1/4 Section 35 T5N - R16N	84	02	--	DOM	
50	NE1/4NE1/4NW1/4 Section 35 T5N - R16N	80	04	35	DOM	

2

TABLE 2.5-6a (Continued)

Well No.	Location	Depth of Well (In Feet)	Diameter (In Inches)	Casing (In Feet)	Use	Remarks
51	SW1/4NE1/4NW1/4 Section 35 T5N - R16N	35	03	30	DOM	
52	SW1/4NE1/4NW1/4 Section 35 T5N - R16N	150+	02	--	DOM	
53	SW1/4NE1/4NW1/4 Section 35 T5N - R16N	70	03	45	DOM	
54	NW1/4NE1/4SW1/4 Section 35 T5N - R16N	50	06	--	DOM	
55	SE1/4NE1/4SW1/4 Section 35 T5N - R16N	--	02	--	DOM	
56	SE1/4NW1/4SE1/4 Section 35 T5N - R16N	40	02	--	DOM	
57	NE1/4NW1/4SE1/4 Section 35 T5N - R16N	200+	02	--	DOM	
58	NE1/4SW1/4SE1/4 Section 35 T5N - R16N	75	02	--	DOM	

2

TABLE 2.5-6a (Continued)

Well No.	Location	Depth of Well (In Feet)	Diameter (In Inches)	Casing (In Feet)	Use	Remarks
59	SW1/4SE1/4SE1/4 Section 35 T5N - R16N	128	02	--	DOM	
60	SE1/4NE1/4SE1/4 Section 35 T5N - R16N	--	02	--	DOM	
61	NW SW SE 5 - 16 - 32	160	04	100+	DOM	1-1/4 inch pump column submersi-ble
62	NW NE NE 5 - 16 - 8	100	02	--	MUN	
63	SE1/4SE1/4NW1/4 Section 6 T4N - R15W	--	06	--	DOM	
64	SW NE SE 4 - 15 - 6	272	02	--	DOM	
65	SE SE SW 5 - 15 - 33	365	05	--	--	Pearless jet pump 1-1/2 inch outlet
66	SW1/4SW1/4NE1/4 Section 9 T4N - R15W	--	02	--	DOM	
67	NW1/4NE1/4NW1/4 Section 23 T4N - R15W	300+	02	--	DOM	

2

TABLE 2.5-6a (Continued)

Well No.	Location	Depth of Well (In Feet)	Diameter (In Inches)	Casing (In Feet)	Use	Remarks
68	NW1/4NW1/4NW1/4 Section 23 T4N - R15W	40	36	10	DOM	
69	SE NW SW 4 - 16 - 12	--	03	--	SCHOOL[6]	Can not remove old jet pump fixtures
70	SW1/4SW1/4SE1/4 Section 11 T4N - R16W	--	02	--	DOM	
71	NW SE SE 5 - 16 - 11	316	03	--	DOM	
72	NE1/4NE1/4NW1/4 Section 11 T4N - R16W	165	08	100	MUN	
73	SE1/4NE1/4NW1/4 Section 11 T4N - R16W	--	04	--	MUN	
74	NW SW NW 4 - 16 - 9	720	04	330	DOM	
75	NE SE NE 4 - 16 - 8	170	04	80	DOM	
76	NE NE NE 4 - 16 - 20	100	02	80	DOM	12-foot water level

2

TABLE 2.5-6a (Continued)

Well No.	Location	Depth of Well (In Feet)	Diameter (In Inches)	Casing (In Feet)	Use	Remarks
77	NW1/4NW1/4SW1/4 Section 18 T4N - R15W	40	36	30	DOM	
78	SE1/4SE1/4SW1/4 Section 18 T4N - R15W	--	02	--	DOM	
79	NE1/4NE1/4NW1/4 Section 17 T4N - R15W	135	02	--	DOM	
80	NE1/4NE1/4NW1/4 Section 17 T4N - R15W	115	02	--	DOM	
81	SE1/4NE1/4NW1/4 Section 19 T4N - R15W	225	02	--	DOM	
82	NE1/4NE1/4NE1/4 Section 25 T4N - R16W	--	02	--	DOM	
83	SW1/4NW1/4NW1/4 Section 30 T4N - R15W	200	02	--	DOM	
84	SE1/4SW1/4SE1/4 Section 19 T4N - R15W	--	02	--	DOM	

2

TABLE 2.5-6a (Continued)

Well No.	Location	Depth of Well (In Feet)	Diameter (In Inches)	Casing (In Feet)	Use	Remarks
85	SW1/4NW1/4SW1/4 Section 26 T5N - R16W	185	03	--	DOM	
86	SW1/4SW1/4NE1/4 Section 27 T5N - T16W	100+	03	--	DOM	
87	NW NW NE 4 - 16 - 24	162	02	162	DOM	Cannot measure 2-inch casing; 1-inch pipe column; Jet Beta Flow Pump
88	NE1/4NW1/4NE1/4 Section 6 T4N - R15W	300	02	--	DOM	
89	NW SE SE 5 - 16 - 27	250	04	150	DOM	

Explanation for Table 2.5-6a

[1]DOM = Domestic
[2]IND = Industrial
[3]MUN = Municipal
[4]UNUSED = Not Presently in Use
[5]COM = Commercial
[6]SCHOOL = On school property

TABLE 2.5-6b

SUMMARY OF DRILL HOLE DATA: PUMPED, OBSERVED, AND REFERENCE WELLS

Hole No. or Name	Total Depth (In Feet)	Elevation of Land Surface	Location	Measured Depth to Limestone	Elevation Top of Limestone	Screen (Feet Below Surface)
No. 1*	1,180	102.47	1,593,400 E. 656,340 N.	180	-78	240 to 290; 315 to 345; 550 to 610
No. 2 **	460	79.09	1,591,000 E. 655,500 N.	170	-90	240 to 290; 315 to 345
26-1	370	72.00	1,590,810.784 E. 655,575.701 N.	54	18	260 to 281; 310 to 331
26-2	50	71.35	1,590,818.542 E. 655,599.019 N.			40 to 50
3-1	150	79.02	1,593,403.638 E. 652,883.327 N.	72	7	
4-1	336	102.26	1,593,576.431 E. 656,261.233 N.	182	-60	
12-1	190	68.71	1,587,269.331 E. 659,470.175 N.	123	54	
13-1	150	59.33	1,587,766.710 E. 654,614.966 N.	19	40	
14-1	100	70.66	1,589,661.261 E. 651,525.676 N.	44	27	

* Potable Water Supply Test Well No. 1
** Potable Water Supply Test Well No. 2

TABLE 2.5-7

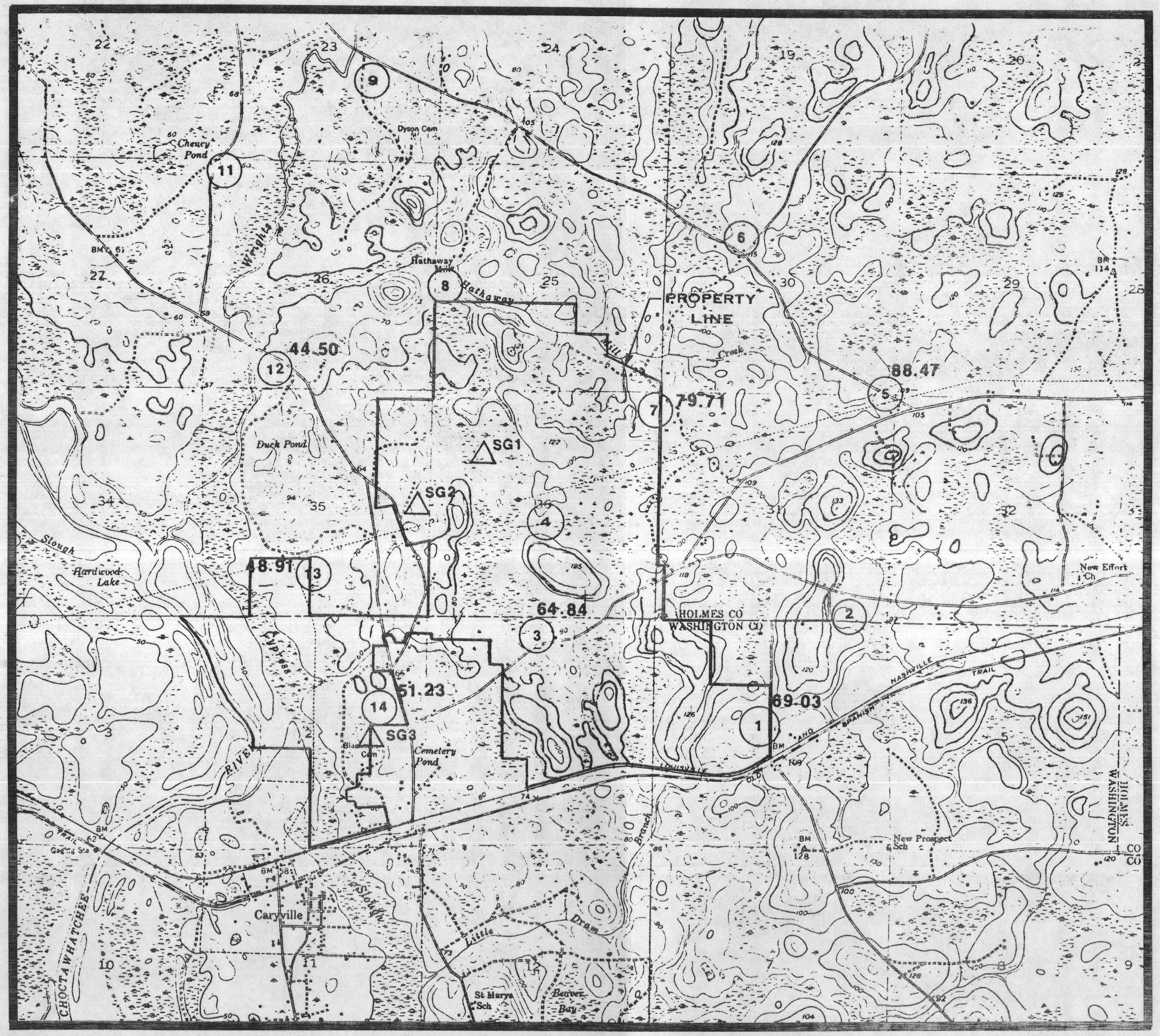
HYDROLOGIC DATA *

Gage No. 02365500 Choctawhatchee River at Caryville, Florida

Records of 1929 to 1971	42 years
Drainage Area	3,499 square miles
Average Discharge	5,292 cubic feet per second (CFS)
7-Day/10-Year Low Flow	870 CFS
Minimum Daily Discharge of Record (September, 1968)	604 CFS
Maximum Daily Discharge of Record (April 7, 1960)	60,100 CFS
Maximum Stage Elevation 66 Feet Mean Sea Level (March, 1929)	206,000 CFS (estimated)

MONTH	DISCHARGE IN CFS AVERAGE	DISCHARGE IN CFS MAXIMUM	DISCHARGE IN CFS MINIMUM
January	7,022	23,510	1,925
February	7,566	15,600	2,994
March	9,125	22,500	1,777
April	8,637	22,010	2,343
May	6,016	15,700	1,618
June	3,392	9,236	1,349
July	3,805	10,130	1,408
August	4,366	17,120	1,046
September	3,525	16,650	905
October	3,014	14,000	721
November	3,335	11,700	992
December	4,653	24,150	1,395

*Source: U. S. Geological Survey Data



Water Level MSL
(Difficult to read ground elevation)

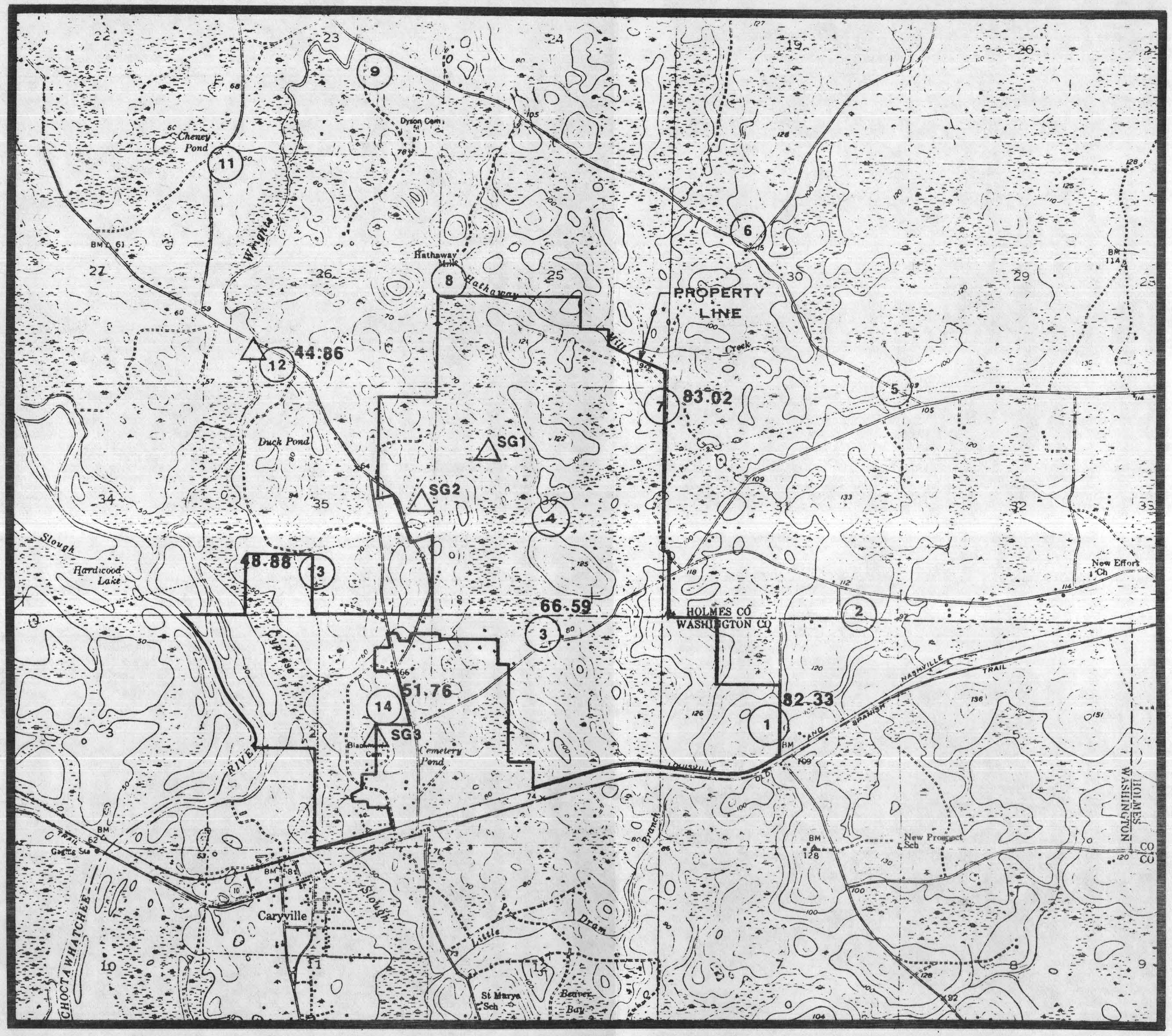
NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

WATER LEVELS IN THE FLORIDAN AQUIFER AS OF 11/11/74

FIGURE 2.5-2



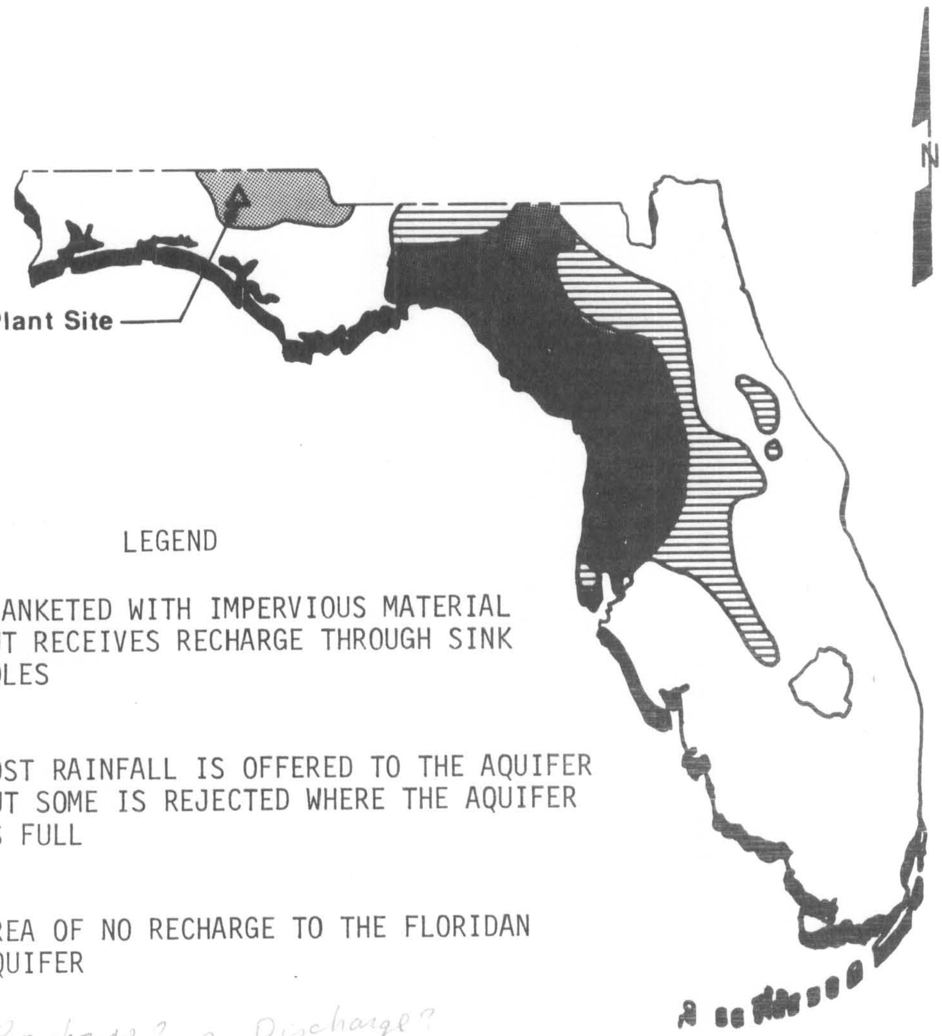
CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

GULF POWER CO.
CARYVILLE STEAM PLANT

WATER LEVELS IN THE SHALLOW AQUIFER AS OF 11/11/74

FIGURE 2.5-3



LEGEND

BLANKETED WITH IMPERVIOUS MATERIAL BUT RECEIVES RECHARGE THROUGH SINK HOLES

MOST RAINFALL IS OFFERED TO THE AQUIFER BUT SOME IS REJECTED WHERE THE AQUIFER IS FULL

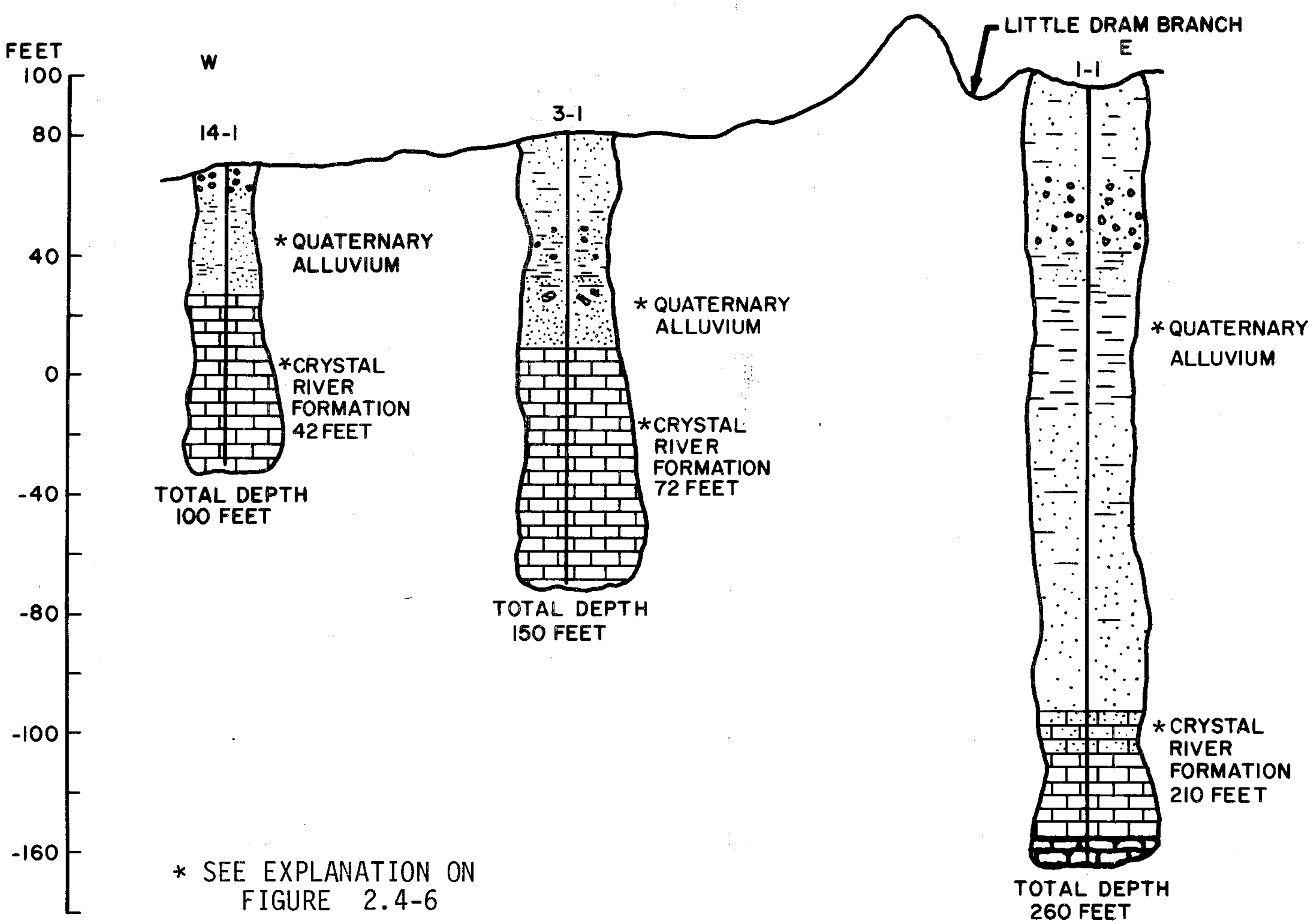
AREA OF NO RECHARGE TO THE FLORIDAN AQUIFER

Recharge? or Discharge?

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

AMENDMENT 2 8/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	AREAS OF RECHARGE TO THE FLORIDAN AQUIFER FIGURE 2.5-4



GULF POWER CO.
CARYVILLE STEAM PLANT

GENERALIZED CROSS-SECTION INCLUDING OBSERVATION WELLS NO.1-1, 3-1 and 14-1

FIGURE 2.5-5

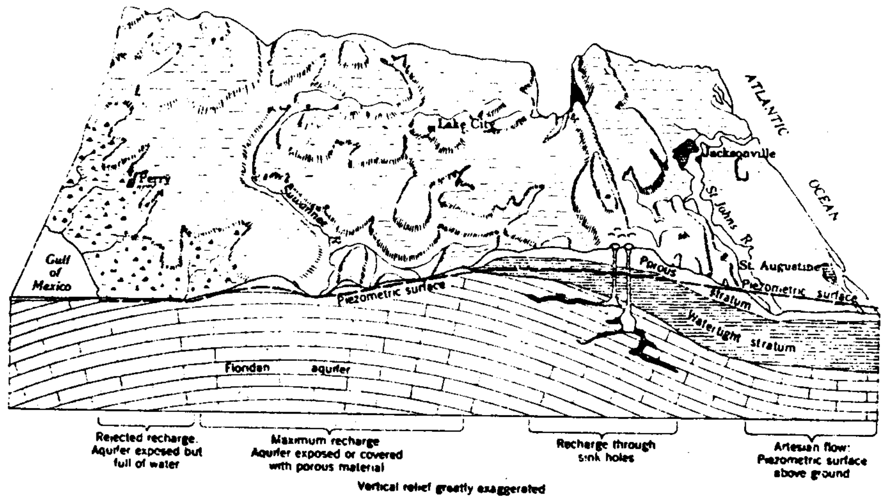


FIGURE 2.5-6A - GEOLOGY CONTROLS RECHARGE AND MOVEMENT OF THE WATER

The Floridan aquifer is a thick section of limestone which crops out at the land surface in some areas, but which is blanketed by watertight material in other areas. Recharge occurs most readily where the aquifer crops out, but a substantial amount of water enters through sinkholes which breach the watertight blanket.

Flowing wells may be obtained wherever the piezometric surface is above the land surface, as in the right-hand part of the section shown. Here the water is confined beneath the watertight blanket, and the aquifer is essentially a conduit. Where the aquifer is unconfined (left half of the section) it functions as a reservoir. At the far left of the section the aquifer is full and, therefore, is rejecting recharge.

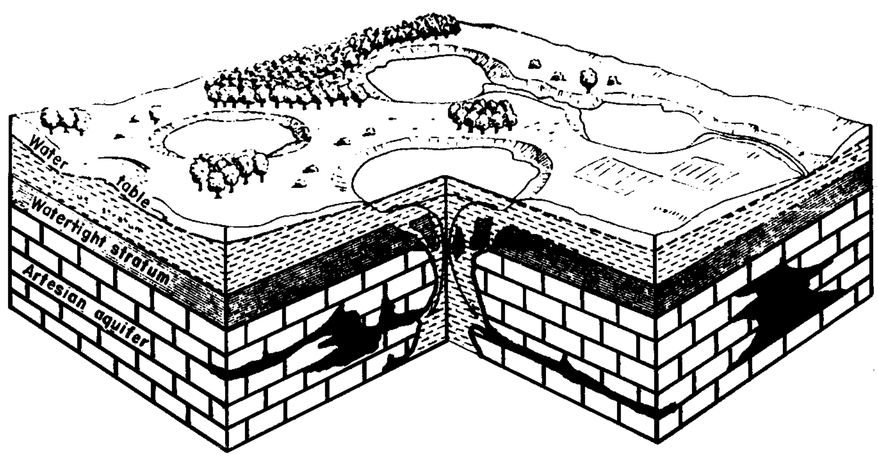
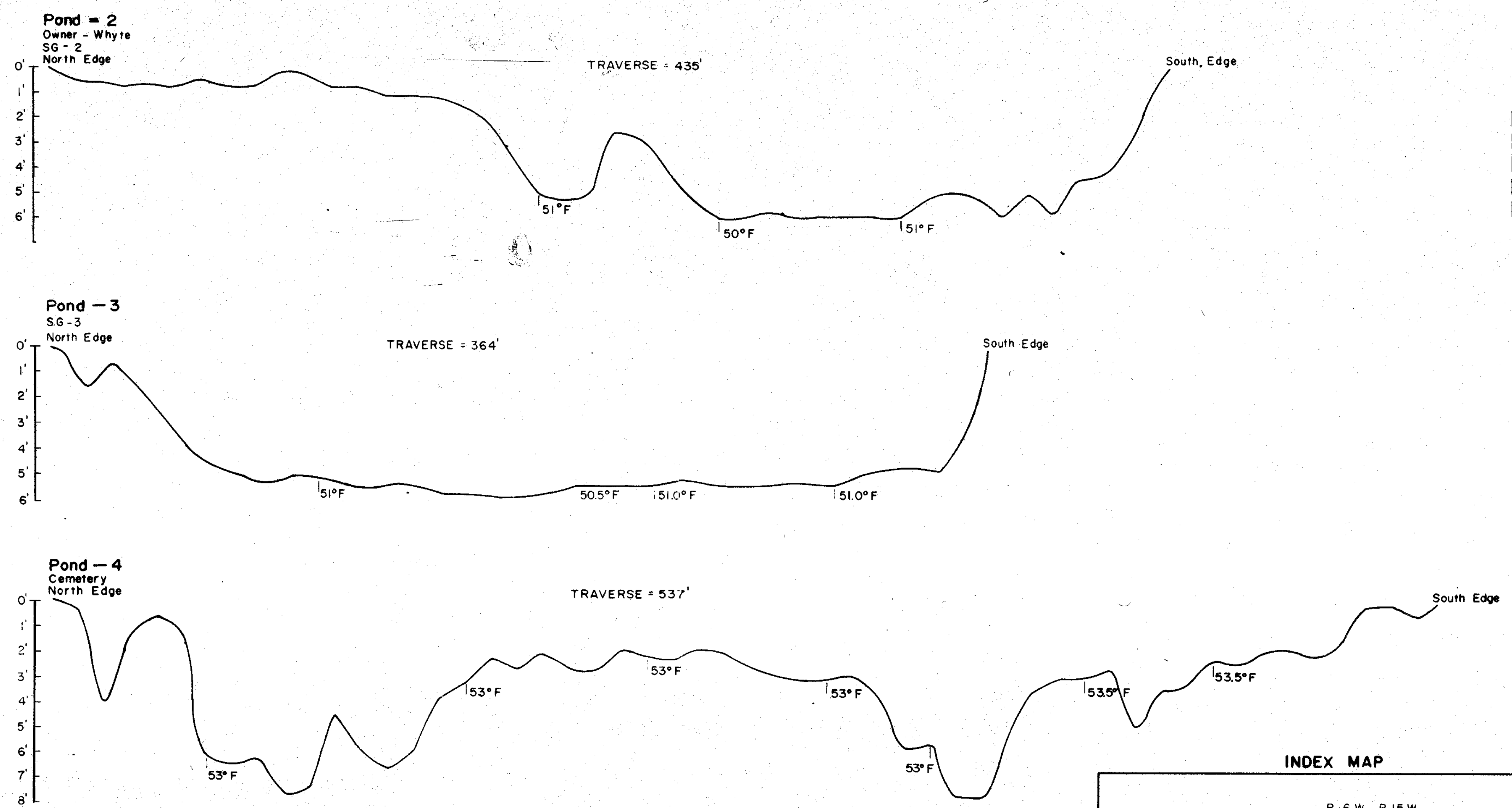
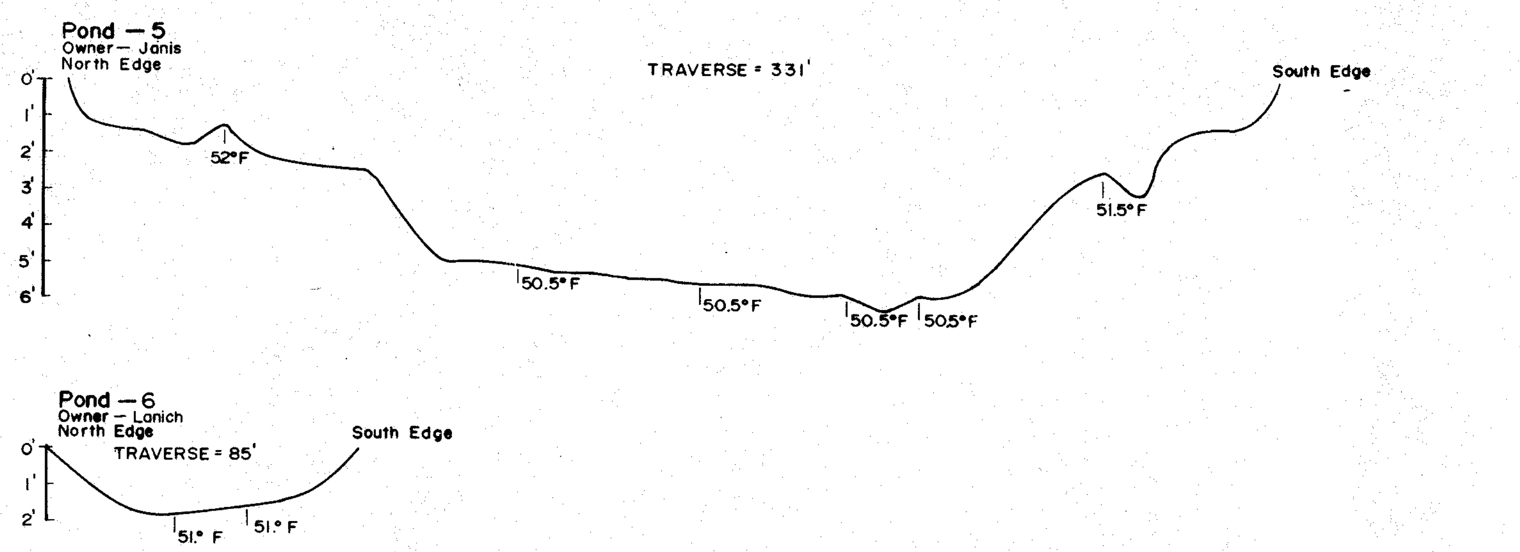


FIGURE 2.5-6B - RECHARGE THROUGH SINKHOLE

Limestone is slightly soluble in water and gradually dissolves as water moves through it. Over the ages, this process of solution creates large caverns, and forever enlarges them until ultimately they collapse under the load of rock and earth above. Collapse of a cavern causes the overlying material to subside, and so breaches the watertight blanket that confines the aquifer. Water from the land surface and in the thin sandy mantle then has a portal through which it may drain into the aquifer.

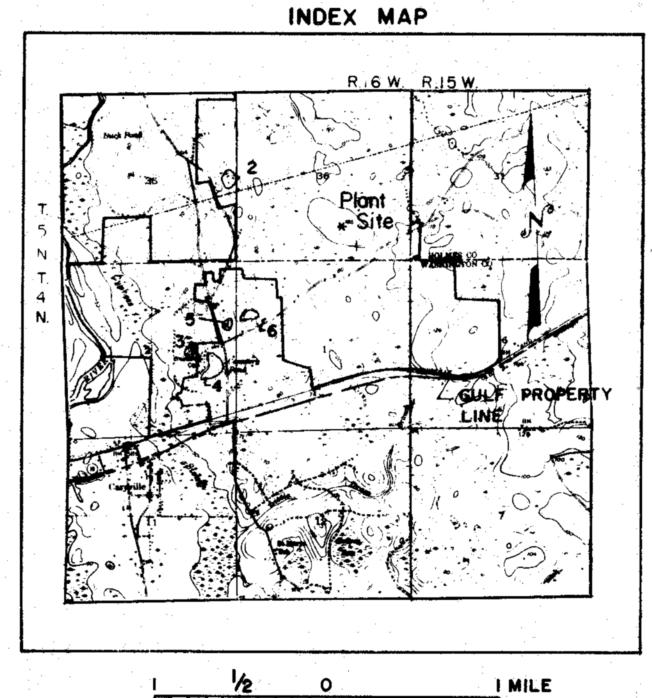
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ILLUSTRATIONS OF RECHARGE CONDITIONS (FROM REFERENCE 1) FIGURE 2.5-6 (A & B)





POND #2	N-656,100	E-1,590,590
POND #3	N-650,750	E-1,589,230
POND #4	N-650,150	E-1,589,940
POND #5	N-651,550	E-1,590,400
POND #6	N-651,790	E-1,591,750

INDEX MAP

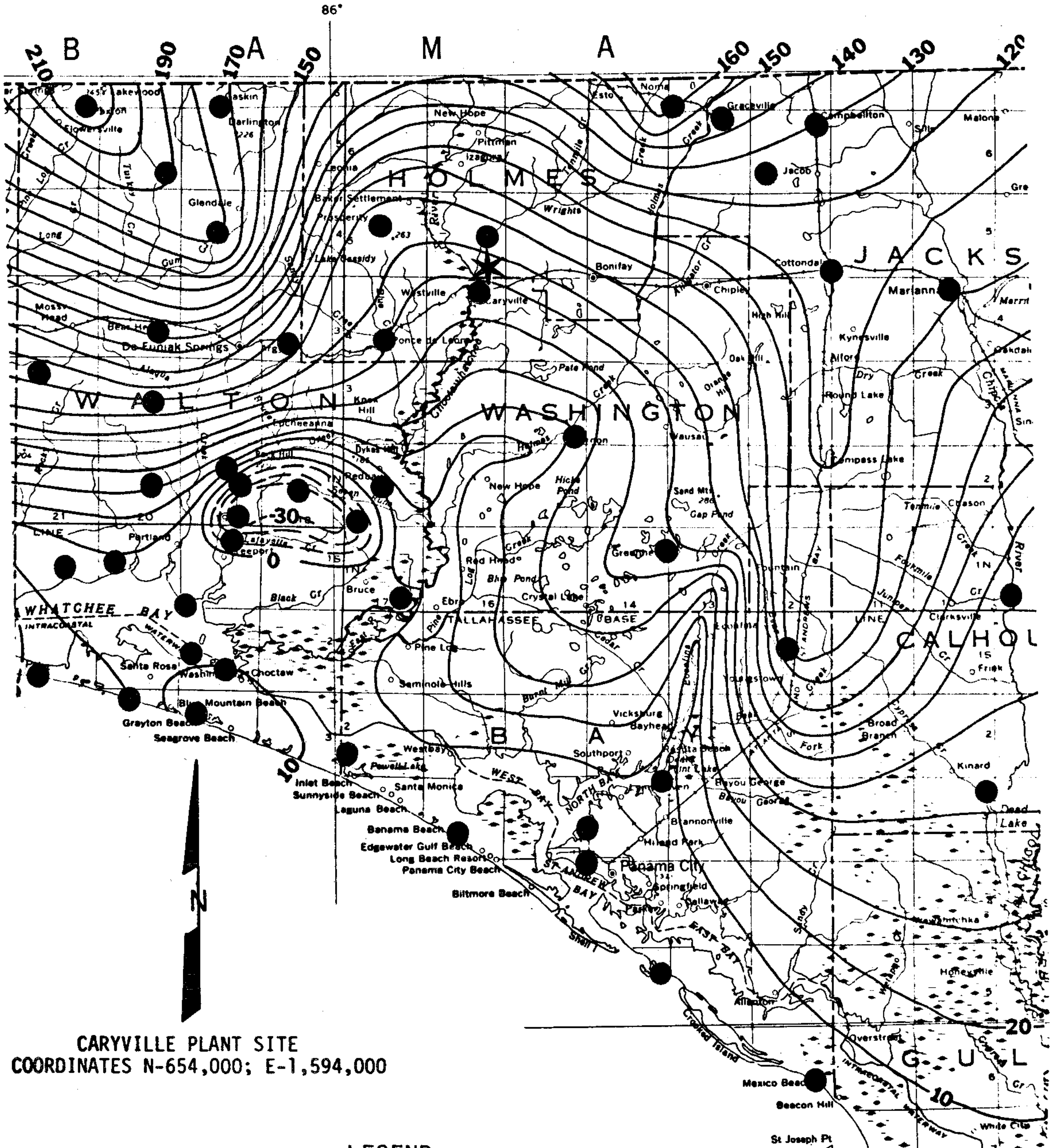


CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

POND DEPTH AND TEMPERATURE SURVEY WEST OF PLANT SITE (DECEMBER 9-13,1974)

FIGURE 2.5-7



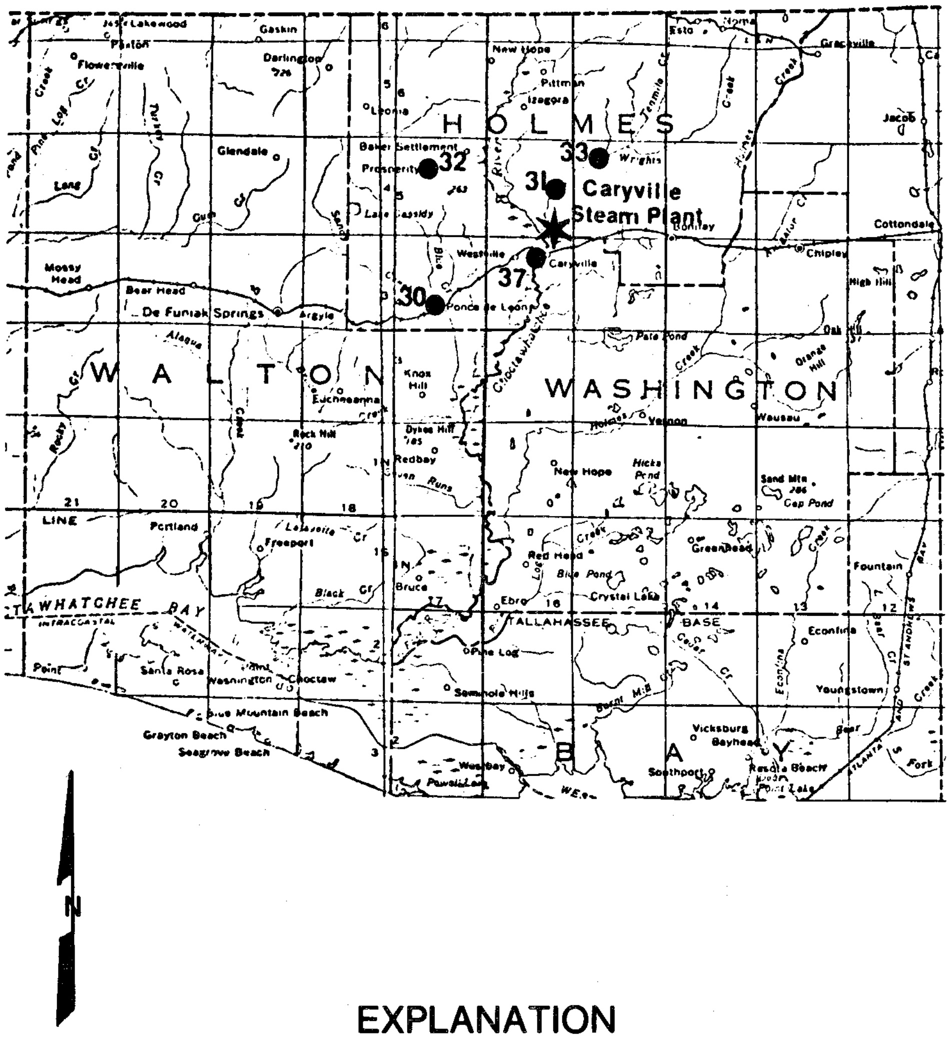
CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

LEGEND

SOLID CONTOURS REPRESENT THE HEIGHT TO WHICH WATER LEVELS WILL RISE ABOVE MEAN SEA LEVEL IN TIGHTLY CASED WELLS IN THE FLORIDAN AQUIFER. DASHED CONTOURS ARE BELOW MEAN SEA LEVEL.

✶ CARYVILLE PLANT SITE

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	WATER LEVELS IN THE FLORIDAN AQUIFER, MAY 1974, NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT FIGURE 2.5-8



EXPLANATION

●37 Well Number

✱ Plant Site

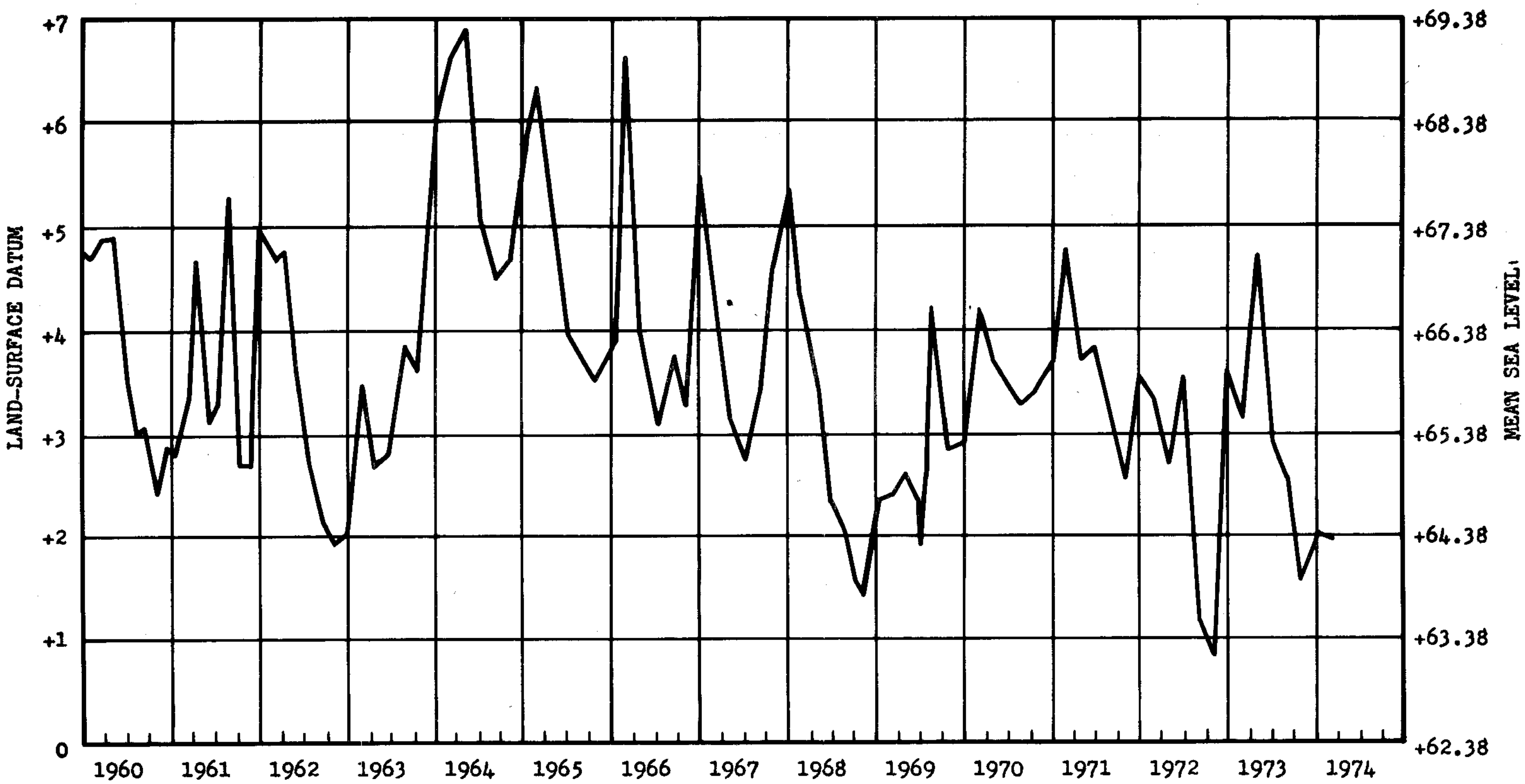
CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	NORTHWEST FLORIDA OBSERVATION WELL PLANT VICINITY. HYDROGRAPHS IN FIGURES 2.5-10 THROUGH -16
		FIGURE 2.5-9

WATER-LEVEL MEASUREMENTS: periodic pressure gage measurements

WELL NUMBER: 304322N0855614.1
LOCAL NUMBER: Holmes 4
GEOGRAPHIC LOCATION: Ponce DeLeon, Fla. under water tank

DEPTH OF WELL: 187 ft
DEPTH OF CASING: NA
AQUIFER: Floridan
ELEV. OF LSD: 62.38 ft
RECORD BEGAN: 1947
REMARKS:
Prepared by U.S. Geological Survey



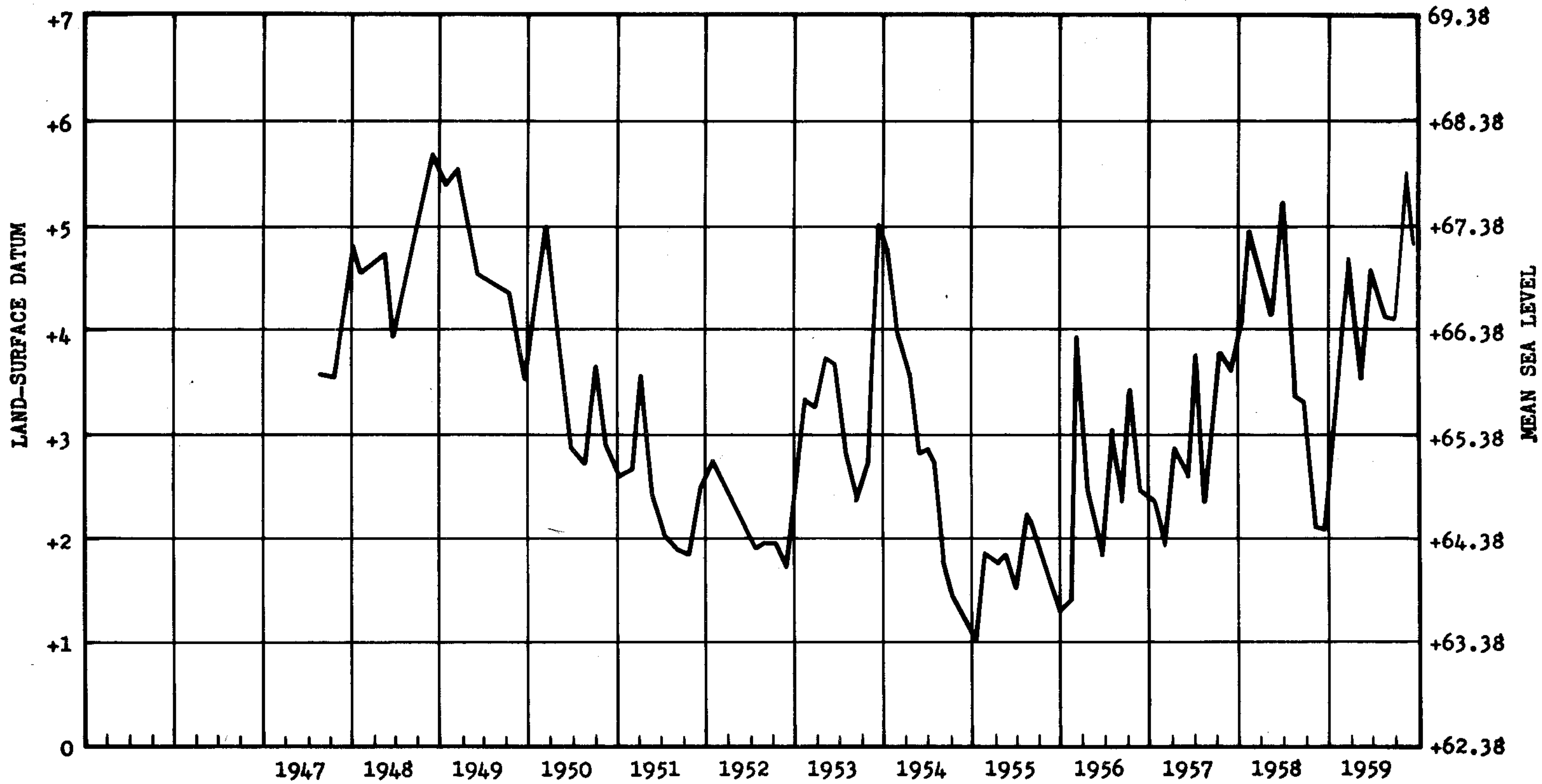
WATER LEVEL, IN FEET, WITH REFERENCE TO LAND-SURFACE DATUM (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT)

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	HYDROGRAPH OF NORTHWEST FLORIDA OBSERVATION WELL 30, 1960 TO 1974 FIGURE 2.5-10

WATER-LEVEL MEASUREMENTS: periodic pressure gage measurements

WELL NUMBER: 304322N0855614.1
LOCAL NUMBER: Holmes 4
GEOGRAPHIC LOCATION: Ponce DeLeon, Fla. under water tank

DEPTH OF WELL: 187 ft
DEPTH OF CASING: NA
AQUIFER: Floridan
ELEV. OF LSD: 62.38 ft
RECORD BEGAN: 1947
REMARKS:
Prepared by U.S. Geological Survey



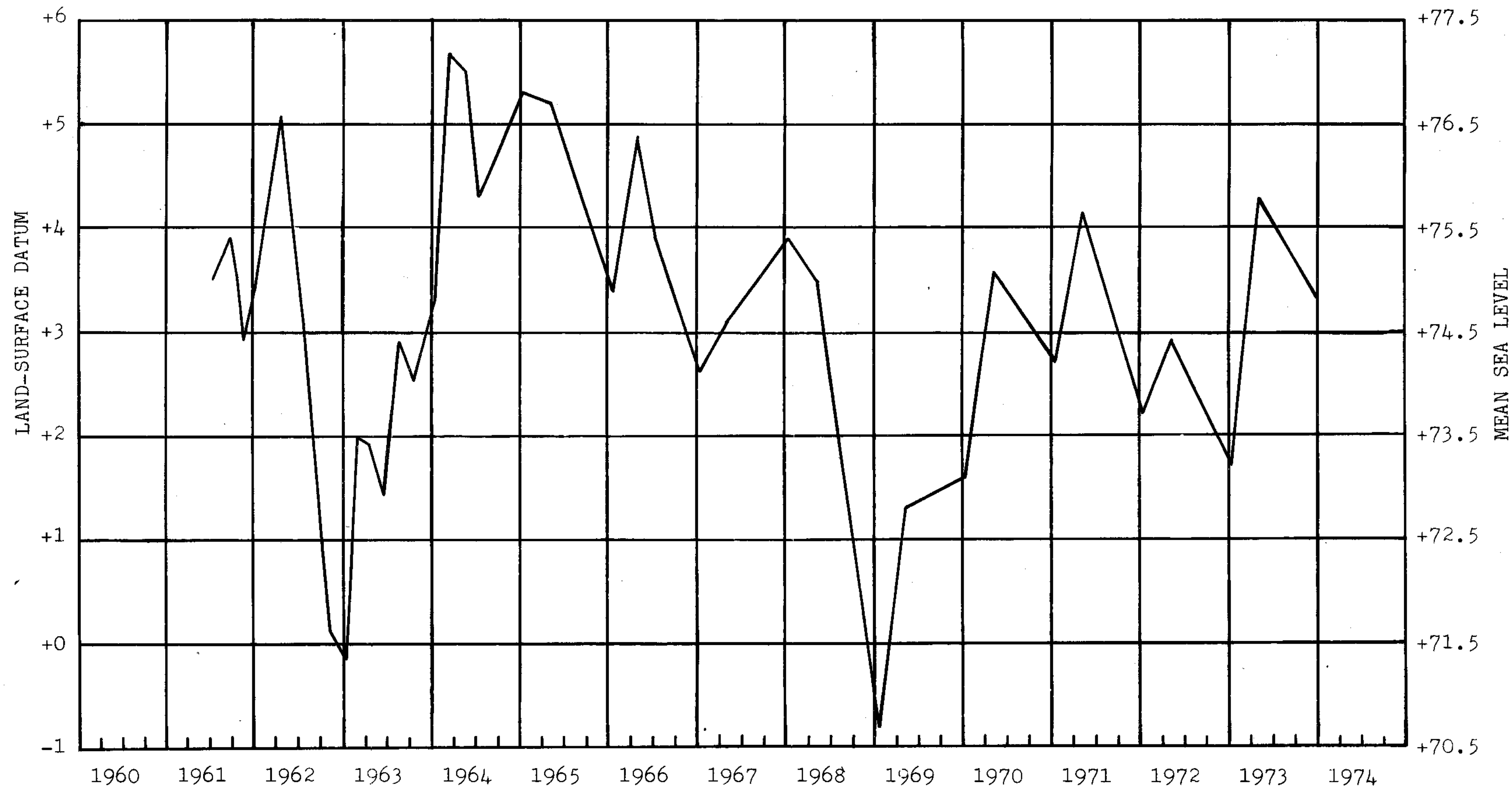
WATER LEVEL, IN FEET, WITH REFERENCE TO LAND-SURFACE DATUM (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT)

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	HYDROGRAPH OF NORTHWEST FLORIDA OBSERVATION WELL 30, 1947 TO 1959
		FIGURE 2.5-11

WATER-LEVEL MEASUREMENTS: Periodic pressure gage measurements

WELL NUMBER: 305014N0854837.1
LOCAL NUMBER: Holmes 050-548-1
GEOGRAPHIC LOCATION: 4 miles north of Caryville, Fla.

DEPTH OF WELL: NA
DEPTH OF CASING: NA
AQUIFER: Floridan
ELEV. OF LSD: 71.5 ft
RECORD BEGAN: 1961
REMARKS:
Prepared by U.S. Geological Survey



WATER LEVEL, IN FEET, WITH REFERENCE TO LAND-SURFACE DATUM (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT)

GULF POWER CO.
CARYVILLE STEAM PLANT

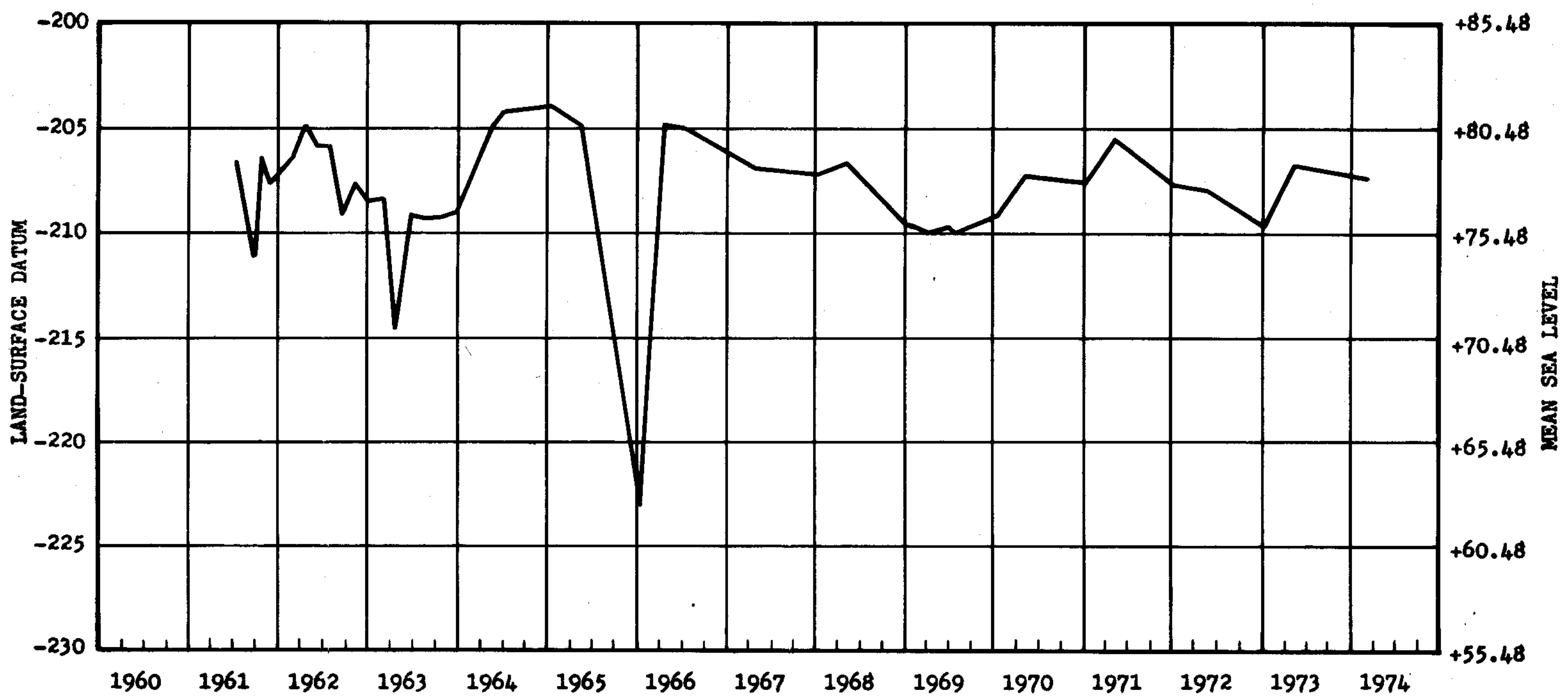
HYDROGRAPH OF NORTHWEST FLORIDA OBSERVATION WELL 31

FIGURE 2.5-12

WATER-LEVEL MEASUREMENTS: Periodic tape measurements

WELL NUMBER: 305119N0855619.1
LOCAL NUMBER: Holmes 051-556-1
GEOGRAPHIC LOCATION: Prosperity, Fla. at fire tower

DEPTH OF WELL: NA
DEPTH OF CASING: NA
AQUIFER: Floridan
ELEV. OF LSD: 285.48 ft
RECORD BEGAN: 1961
REMARKS:
Prepared by U.S. Geological Survey



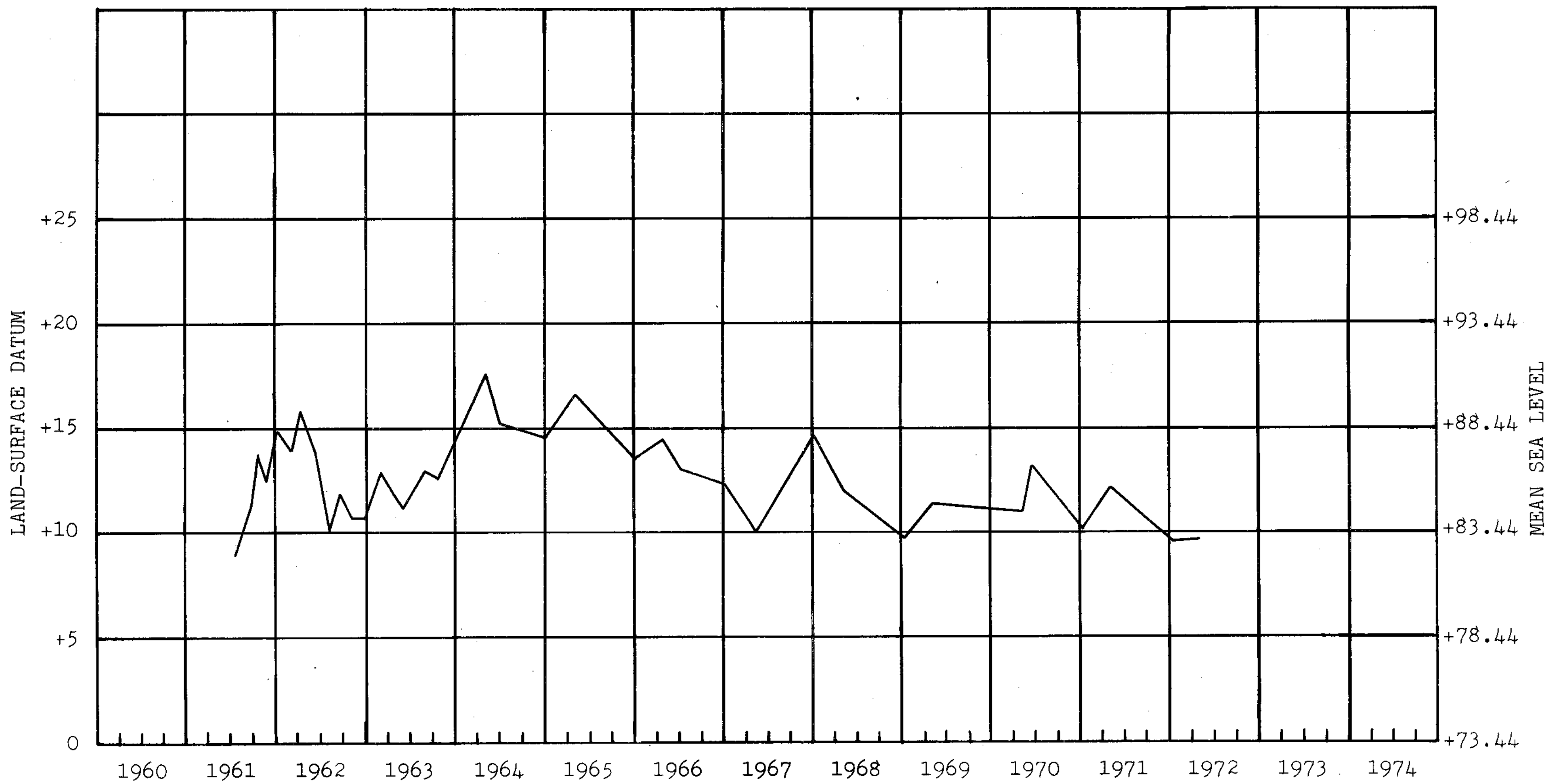
WATER LEVEL, IN FEET, WITH REFERENCE TO LAND-SURFACE DATUM (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT)

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	HYDROGRAPH OF NORTHWEST FLORIDA OBSERVATION WELL 32 FIGURE 2.5-13

WATER-LEVEL MEASUREMENTS: Periodic pressure gage measurements

WELL NUMBER: 305202N0854529.1
LOCAL NUMBER: Holmes 052-545-2
GEOGRAPHIC LOCATION: 6 miles NE of Caryville, Fla.

DEPTH OF WELL: 300+ ft
DEPTH OF CASING: NA
AQUIFER: Floridan
ELEV. OF LSD: 73.44 ft
RECORD BEGAN: 1961
REMARKS:
Prepared by U.S. Geological Survey



WATER LEVEL, IN FEET, WITH REFERENCE TO LAND-SURFACE DATUM (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT)

GULF POWER CO.
CARYVILLE STEAM PLANT

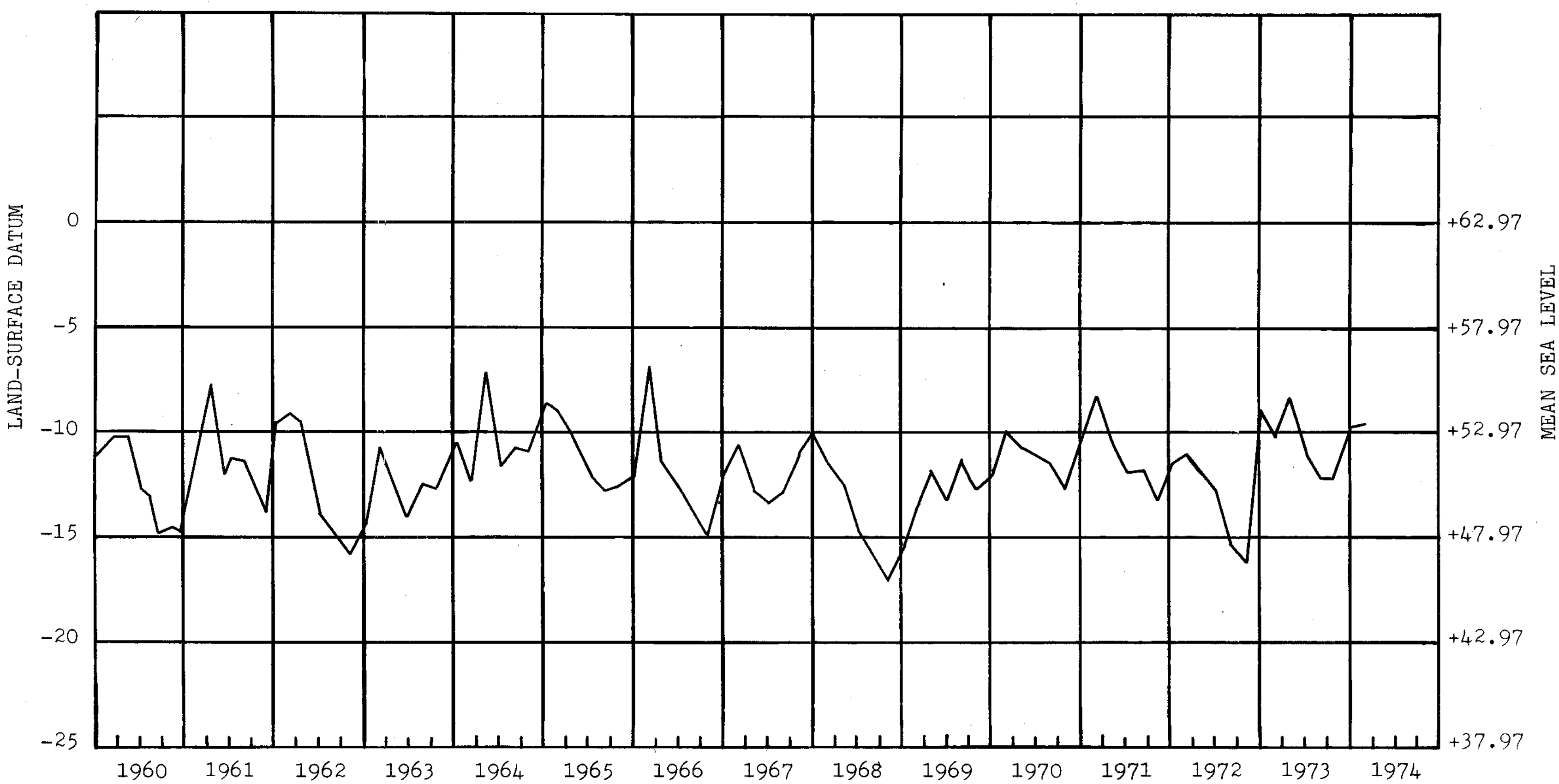
HYDROGRAPH OF NORTHWEST FLORIDA
OBSERVATION WELL 33

FIGURE 2.5-14

WATER LEVEL MEASUREMENTS: Periodic tape measurements

WELL NUMBER: 304632N0854851.1
LOCAL NUMBER: Washington 4
GEOGRAPHIC LOCATION: Caryville, Florida

DEPTH OF WELL: 785 ft
DEPTH OF CASING: NA
AQUIFER: Floridan
ELEV. OF LSD: 62.97 ft
RECORD BEGAN: 1935, 1946-
REMARKS:
Prepared by U.S. Geological Survey



WATER LEVEL, IN FEET, WITH REFERENCE TO LAND-SURFACE DATUM (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT)

GULF POWER CO.
CARYVILLE STEAM PLANT

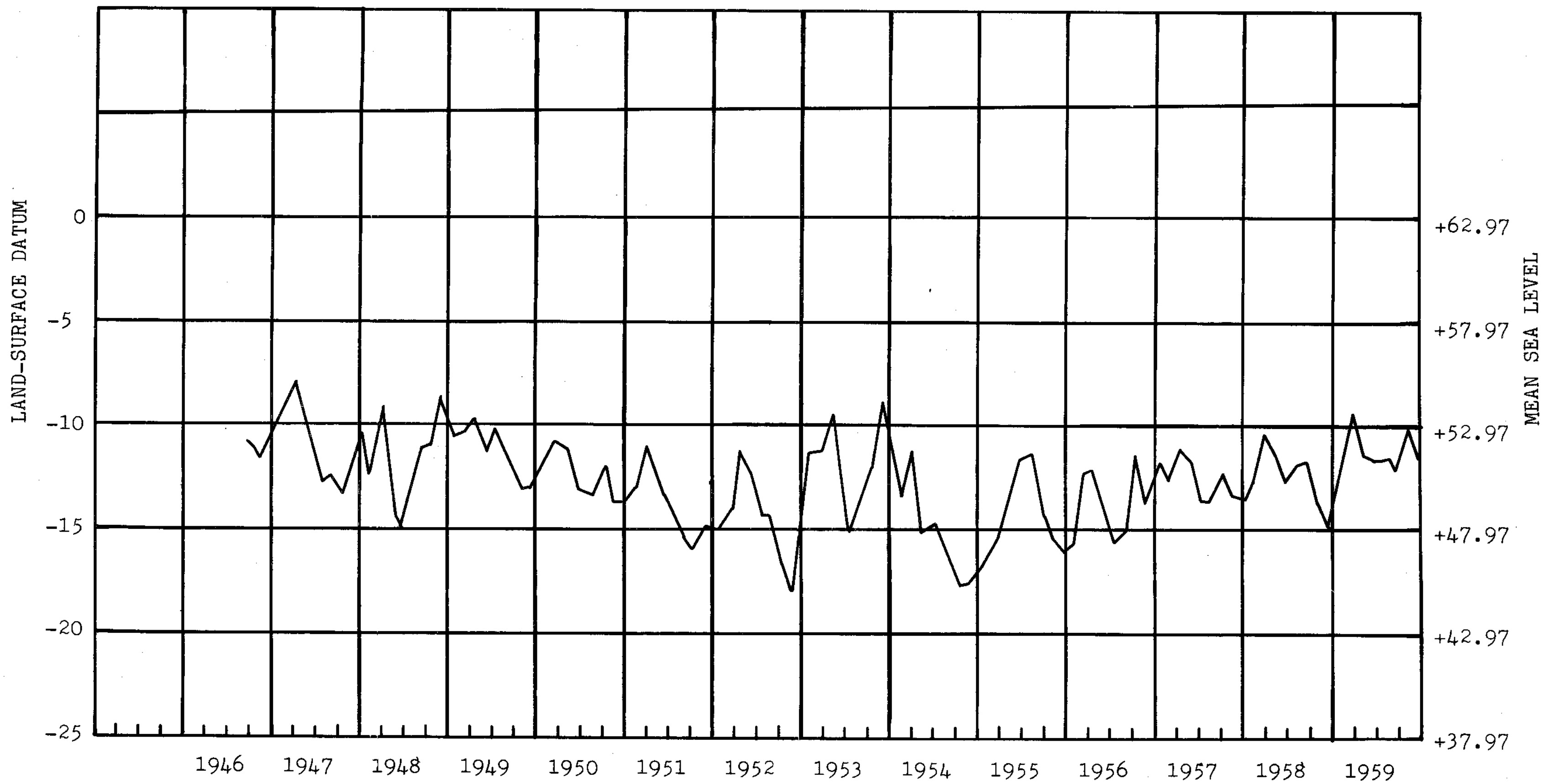
HYDROGRAPH OF NORTHWEST FLORIDA
OBSERVATION WELL 37, 1960 to 1974

FIGURE 2.5-15

WATER LEVEL MEASUREMENTS: Periodic tape measurements

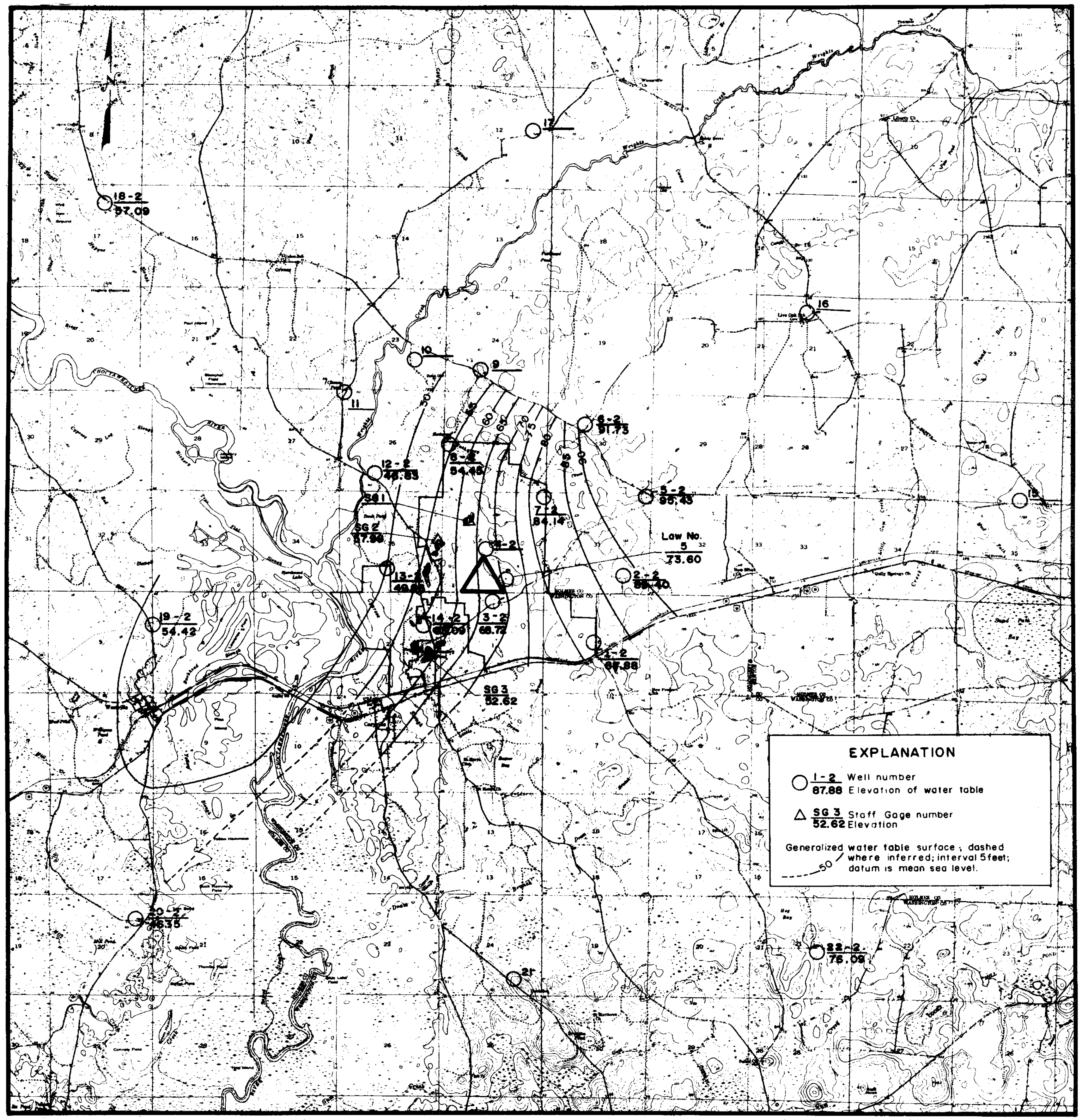
WELL NUMBER: 304632N0854851.1
LOCAL NUMBER: Washington 4
GEOGRAPHIC LOCATION: Caryville, Florida

DEPTH OF WELL: 785 ft
DEPTH OF CASING: NA
AQUIFER: Floridan
ELEV. OF LSD: 62.97 ft
RECORD BEGAN: 1935, 1946-
REMARKS:
Prepared by U.S. Geological Survey



WATER LEVEL, IN FEET, WITH REFERENCE TO LAND-SURFACE DATUM (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT)

	GULF POWER CO. CARYVILLE STEAM PLANT	HYDROGRAPH OF NORTHWEST FLORIDA OBSERVATION WELL 37, 1947 TO 1959
		FIGURE 2.5-16



△ PLANT SITE

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

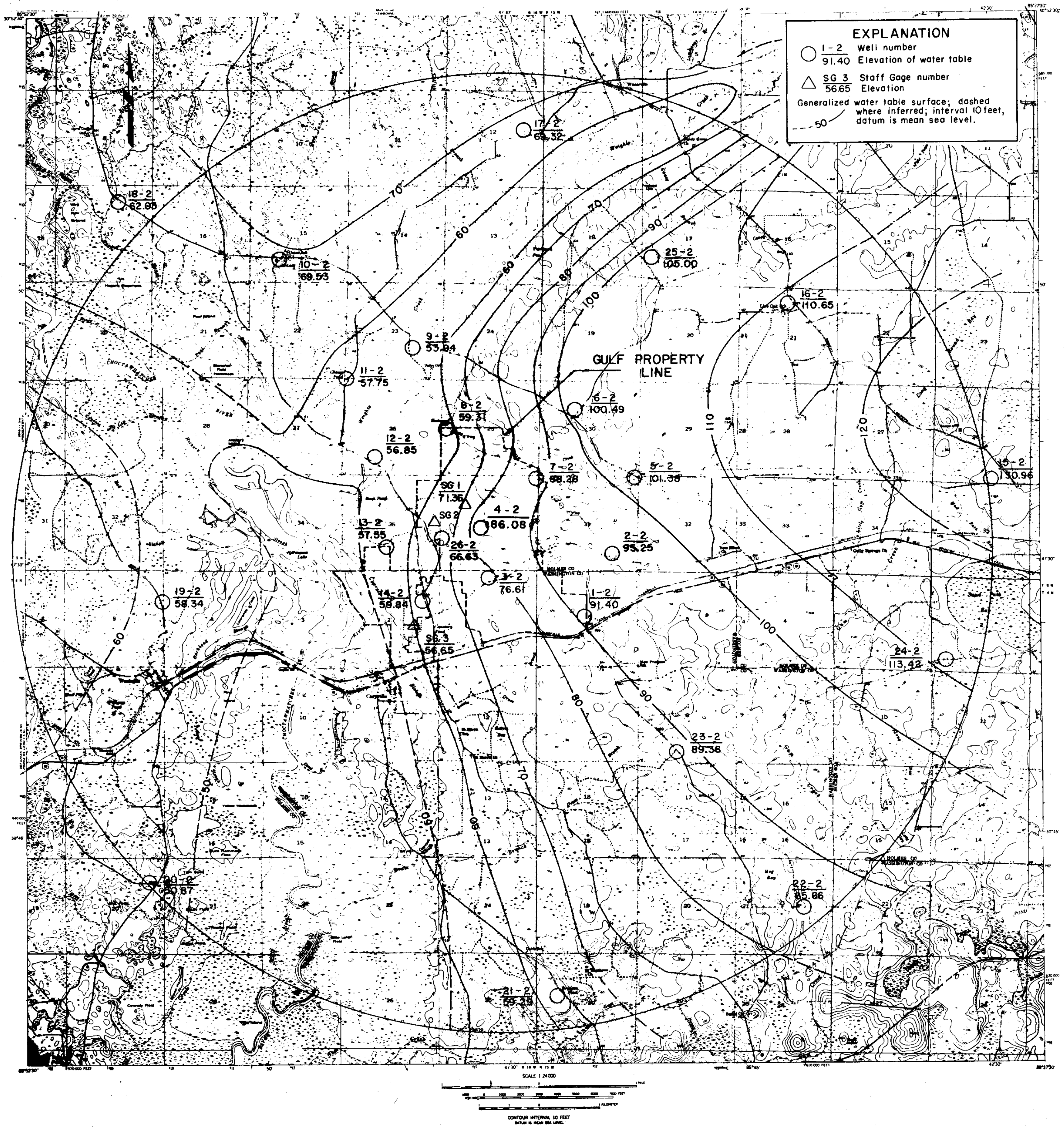
NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

DATE OF DATA TAKEN:
JANUARY 6, 1975

GULF POWER CO.
CARYVILLE STEAM PLANT

MAP OF GENERALIZED WATER TABLE AQUIFER, CARYVILLE AREA

FIGURE 2.5-17



CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

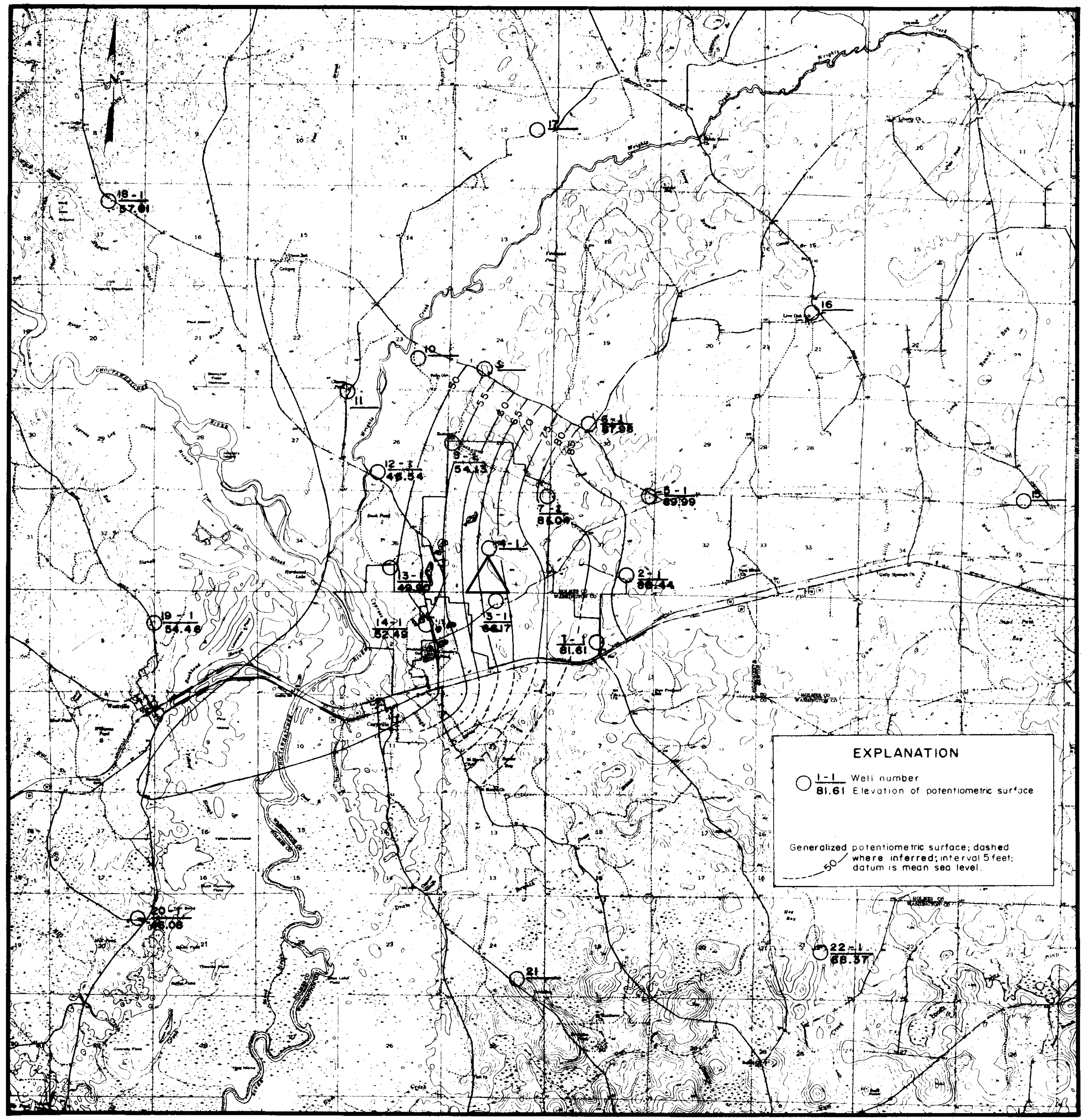
NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

AMENDMENT 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

GENERALIZED WATER TABLE MAP OF WATER TABLE AQUIFER IN CARYVILLE AREA, 4-11-75 to 4-18-75

FIGURE 2.5-17a



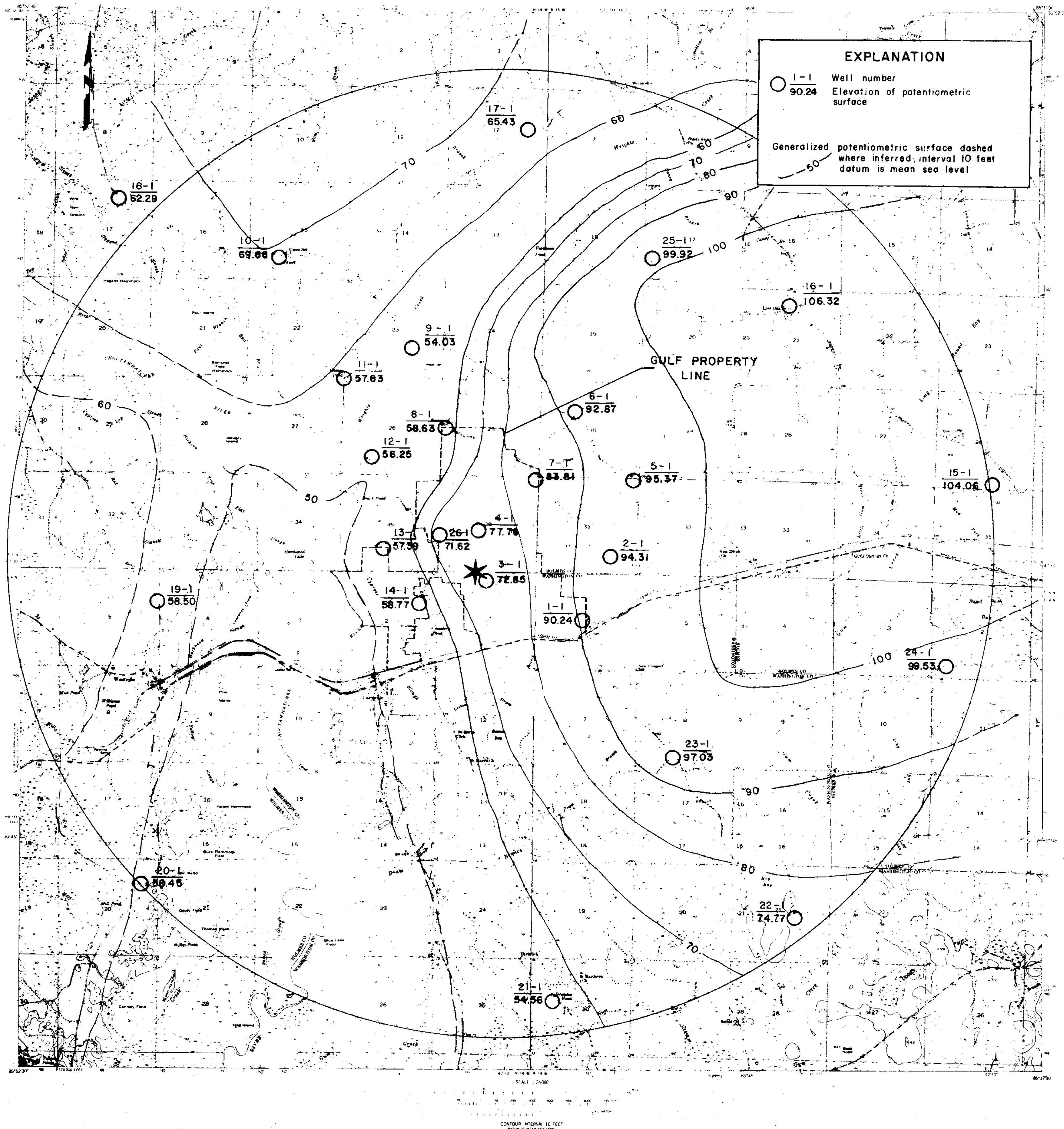
△ PLANT SITE

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

DATE OF DATA TAKEN:
JANUARY 6, 1975

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT
GENERALIZED POTENTIOMETRIC MAP, FLORIDAN AQUIFER, CARYVILLE AREA	
FIGURE 2.5-18	



✱ PLANT SITE

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

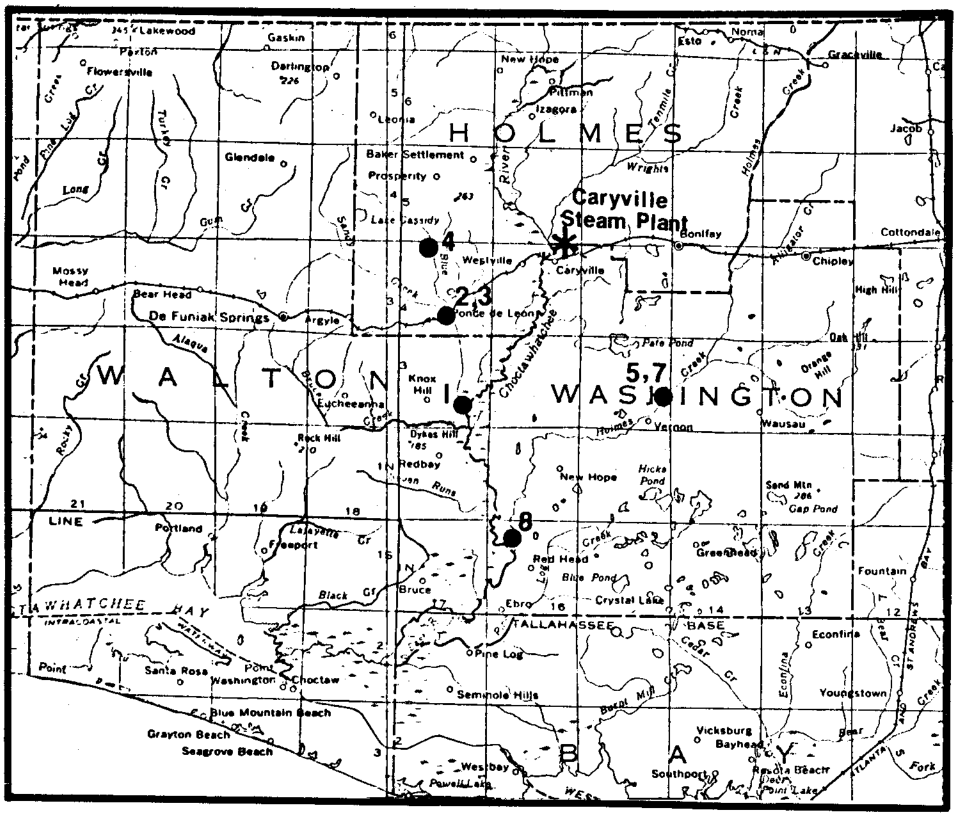
NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

AMENDMENT 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

GENERALIZED POTENTIOMETRIC MAP
OF FLORIDAN AQUIFER IN CARYVILLE AREA

FIGURE 2.5-18a



LEGEND

● SPRING NUMERICAL SUPERSCRIPTS REFER TO THE NUMBERS BELOW

WALTON COUNTY

1 MORRISON SPRING

HOLMES COUNTY

2 JACKSON SPRINGS

3 PONCE DE LEON SPRING

4 VORTEX BLUE SPRING

WASHINGTON COUNTY

5 BECKTON SPRINGS

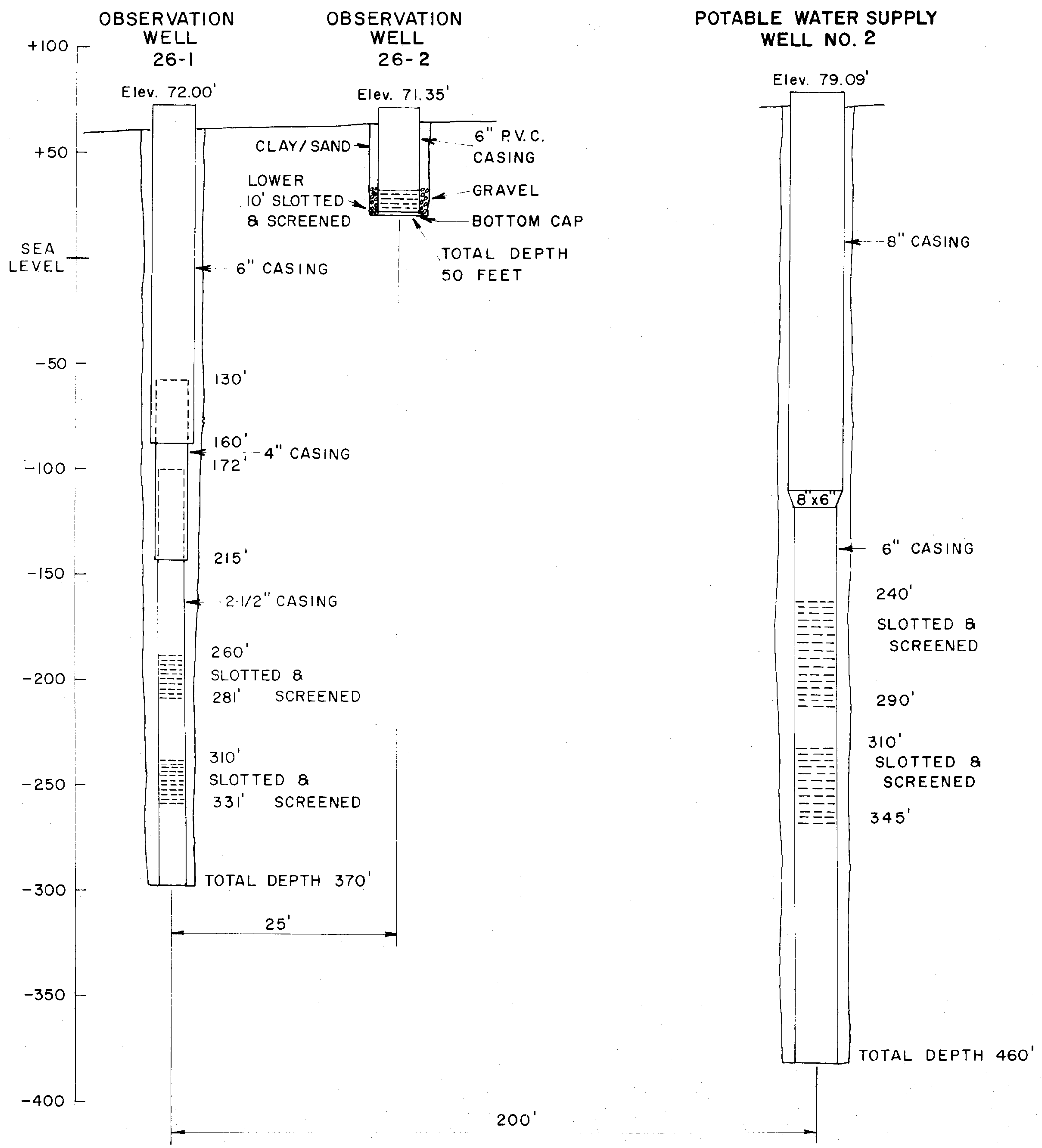
7 CYPRESS SPRINGS

8 BLUE SPRING

N

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	SPRINGS DISCHARGING FROM THE FLORIDAN AQUIFER, NORTHWEST FLORIDA FIGURE 2.5-19

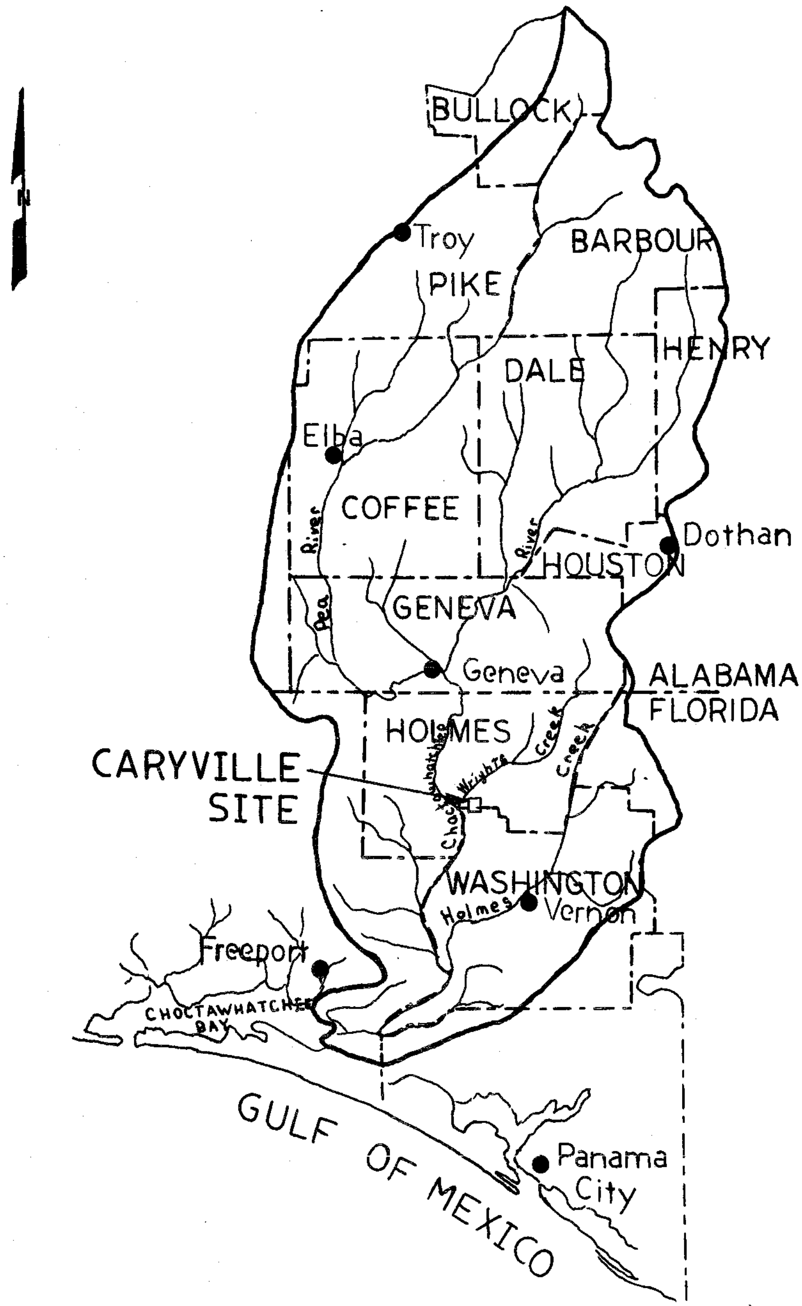


AMENDMENT 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

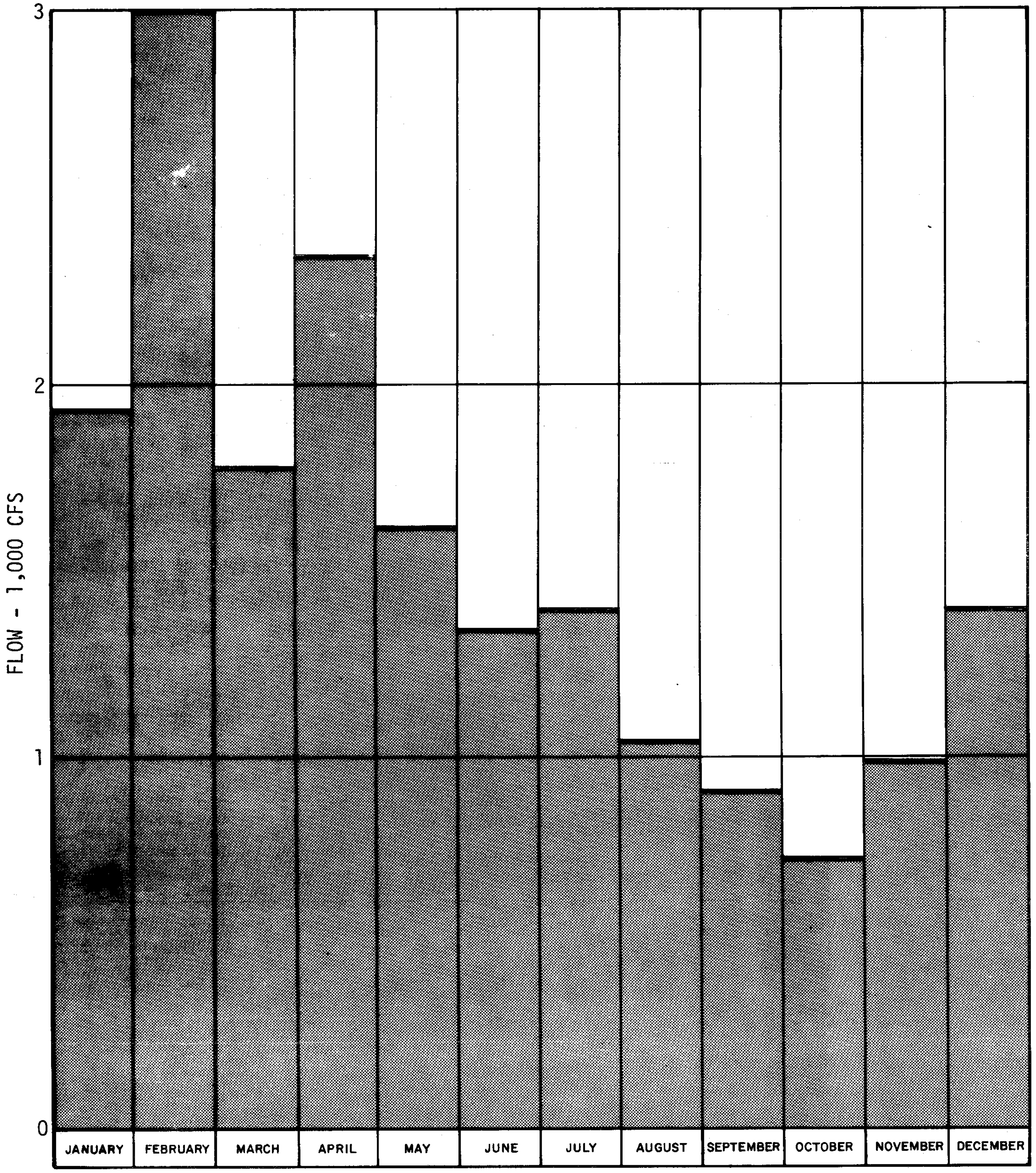
SCHEMATIC DIAGRAM SHOWING CONSTRUCTION OF PUMPED WELL AND OBSERVATION WELLS

FIGURE 2.5-19a



CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	MAP OF CHOCTAWHATCHEE BASIN
		FIGURE 2.5-20



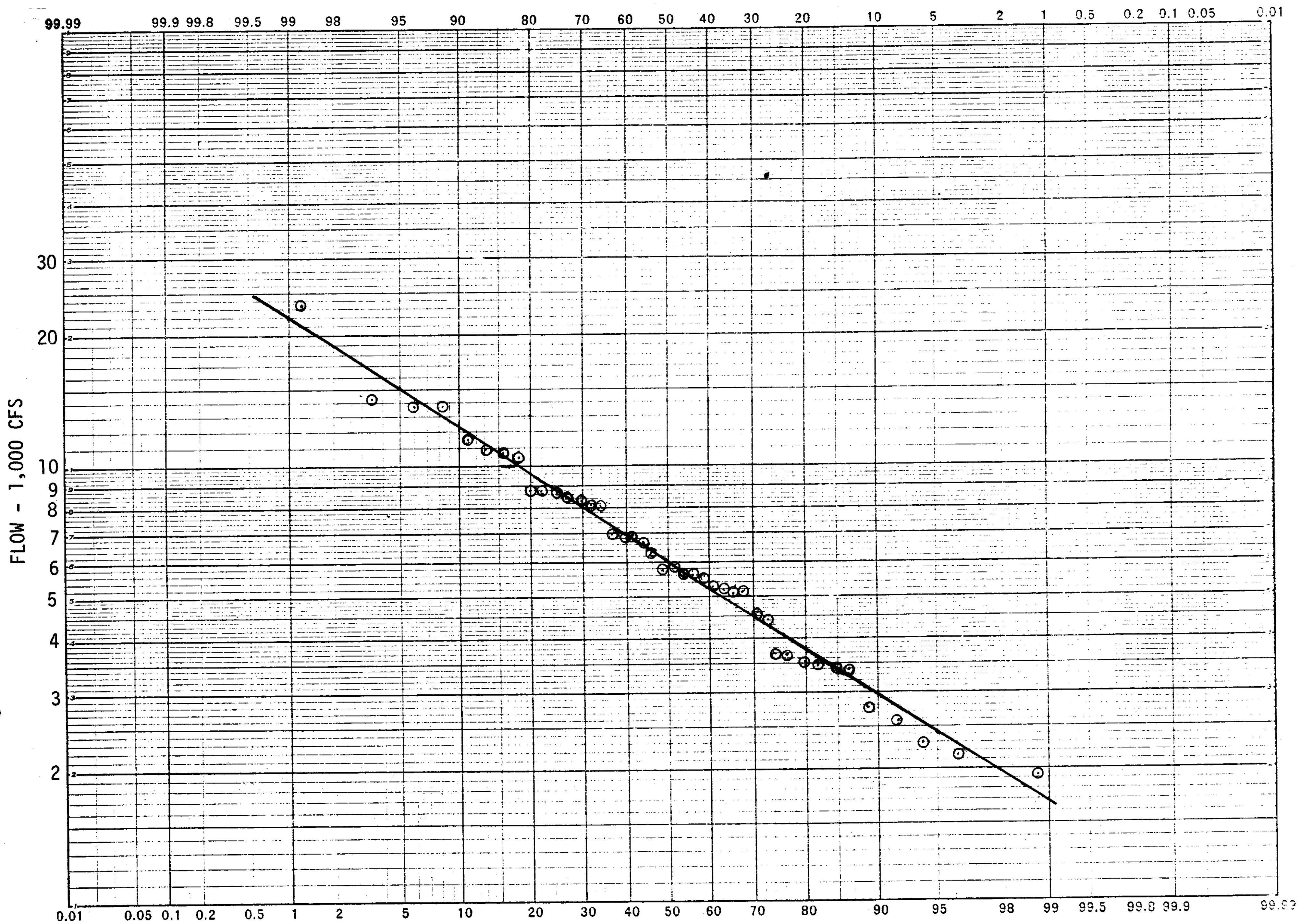
CFS = CUBIC FEET PER SECOND

NOTE:
LOWEST FLOW OF RECORD FOR THE 42 YEAR PERIOD/MONTHLY AVERAGE

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE:
LOWEST MONTHLY MEAN FLOWS,
1929 - 1971

FIGURE 2.5-21

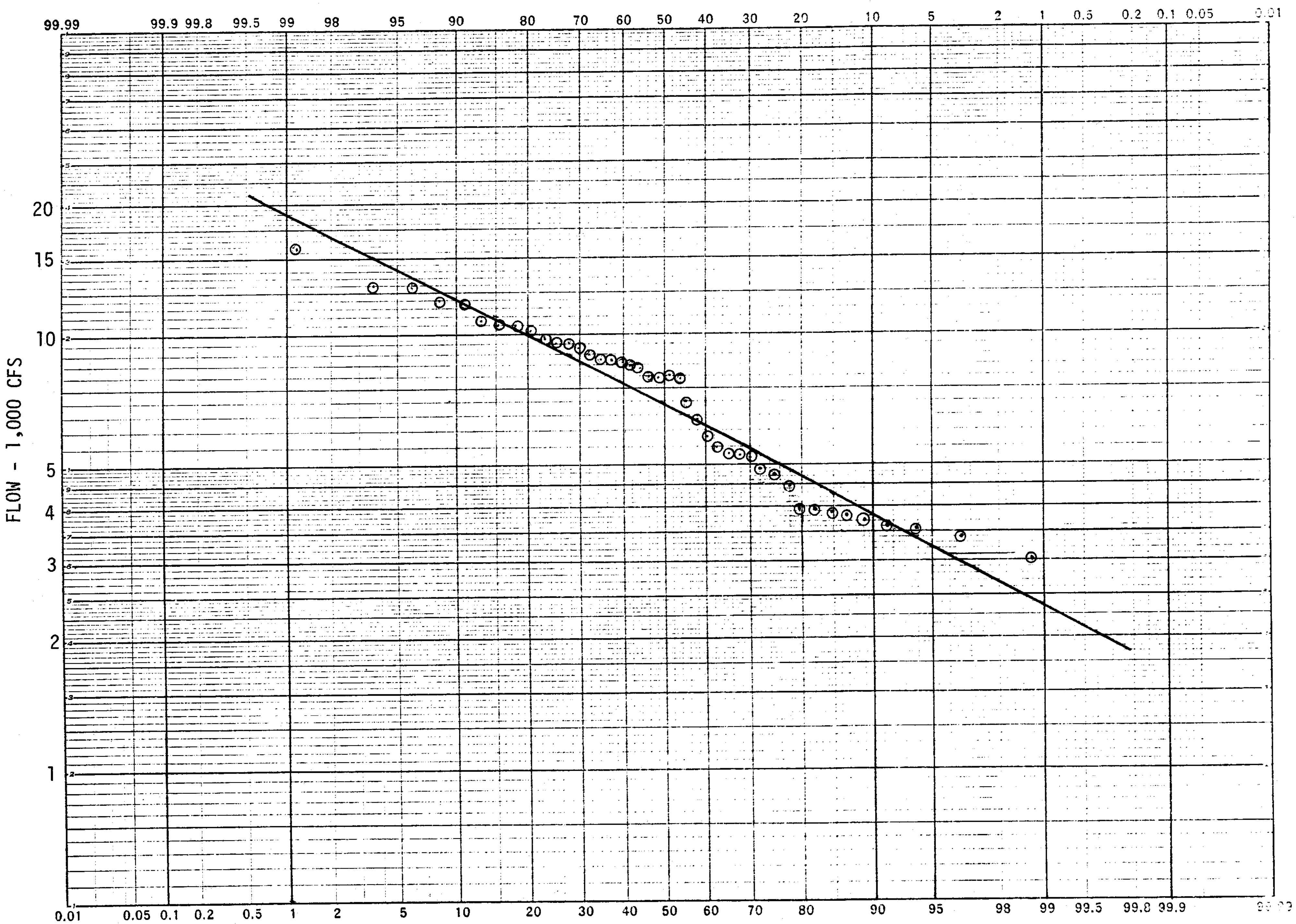


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: JAN.
FLOW FREQUENCIES, HAZEN'S
METHOD, 1929 - 1971

FIGURE 2.5-22

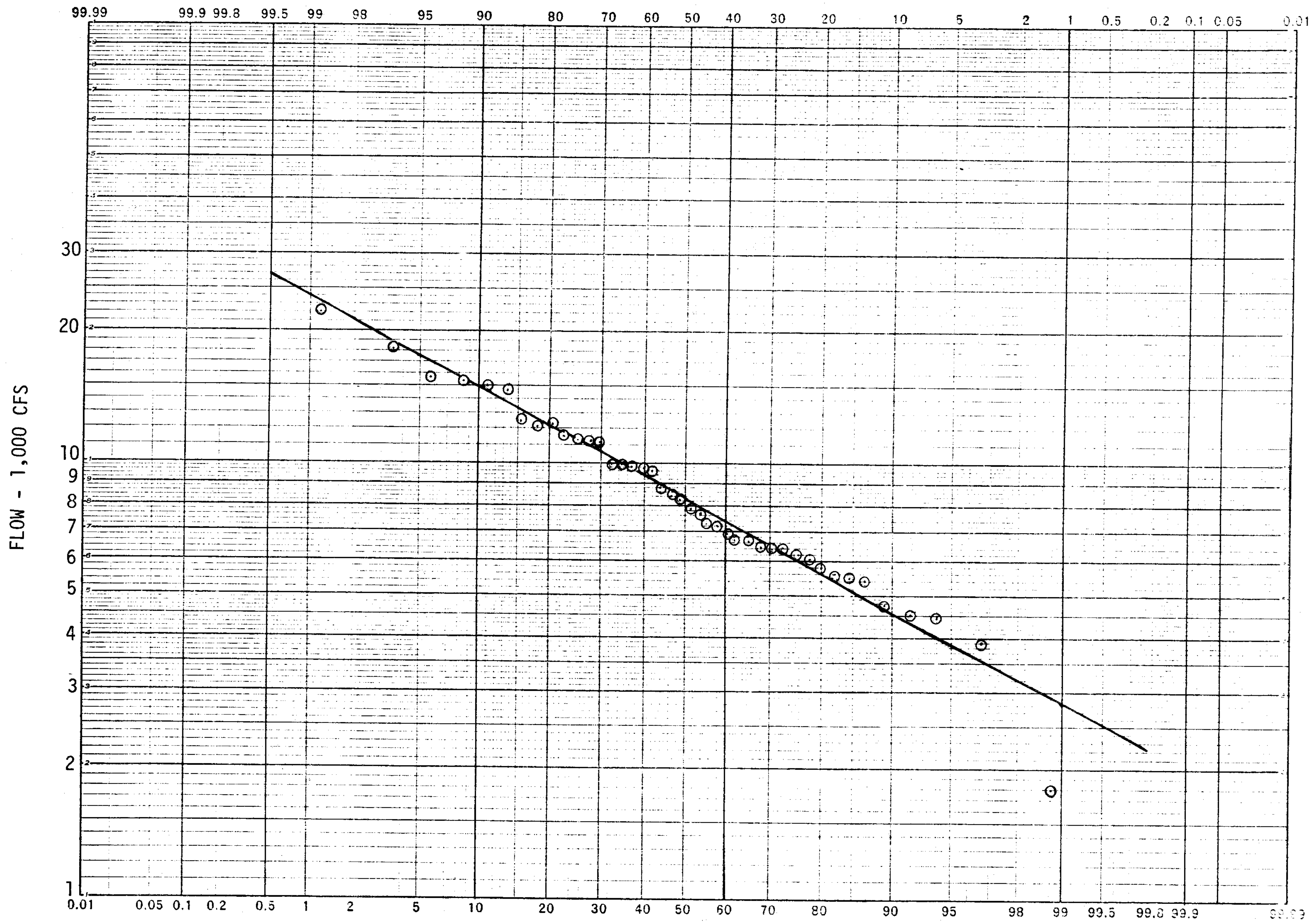


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: FEB.
FLOW FREQUENCIES, HAZEN'S
METHOD, 1929 - 1971

FIGURE 2.5-23

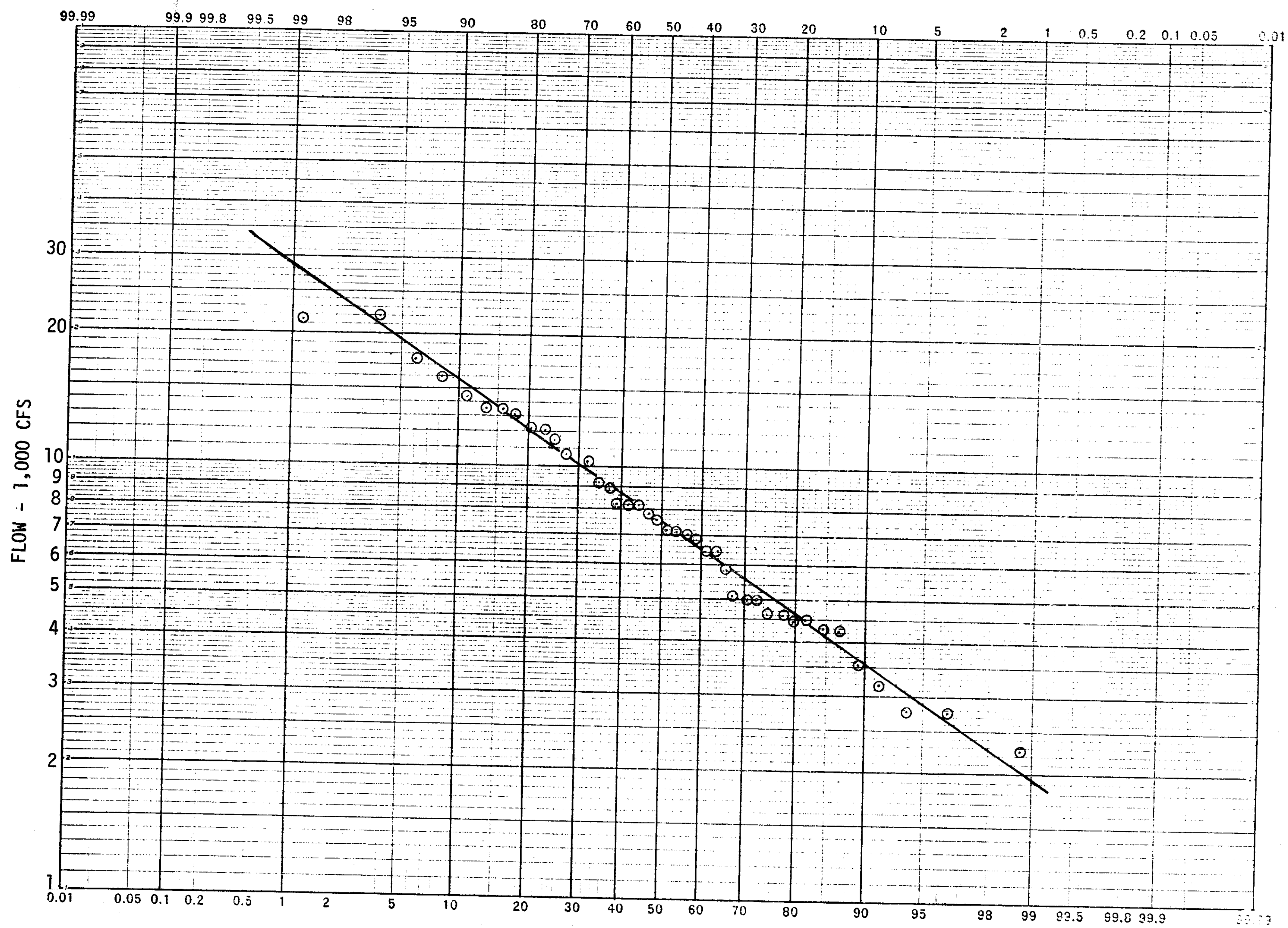


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: MARCH FLOW FREQUENCIES, HAZEN'S METHOD, 1929 - 1971

FIGURE 2.5-24

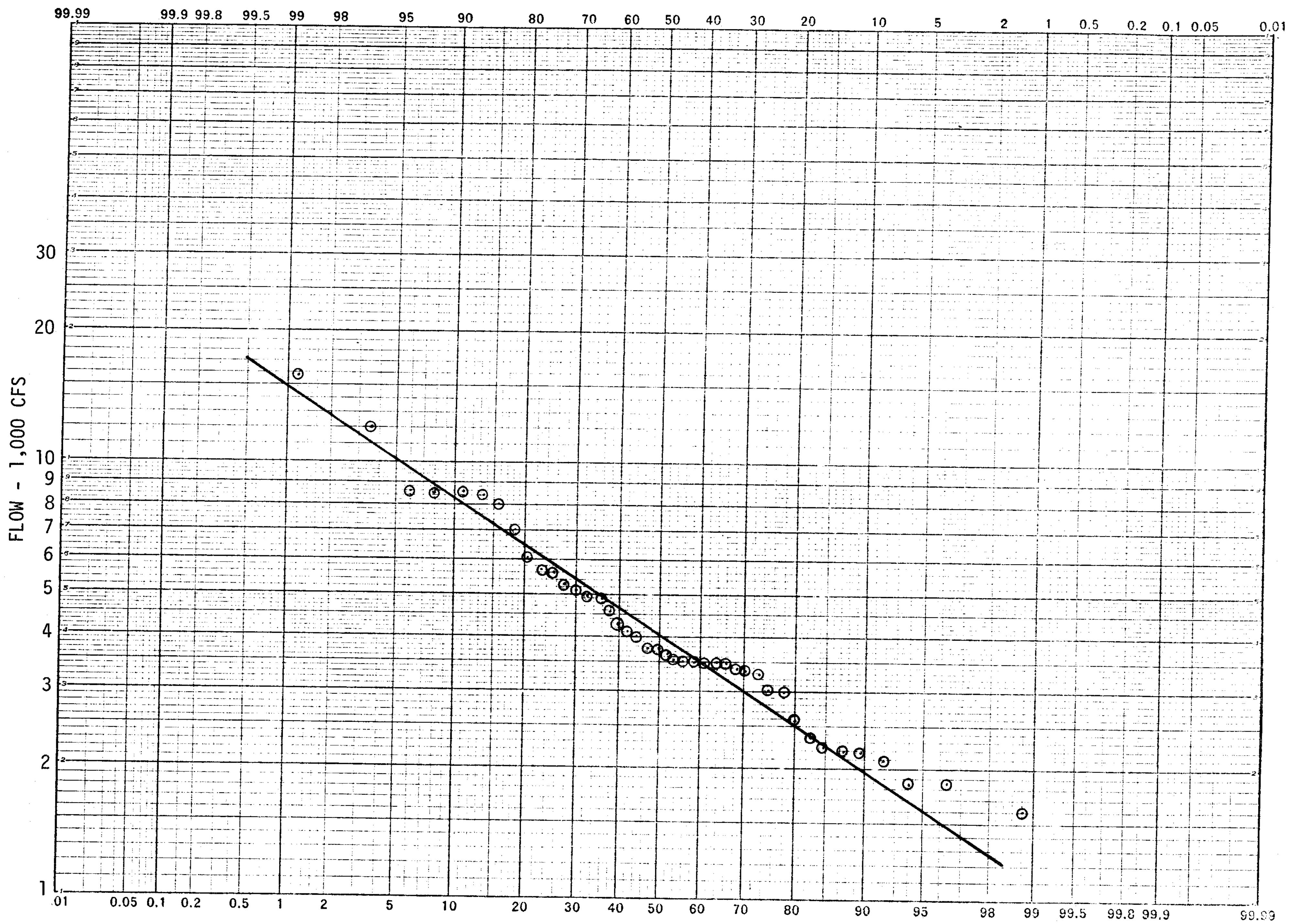


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: APRIL FLOW FREQUENCIES, HAZEN'S METHOD, 1929 - 1971

FIGURE 2.5-25

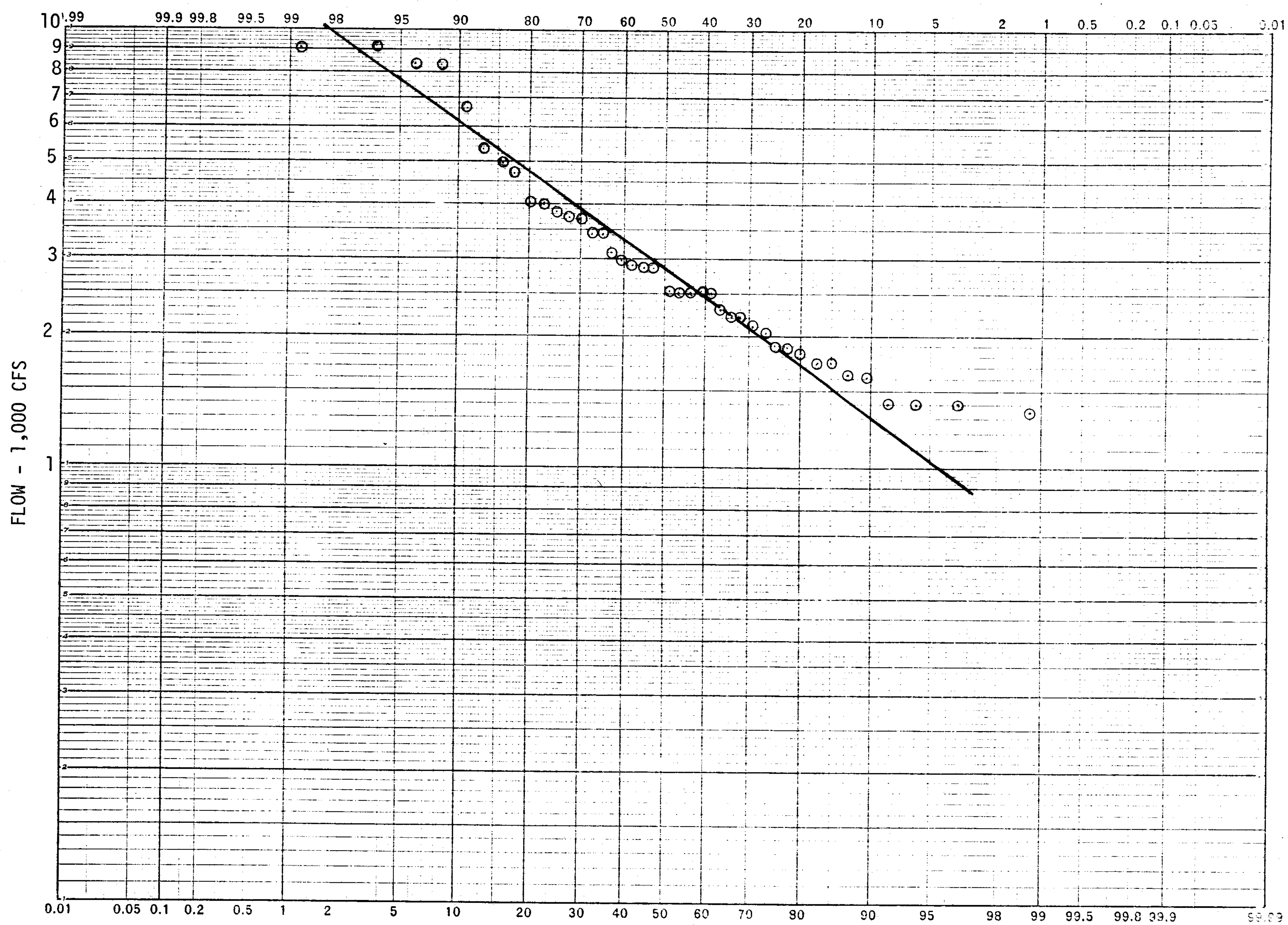


CFS = CUBIC FEET PER SECOND

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: MAY
FLOW FREQUENCIES, HAZEN'S
METHOD, 1929 - 1971

FIGURE 2.5-26

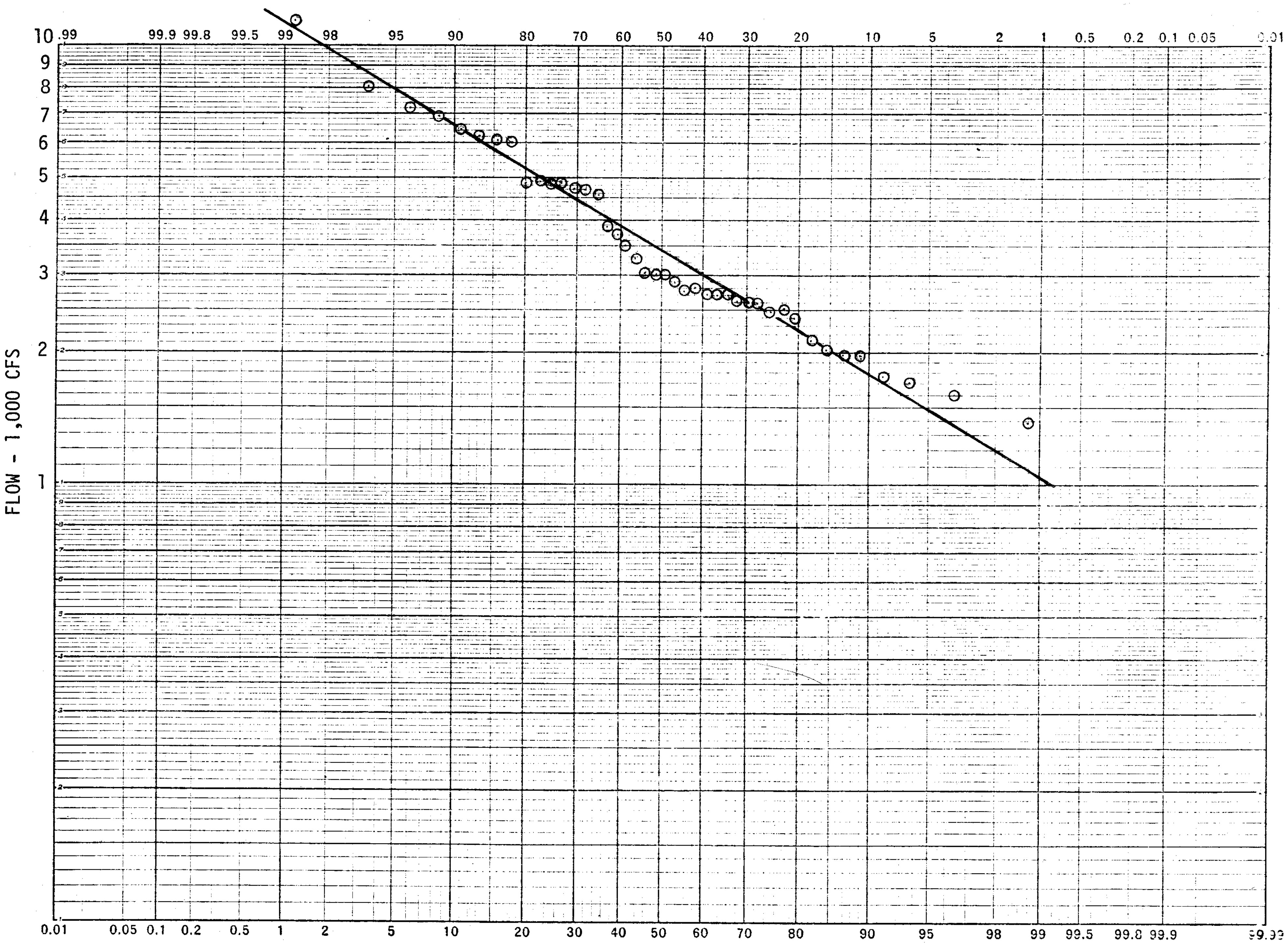


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: JUNE FLOW FREQUENCIES, HAZEN'S METHOD, 1929 - 1971

FIGURE 2.5-27

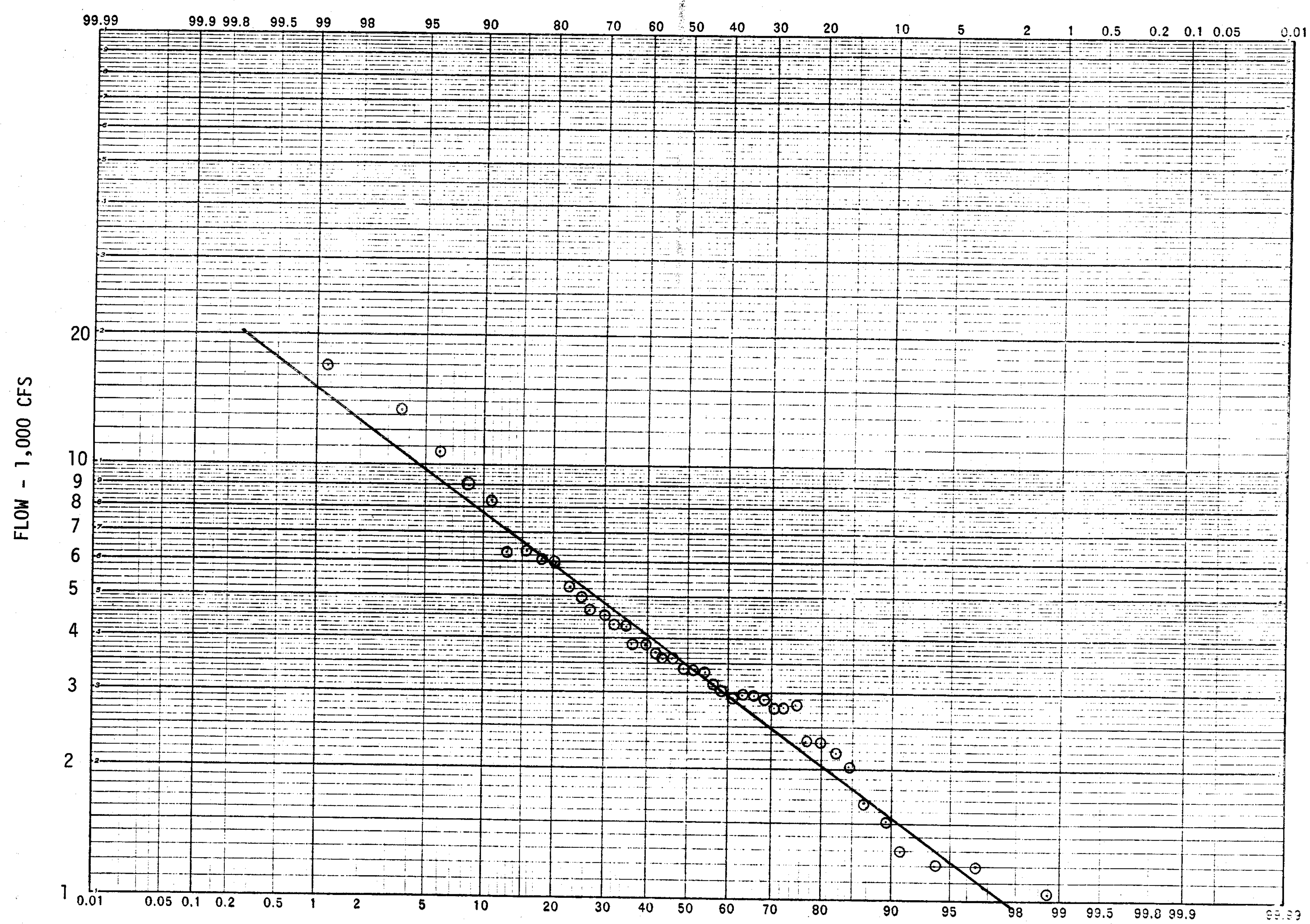


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: JULY
FLOW FREQUENCIES, HAZEN'S
METHOD, 1929 - 1971

FIGURE 2.5-28

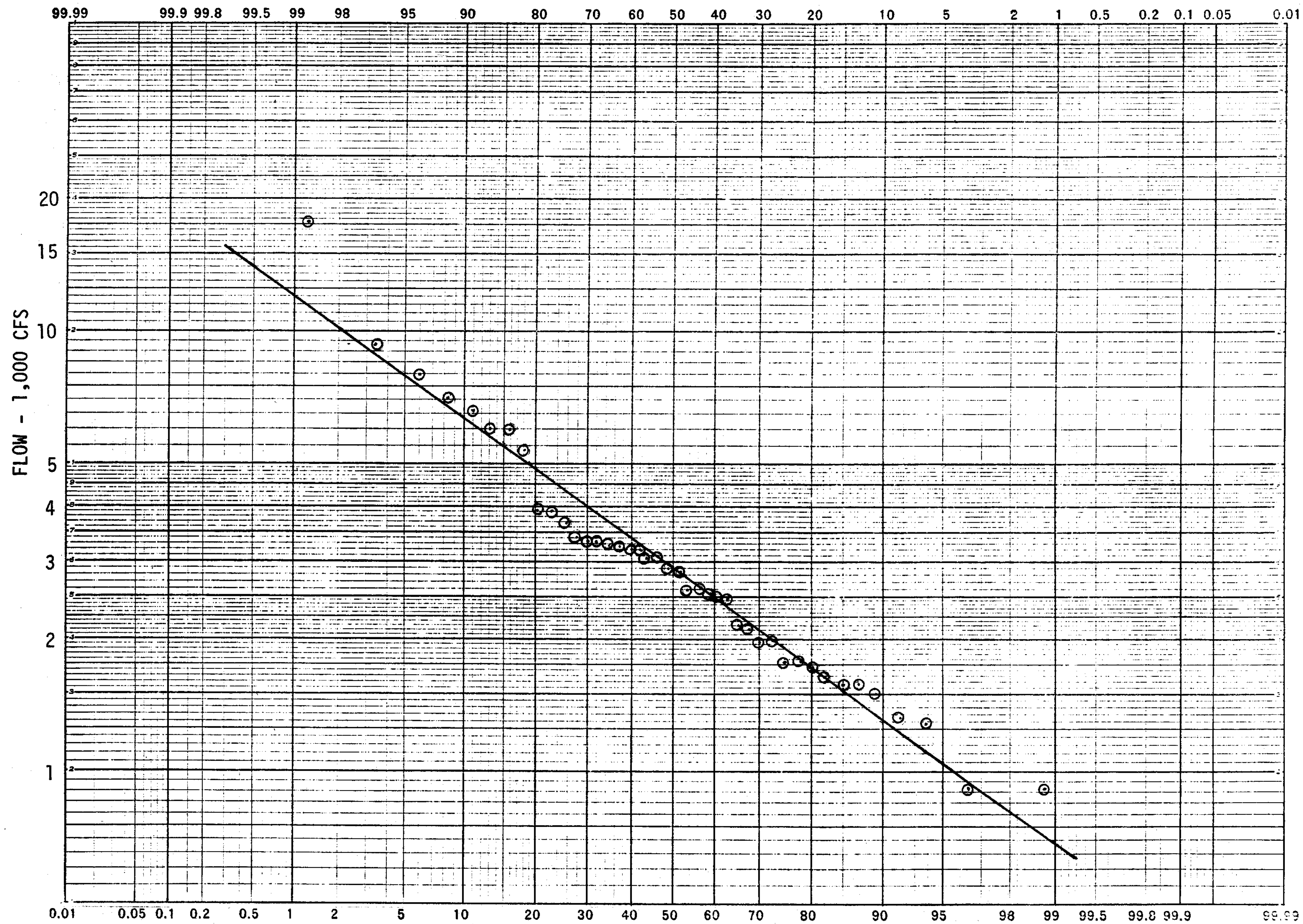


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: AUG.
FLOW FREQUENCIES, HAZEN'S METHOD,
1929 - 1971

FIGURE 2.5-29

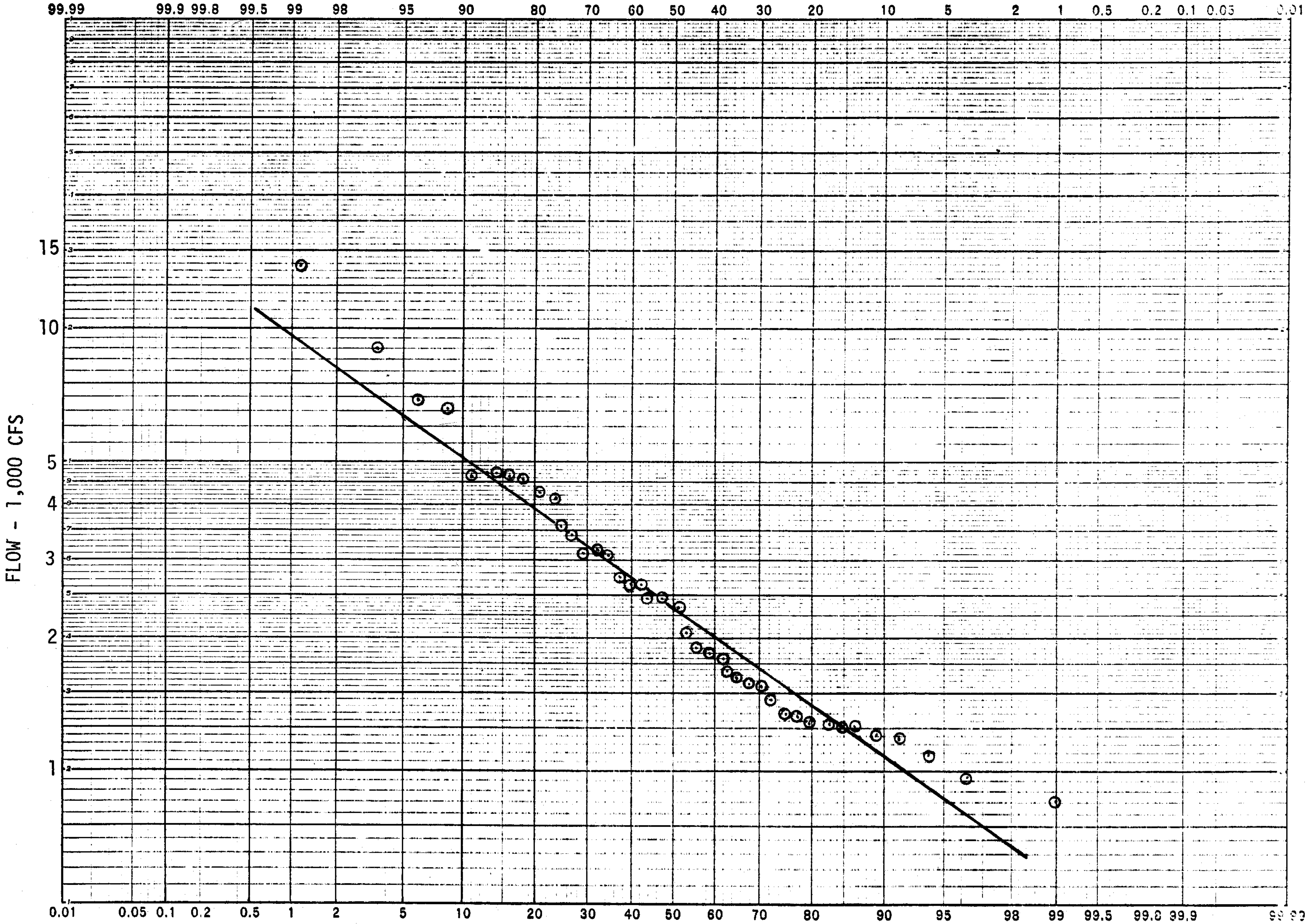


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: SEPT.
FLOW FREQUENCIES, HAZEN'S
METHOD, 1929 - 1971

FIGURE 2.5-30

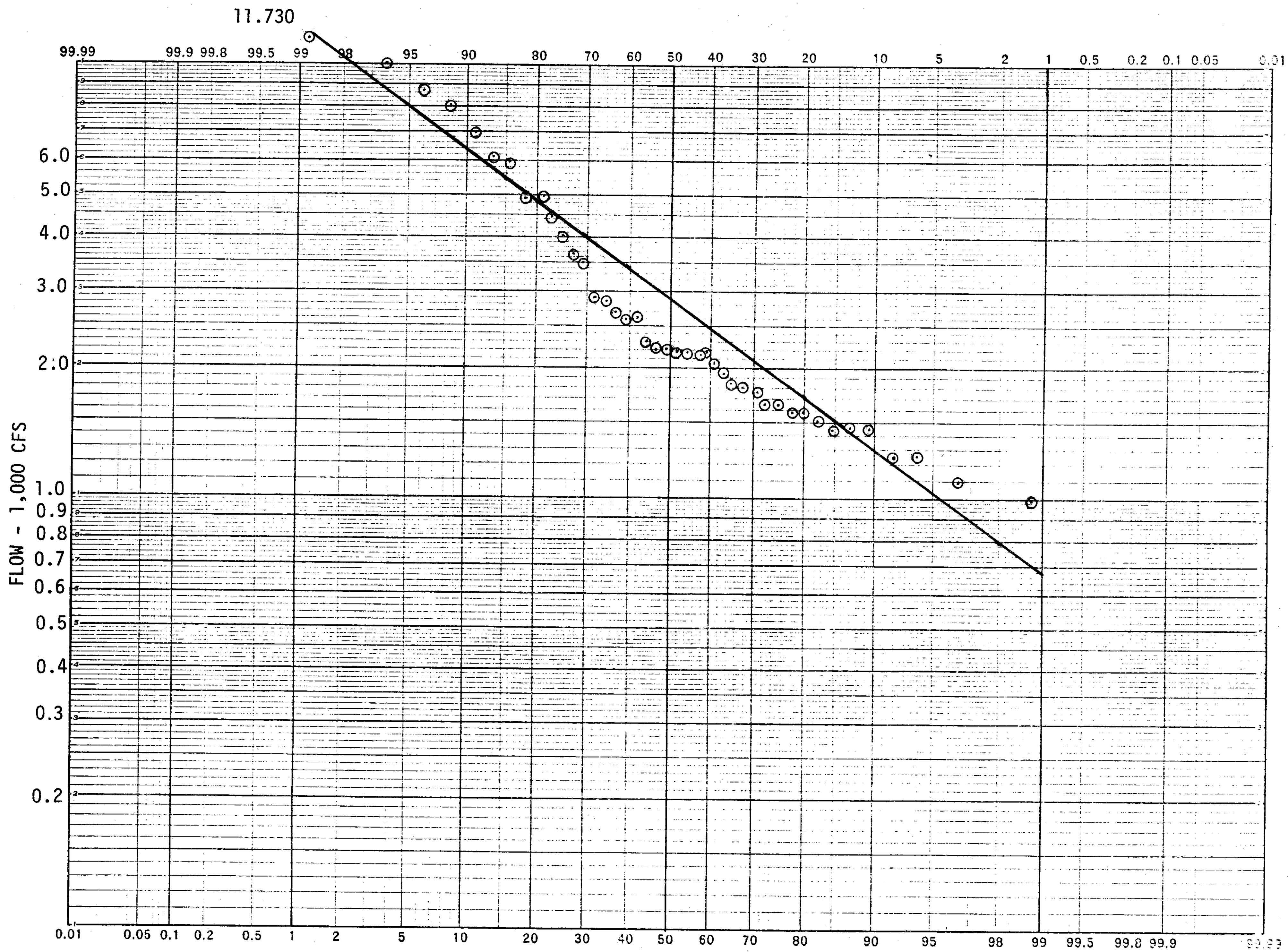


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: OCT.
FLOW FREQUENCIES, HAZEN'S
METHOD, 1929 - 1971

FIGURE 2.5-31

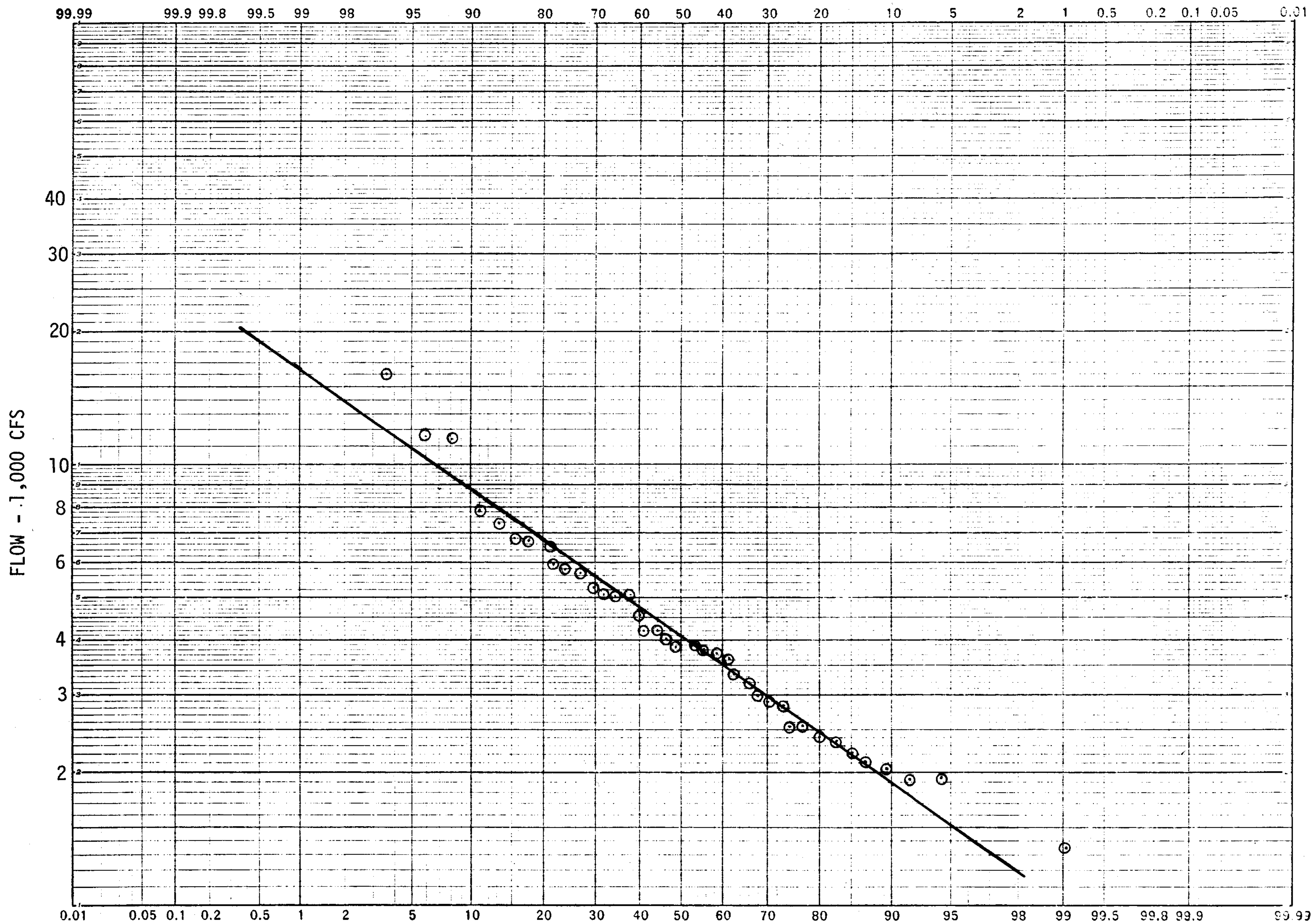


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: NOV.
FLOW FREQUENCIES, HAZEN'S
METHOD, 1929 - 1971

FIGURE 2.5-32

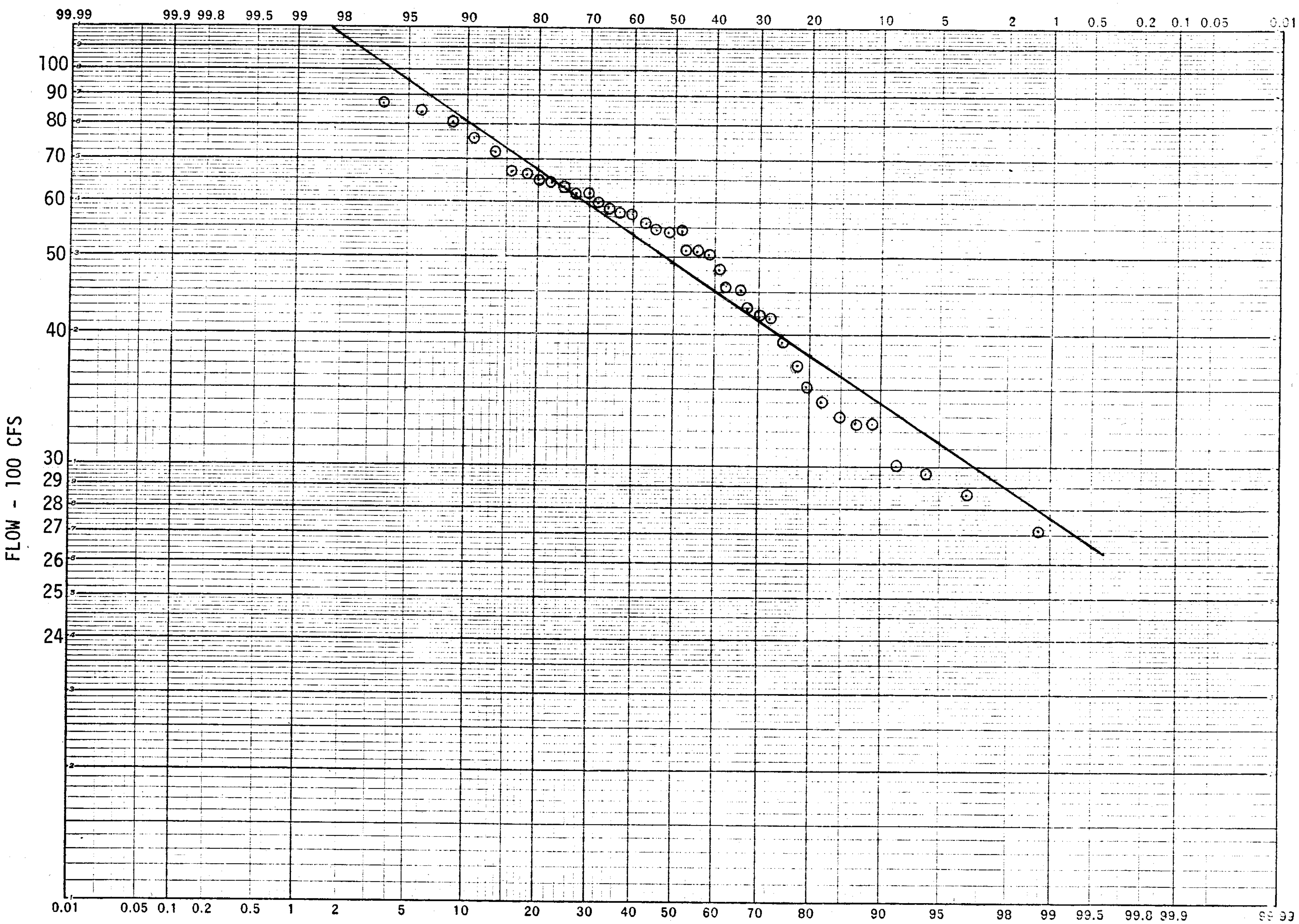


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: DECEMBER FLOW FREQUENCIES, HAZEN'S METHOD, 1929 - 1971

FIGURE 2.5-33

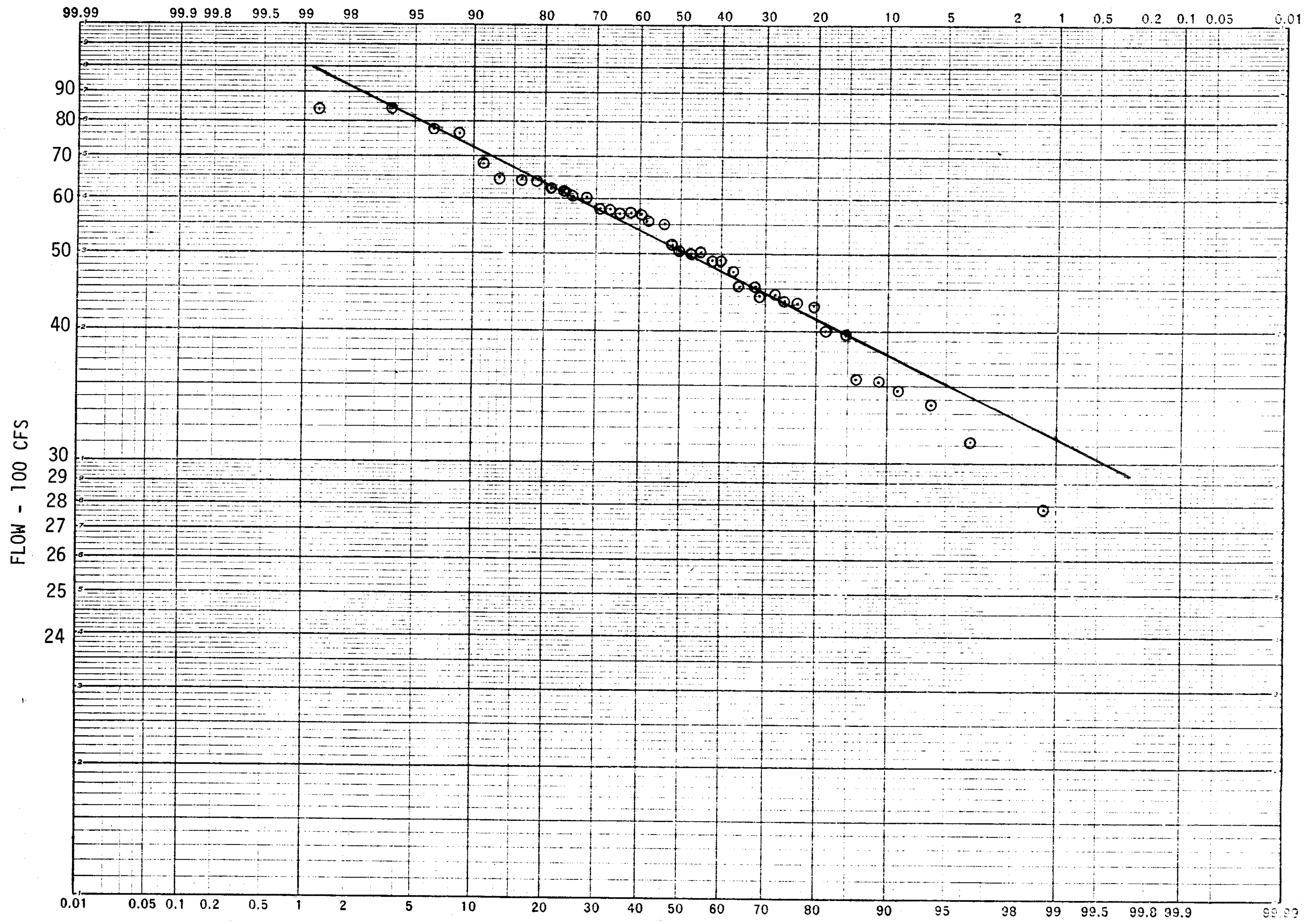


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

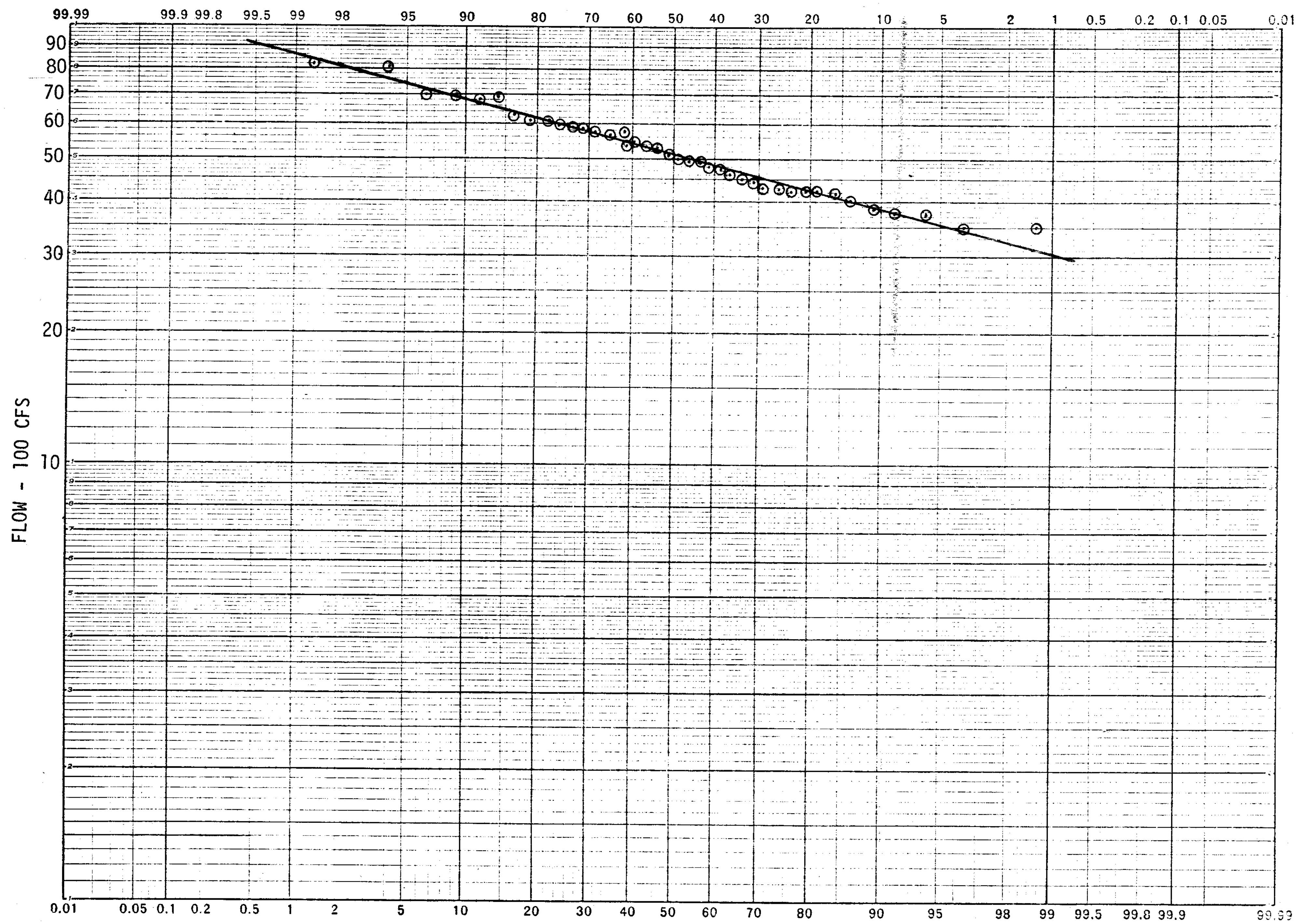
CHOCTAW. RIVER, CARYVILLE: 1 YEAR AVERAGE FLOW FREQUENCIES, HAZEN'S METHOD, 1929 - 1971

FIGURE 2.5-34



CFS = CUBIC FEET PER SECOND

GULF POWER COMPANY	GULF POWER CO. CARYVILLE STEAM PLANT
CHOCTAW. RIVER, CARYVILLE: 2 YEAR AVERAGE FLOW FREQUENCIES, HAZEN'S METHOD, 1929 - 1971	
FIGURE 2.5-35	

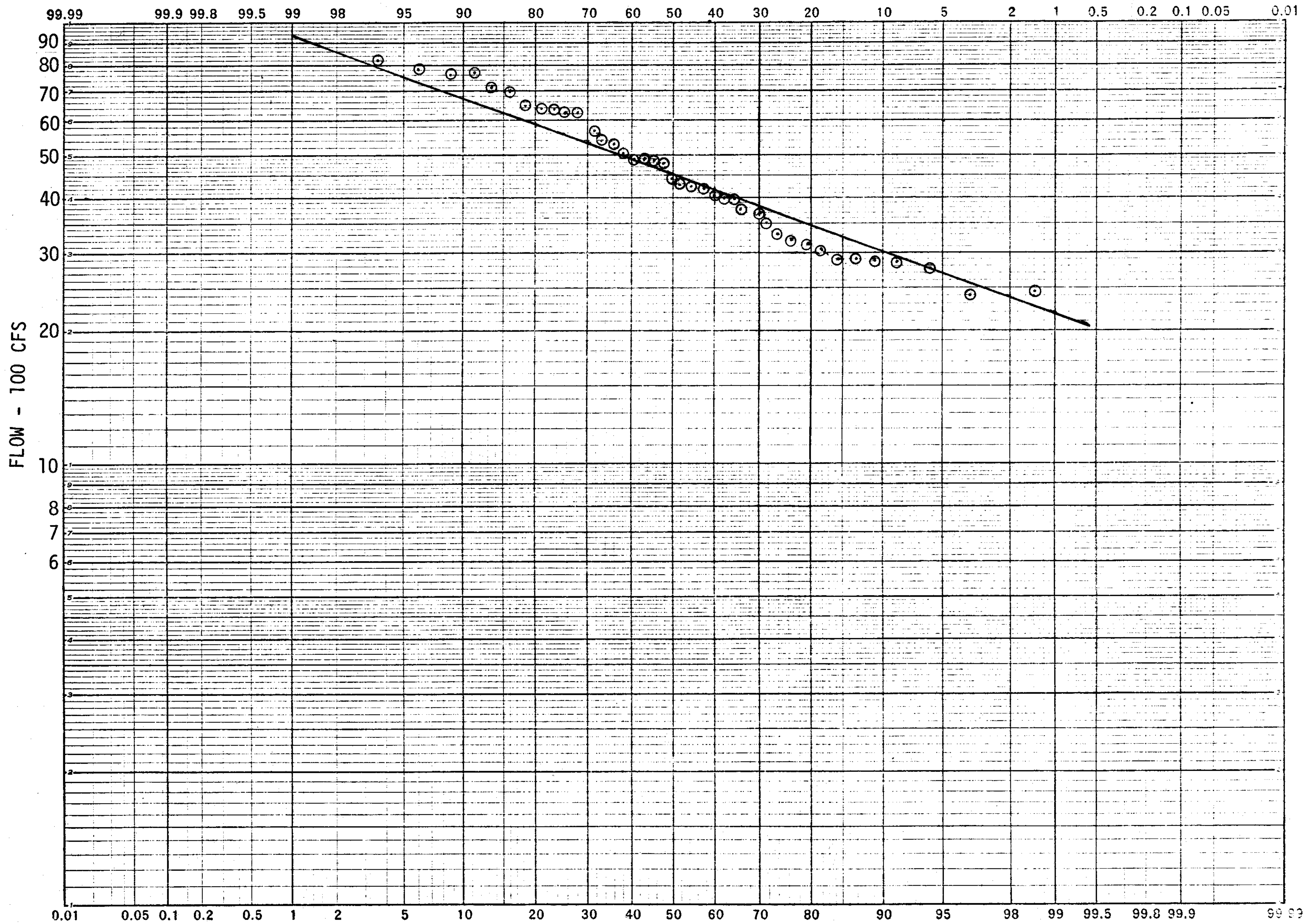


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: 3 YEAR AVERAGE FLOW FREQUENCIES, HAZEN'S METHOD, 1929 - 1971

FIGURE 2.5-36

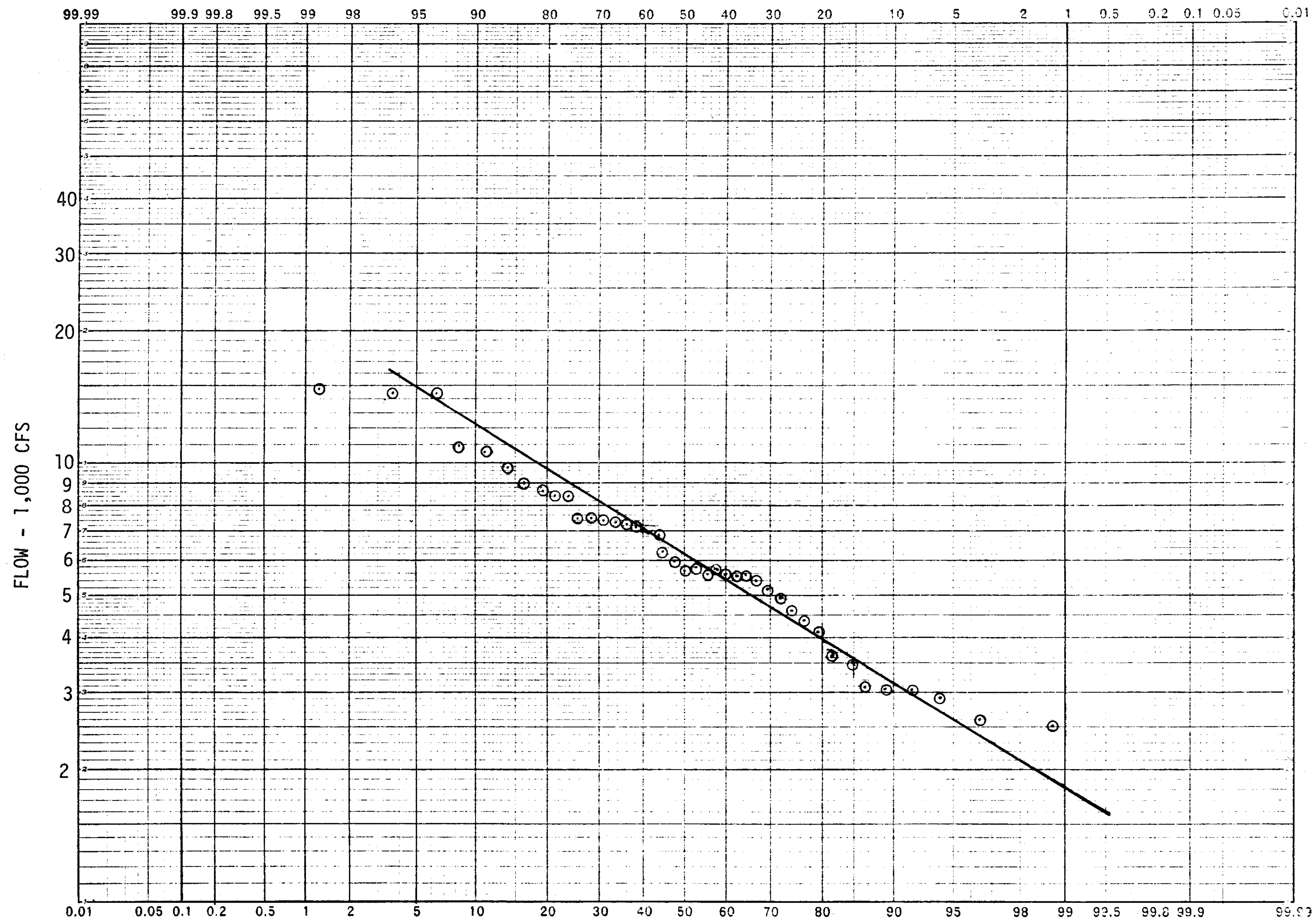


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: 9 MO. AVERAGE FLOW FREQUENCIES, HAZEN'S METHOD, 1929 - 1971

FIGURE 2.5-37

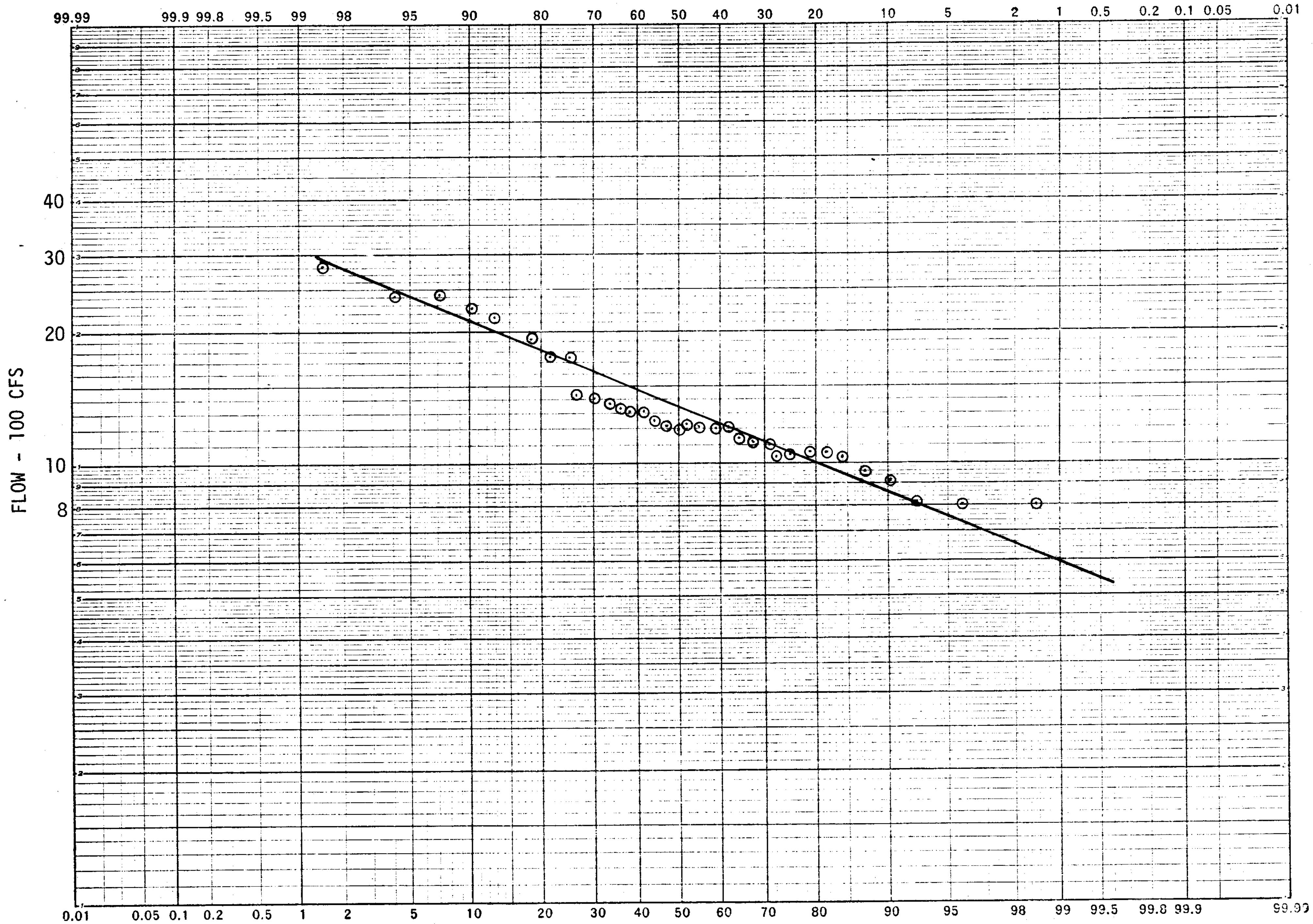


CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE: 3 MO. AVERAGE FLOW FREQUENCIES, HAZEN'S METHOD, 1929 - 1971

FIGURE 2.5-38



CFS = CUBIC FEET PER SECOND

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAW. RIVER, CARYVILLE:
7 DAY LOW FLOW FREQUENCIES, HAZEN'S METHOD, 1929 - 1971

FIGURE 2.5-39

2.6

2.6 Meteorology

2.6.1 Data Sources

Tallahassee, Florida, is located approximately 92 miles east - southeast of the Caryville site, and is the nearest noncoastal station for which meteorological data required for air quality modeling were available. Consequently, these data have been used to indicate trends in the Caryville meteorological conditions.

Trends and data for temperature, precipitation, wind, and humidity were obtained for Tallahassee from the National Climatic Center as annual summaries (1).

A program to obtain ~~meteorological~~ data for the plant site is underway and, when these data become available, they will be incorporated into subsequent Amendments to this Site Certification Application.

2.6.2 Regional Climatology

The Caryville site is in the Panhandle of Florida near the Choctawhatchee River, in Washington and Holmes Counties. The site is approximately 42 miles north of Panama City, Florida, which is located on the Gulf of Mexico. (See figures 2.5-8 and -9.)

The climate is humid and subtropical, with continental influences, especially 1
in winter. In winter, there are frequent shifts between warm moist air from the Gulf of Mexico and cool dry continental air. Extremely cold weather seldom occurs, but morning temperatures near freezing are common in the winter. The summers are long, hot, and humid, with little day-to-day temperature change. (Refer to 2.6.2.2 below.)

Precipitation occurs almost entirely as rain. In summer, nearly all precipitation is due to thunderstorms, which occur mainly in the afternoon. There is a definite sequence to the four seasons with considerable winter rainfall, in contrast to the southern part of the Florida Peninsula. There is a marked decrease in the average precipitation in October and November and a similar, but less pronounced decrease in the spring; however, there are still occasional heavy falls due to tropical disturbances. (Refer to 2.6.2.4 below.)

The following data represent trends in climatological conditions at Tallahassee and should be indicative of trends exhibited at the Caryville site.

2.6.2.1 Wind - Mean wind speeds and prevailing directions for each month of the year are presented in table 2.6-1. The fastest monthly average wind speeds occur during the winter and spring. These average about 7.8 miles per hour (MPH). The "fastest mile" (highest observed one-minute value) of wind occurred in August 1962 when 58 MPH was recorded. Tables 2.6-2

through -5 present speed-stability-direction frequencies for the four seasons of the year and table 2.6-6 is a presentation of the same frequencies on an annual basis. The stability categories are those of Pasquill (2). The annual speed-stability-frequency information was input to the Air Quality Display Model as described in section 6.5, "Air," to enable prediction of annual average ground level gaseous pollutant concentrations.

2.6.2.2 Temperature - Normals and extremes of temperature are presented in table 2.6-7. The normals of temperature were calculated from 30 years of record 2
from 1941 to 1970. The extremes of temperature were obtained from 14 years of record through 1974. Table 2.6-8 shows the number of days that the temperature was above 90°F or below 32°F and 0°F. The highest average daily maximum temperature, as shown in table 2.6-7, occurs from June through August averaging about 90.5°F. The lowest average daily minimum of about 41°F occur from December to January. The highest monthly average of about 81°F usually occurs from June to August. The highest recorded temperature at Tallahassee occurred in June 1933 when it was observed to be 104°F. In February 1899, the lowest recorded temperature of minus 2°F occurred. For 13 years of record through 1974, a temperature of 32°F or lower did not exist for more than half a day.

2.6.2.3 Water Vapor - Average six-hour relative humidities for each month are shown in table 2.6-9 for 13 years of record. The figures illustrate a humid climate with afternoon humidities around 65 percent in both winter and summer. The air is driest in late spring and autumn with an average afternoon humidity of about 54 percent in late spring and about 61 percent in mid-autumn.

2.6.2.4 Precipitation - Monthly normals, means, and extremes of precipitation for 14 years of Tallahassee data are listed in table 2.6-9. The normal yearly rainfall is 61.58 inches, based on 30 years of record from 1941 to 1970. July is usually the wettest month with the normal rainfall being 8.92 inches while November is the driest with a normal rainfall of 2.81 inches. Table 2.6-8 shows the mean number of days that precipitation of 0.01 inches or more occurred for 13 years of record.

2.6.3 Severe Weather

2.6.3.1 Heavy Precipitation - Unusually heavy precipitation lasting for several hours in this region is associated with tropical storms or hurricanes. Heavy rainfall for shorter periods is caused by thunderstorms occurring predominantly in the summer. Estimates of the recurrence periods for rainfall accumulated in periods of 30 minutes to 10 days are in Technical Papers No. 40 and 49 (3 and 4, respectively) in the form of maps and are shown in table 2.6-10 for the Caryville site. The maximum recorded rainfall in a 24 hour period for Tallahassee occurred in September 1969, when 9.47 inches was recorded. The maximum monthly precipitation was observed to be 23.85 inches, in September 1924.

2.6.3.2 Hail - Severe hailstorms are infrequent in the area of the proposed plant site. As shown in figure 2.6-1, the occurrence in this area of heavy hail (greater than three-quarters of an inch in diameter) number approximately two in thirteen years for a 1° (latitude and longitude). square. Figure 2.6-2 shows the frequency of hailstorms by 2° squares (5).

2.6.3.3 Ice Storms - Freezing rain resulting in heavy ice loading is rare in this part of Florida. Bennett (6) refers to one study in which no glaze storms were reported for the 28-year period ending with the winter of 1952/1953. However, one study referred to by Bennett showed at least one storm was observed in this area during the nine year period 1928/1929 to 1936/1937. According to this study, the accumulation of ice did not reach 0.25 inch.

2.6.3.4 Snow - Accumulation of snow is rare in this area. The greatest accumulation of snowfall occurred in February 1973 when 0.4 inch was recorded.

2.6.3.5 Thunderstorms - The incidence of thunderstorms in this area is significant in relation to associated weather, including strong winds, heavy precipitation, and lightning.

The average number of thunderstorms per year reported at Tallahassee for 13 years of record is 85, as shown on table 2.6-8. The majority of the thunderstorms usually occur from June to August with a peak in July. 1

2.6.3.6 Tornadoes - The probability of a particular point being affected by a tornado is a function of the average number of tornadoes occurring in a given area and the average area covered by a tornado (5). Figure 2.6-3 shows that from 1955 to 1967, the total number of tornadoes reported for a 1° square encompassing the site was 18, for an average of 1.4 per year. Figure 2.6-4 shows a total of 50 to 100 for a 2° square containing the site region for an annual average of 3.8 to 7.7.

Thom (7) has estimated the area encompassed by a typical tornado to be 2.82 square miles. The 1° square containing the plant site has an area of approximately 4,020 square miles. Therefore, a conservative estimate of a point being affected by a tornado in a given year is approximately:

$$\frac{\left(\frac{18}{13}\right) 2.82}{4020} = 0.00097$$

A given point, therefore, can be expected to be affected by a tornado once in 1,030 years, on the average.

2.6.3.7 Strong Winds - The frequency of strong winds, 50 knots or greater, as estimated from damage reports, has been analyzed for the 13-year period 1955-1967 (5). The results are shown in figures 2.6-5 and -6, showing frequencies of 1° and 2° squares, respectively. For the proposed

plant site, the number of occurrences for the 13-year period are about 25 to 50 per 2° square and 14 for the 1° square. Since a considerable number of occurrences are likely to be overlooked or unreported, a reasonably conserva- 1
tive estimate would be about twice the given frequencies, or approximately 2.5 per year for the 1° square of about 4,000 square miles.

2.6.4 References

(1) Local Climatological Data, Annual Summary With Comparative Date, 1974, Tallahassee, Florida, NOAA, Environmental Data Service, National Climatic Center, Asheville, N.C.

(2) Seasonal and Annual Wind Distribution by Pasquill Stability Classes, Star Program, Station Number 93805, Tallahassee, Florida, Period January 1969-December 1973, U. S. Department of Commerce, NOAA, Environmental Data Service, June 18, 1974.

(3) Hershfield, D. M. Rainfall Frequency Atlas of the U. S., Technical Paper No. 40, U. S. Department of Commerce, U. S. Weather Bureau, 1963.

(4) Miller, J. F. Two- to Ten-Day Precipitation for Return Periods of Two to One Hundred Years in the Contiguous United States, Technical Paper No. 49, U. S. Department of Commerce, U. S. Weather Bureau, 1964.

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(6) Bennett, I. Glaze, Its Meteorology and Climatology, Geographical Distribution, and Economic Effects, Technical Paper EP-105, U. S. Army, Quartermaster Research and Engineering Command, 1959.

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TABLE 2.6-1

WIND DATA FOR TALLAHASSEE, FLORIDA (1)

Month	WIND				
	Mean Speed (MPH)	Prevailing Direction	Fastest Mile (Fastest Observed One-Minute Value)		
			Speed (MPH)	Direction (Tens of Degrees from True North)	Year
	13*	2*	15*	15*	
J	7.8	N	46	23	1963
F	8.4	S	40	09	1969
M	8.6	S	48	27	1964
A	7.8	S	35	27	1961
M	7.0	E	40	29	1961
J	6.7	S	44	03	1966
J	5.8	SW	36	23	1963
A	5.6	E	58	02	1962
S	6.7	ENE	44	36	1963
O	7.1	N	30	34	1961
N	6.8	N	37	29	1963
D	7.0	N	32	15	1969
Year	7.1	N	58	02	Aug. 1962

*Years of Record

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TABLE 2.6-2

SEASONAL WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES FOR WINTER (2)

SEA= DJF RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

	SPEED(KTS)						
DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
NNE	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
NE	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
ENE	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
E	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
ESE	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
SE	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
SSE	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
S	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
SSW	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
SW	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
WSW	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
W	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
WNW	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
NW	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
NNW	0.000087	0.000000	0.000000	0.000000	0.000000	0.000000	0.000087
TOTAL	0.001389	0.000000	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF A STABILITY = 0.001389

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = 0.001389

TABLE 2.6-2 (Continued)

SEA= DJF RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001001	0.002500	0.000833	0.000000	0.000000	0.000000	0.004334
NNE	0.000717	0.000556	0.000833	0.000000	0.000000	0.000000	0.002106
NE	0.001516	0.001667	0.001111	0.000000	0.000000	0.000000	0.004293
ENE	0.001556	0.001944	0.000556	0.000000	0.000000	0.000000	0.004056
E	0.001990	0.000556	0.000000	0.000000	0.000000	0.000000	0.002546
ESE	0.000520	0.001389	0.000000	0.000000	0.000000	0.000000	0.001909
SE	0.001435	0.001111	0.000278	0.000000	0.000000	0.000000	0.002824
SSE	0.001834	0.001667	0.000278	0.000000	0.000000	0.000000	0.003778
S	0.000440	0.000833	0.000833	0.000000	0.000000	0.000000	0.002106
SSW	0.000040	0.000278	0.000278	0.000000	0.000000	0.000000	0.000596
SW	0.001394	0.000833	0.000556	0.000000	0.000000	0.000000	0.002783
WSW	0.000798	0.001111	0.000000	0.000000	0.000000	0.000000	0.001909
W	0.000520	0.001389	0.000556	0.000000	0.000000	0.000000	0.002465
WNW	0.000081	0.000556	0.000000	0.000000	0.000000	0.000000	0.000636
NW	0.000480	0.001111	0.000278	0.000000	0.000000	0.000000	0.001869
NNW	0.000399	0.000556	0.000556	0.000000	0.000000	0.000000	0.001510
TOTAL	0.014722	0.018056	0.006944	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF B STABILITY = 0.039722

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = 0.004167

TABLE 2.6-2 (Continued)

SEA= DJF RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA, 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000132	0.003333	0.015556	0.000833	0.000000	0.000000	0.019854
NNE	0.000487	0.005000	0.005278	0.000000	0.000000	0.000000	0.010765
NE	0.000366	0.001944	0.003611	0.000278	0.000000	0.000000	0.006199
ENE	0.000066	0.001667	0.005556	0.000000	0.000000	0.000000	0.007288
E	0.000176	0.004444	0.002778	0.000000	0.000000	0.000000	0.007399
ESE	0.000099	0.002500	0.003611	0.000000	0.000000	0.000000	0.006210
SE	0.000066	0.001667	0.001944	0.000278	0.000000	0.000000	0.003955
SSE	0.000033	0.000833	0.003056	0.000000	0.000000	0.000000	0.003922
S	0.000955	0.002222	0.007222	0.000278	0.000000	0.000000	0.010677
SSW	0.000055	0.001389	0.001944	0.000556	0.000000	0.000000	0.003944
SW	0.000033	0.000833	0.000278	0.000000	0.000000	0.000000	0.001144
WSW	0.000011	0.000278	0.002500	0.000000	0.000000	0.000000	0.002789
W	0.000110	0.002778	0.005000	0.000278	0.000000	0.000000	0.008166
WNW	0.000677	0.002500	0.001944	0.000000	0.000000	0.000000	0.005121
NW	0.000044	0.001111	0.002500	0.000278	0.000000	0.000000	0.003933
NNW	0.000022	0.000556	0.002778	0.000278	0.000000	0.000000	0.003633
TOTAL	0.003333	0.033056	0.065556	0.003056	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF C STABILITY = 0.105000

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = 0.001389

TABLE 2.6-2 (Continued)

SEA- DJF   RELATIVE FREQUENCY DISTRIBUTION   STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.005382	0.010000	0.027222	0.029444	0.000833	0.000000	0.072882
NNE	0.000594	0.003333	0.013611	0.006389	0.000000	0.000000	0.023927
NE	0.001397	0.004167	0.010833	0.009167	0.000000	0.000000	0.025564
ENE	0.001724	0.004167	0.011667	0.004444	0.000000	0.000000	0.022002
E	0.003190	0.010556	0.013333	0.004444	0.000278	0.000000	0.031801
ESE	0.002448	0.006389	0.008056	0.002778	0.000000	0.000000	0.019670
SE	0.003350	0.007778	0.006111	0.003333	0.000000	0.000000	0.020572
SSE	0.004023	0.009722	0.010278	0.009722	0.001667	0.000556	0.035968
S	0.005478	0.019722	0.029722	0.030833	0.001944	0.000000	0.087700
SSW	0.002398	0.006111	0.006944	0.005000	0.000556	0.000000	0.021009
SW	0.002151	0.004722	0.003333	0.002500	0.000000	0.000000	0.012706
WSW	0.001873	0.005000	0.004722	0.001667	0.000000	0.000000	0.013262
W	0.001496	0.004722	0.006389	0.003333	0.000278	0.000000	0.016218
WNW	0.002558	0.003333	0.004167	0.005833	0.000000	0.000000	0.015891
NW	0.003231	0.005278	0.007222	0.010556	0.001111	0.000000	0.027398
NNW	0.003152	0.006667	0.011944	0.012222	0.000000	0.000000	0.033985
TOTAL	0.044444	0.111667	0.175555	0.141667	0.006667	0.000556	

RELATIVE FREQUENCY OF OCCURRENCE OF D STABILITY = 0.480556

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = 0.023611

TABLE 2.6-2 (Continued)

SEA= D.F RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.011111	0.009167	0.000000	0.000000	0.000000	0.020278
NNE	0.000000	0.003611	0.001944	0.000000	0.000000	0.000000	0.005556
NE	0.000000	0.002778	0.002222	0.000000	0.000000	0.000000	0.005000
ENE	0.000000	0.003889	0.001389	0.000000	0.000000	0.000000	0.005278
E	0.000000	0.006111	0.002222	0.000000	0.000000	0.000000	0.008333
ESE	0.000000	0.002778	0.000556	0.000000	0.000000	0.000000	0.003333
SE	0.000000	0.002500	0.000000	0.000000	0.000000	0.000000	0.002500
SSE	0.000000	0.002778	0.000278	0.000000	0.000000	0.000000	0.003056
S	0.000000	0.005278	0.002500	0.000000	0.000000	0.000000	0.007778
SSW	0.000000	0.001944	0.000556	0.000000	0.000000	0.000000	0.002500
SW	0.000000	0.001389	0.000278	0.000000	0.000000	0.000000	0.001667
WSW	0.000000	0.001667	0.000833	0.000000	0.000000	0.000000	0.002500
W	0.000000	0.003889	0.000556	0.000000	0.000000	0.000000	0.004444
WNW	0.000000	0.002222	0.001389	0.000000	0.000000	0.000000	0.003611
NW	0.000000	0.003333	0.006944	0.000000	0.000000	0.000000	0.010278
NNW	0.000000	0.003056	0.009722	0.000000	0.000000	0.000000	0.012778
TOTAL	0.000000	0.058333	0.040556	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF E STABILITY = 0.098889

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = 0.000000

TABLE 2.6-2 (Continued)

SEA= DJF RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.040348	0.018056	0.000000	0.000000	0.000000	0.000000	0.058403
NNE	0.007482	0.003889	0.000000	0.000000	0.000000	0.000000	0.011371
NE	0.003980	0.002222	0.000000	0.000000	0.000000	0.000000	0.006202
ENE	0.003263	0.001389	0.000000	0.000000	0.000000	0.000000	0.004652
E	0.005492	0.002778	0.000000	0.000000	0.000000	0.000000	0.008270
ESE	0.005492	0.002778	0.000000	0.000000	0.000000	0.000000	0.008270
SE	0.004574	0.001111	0.000000	0.000000	0.000000	0.000000	0.005685
SSE	0.004775	0.001944	0.000000	0.000000	0.000000	0.000000	0.006719
S	0.016630	0.006111	0.000000	0.000000	0.000000	0.000000	0.022741
SSW	0.007837	0.002500	0.000000	0.000000	0.000000	0.000000	0.010337
SW	0.007197	0.000556	0.000000	0.000000	0.000000	0.000000	0.007753
WSW	0.010344	0.003611	0.000000	0.000000	0.000000	0.000000	0.013955
W	0.012696	0.006944	0.000000	0.000000	0.000000	0.000000	0.019640
WNW	0.012179	0.006944	0.000000	0.000000	0.000000	0.000000	0.019123
NW	0.026580	0.011667	0.000000	0.000000	0.000000	0.000000	0.038246
NNW	0.020022	0.013056	0.000000	0.000000	0.000000	0.000000	0.033078
TOTAL	0.188889	0.085555	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF F STABILITY = 0.274444

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = 0.126944

TABLE 2.6-3

SEASONAL WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES FOR SPRING (2)

SEA= MAM   RELATIVE FREQUENCY DISTRIBUTION   STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000687	0.000000	0.000000	0.000000	0.000000	0.000000	0.000687
NNE	0.000288	0.001087	0.000000	0.000000	0.000000	0.000000	0.001375
NE	0.001103	0.000272	0.000000	0.000000	0.000000	0.000000	0.001375
ENE	0.000216	0.000815	0.000000	0.000000	0.000000	0.000000	0.001031
E	0.000144	0.000543	0.000000	0.000000	0.000000	0.000000	0.000687
ESE	0.000631	0.001087	0.000000	0.000000	0.000000	0.000000	0.001718
SE	0.000144	0.000543	0.000000	0.000000	0.000000	0.000000	0.000687
SSE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	0.000416	0.000272	0.000000	0.000000	0.000000	0.000000	0.000687
SSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SW	0.000144	0.000543	0.000000	0.000000	0.000000	0.000000	0.000687
WSW	0.000144	0.000543	0.000000	0.000000	0.000000	0.000000	0.000687
W	0.000344	0.000000	0.000000	0.000000	0.000000	0.000000	0.000344
WNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NW	0.000488	0.000543	0.000000	0.000000	0.000000	0.000000	0.001031
NNW	0.000144	0.000543	0.000000	0.000000	0.000000	0.000000	0.000687
TOTAL	0.004891	0.006793	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF A STABILITY = 0.011685

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = 0.002446

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TABLE 2.6-3 (Continued)

SEA= MAM RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. B OBS 69-73

SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.002144	0.005707	0.002717	0.000000	0.000000	0.000000	0.010568
NNE	0.000614	0.004620	0.002717	0.000000	0.000000	0.000000	0.007951
NE	0.001253	0.005435	0.003261	0.000000	0.000000	0.000000	0.009948
ENE	0.001334	0.002446	0.001630	0.000000	0.000000	0.000000	0.005410
E	0.000943	0.005163	0.001902	0.000000	0.000000	0.000000	0.008008
ESE	0.000929	0.000815	0.000815	0.000000	0.000000	0.000000	0.002560
SE	0.000190	0.002717	0.001902	0.000000	0.000000	0.000000	0.004810
SSE	0.000986	0.001630	0.001359	0.000000	0.000000	0.000000	0.003976
S	0.000481	0.002717	0.003533	0.000000	0.000000	0.000000	0.006731
SSW	0.000190	0.002717	0.000272	0.000000	0.000000	0.000000	0.003179
SW	0.000095	0.001359	0.001359	0.000000	0.000000	0.000000	0.002812
WSW	0.000481	0.002717	0.001902	0.000000	0.000000	0.000000	0.005101
W	0.000677	0.001359	0.002174	0.000000	0.000000	0.000000	0.004209
WNW	0.000209	0.002989	0.002989	0.000000	0.000000	0.000000	0.006188
NW	0.000443	0.002174	0.002174	0.000000	0.000000	0.000000	0.004791
NNW	0.000715	0.001902	0.002174	0.000000	0.000000	0.000000	0.004791
TOTAL	0.011685	0.046467	0.032880	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF B STABILITY = 0.091033

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = 0.003804

TABLE 2.6-3 (Continued)

SEA= MAM RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

	SPEED(KTS)						
DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001888	0.003261	0.007337	0.000815	0.000000	0.000000	0.013301
NNE	0.000558	0.000815	0.004891	0.001359	0.000000	0.000000	0.007623
NE	0.000486	0.000543	0.006250	0.000815	0.000000	0.000000	0.008095
ENE	0.000915	0.002174	0.005435	0.000000	0.000000	0.000000	0.008524
E	0.001745	0.002717	0.004620	0.000272	0.000000	0.000000	0.009354
ESE	0.000501	0.001902	0.002989	0.001087	0.000000	0.000000	0.006479
SE	0.000143	0.000543	0.004620	0.001630	0.000000	0.000000	0.006936
SSE	0.000000	0.000000	0.004891	0.002174	0.000000	0.000000	0.007065
S	0.001316	0.001087	0.010870	0.005707	0.000000	0.000000	0.018979
SSW	0.000072	0.000272	0.004348	0.001359	0.000000	0.000000	0.006050
SW	0.000415	0.000272	0.002446	0.001630	0.000000	0.000000	0.004763
WSW	0.000701	0.001359	0.003804	0.000272	0.000000	0.000000	0.006136
W	0.000486	0.000543	0.002989	0.000815	0.000000	0.000000	0.004834
WNW	0.000772	0.001630	0.003804	0.001359	0.000000	0.000000	0.007566
NW	0.000486	0.000543	0.004620	0.003261	0.000000	0.000000	0.008910
NNW	0.002288	0.002174	0.005707	0.001902	0.000000	0.000000	0.012071
TOTAL	0.012772	0.019837	0.079619	0.024457	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF C STABILITY = 0.136685

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = 0.006793

TABLE 2.6-3 (Continued)

SEA: MAM RELATIVE FREQUENCY DISTRIBUTION STATION #93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001883	0.008424	0.010598	0.009783	0.000000	0.000000	0.030688
NNE	0.000365	0.002446	0.004076	0.004620	0.000272	0.000000	0.011778
NE	0.001003	0.004620	0.005435	0.001087	0.000000	0.000000	0.012144
ENE	0.001124	0.005435	0.005163	0.002717	0.000000	0.000000	0.014440
E	0.001721	0.007337	0.016848	0.004076	0.000000	0.000000	0.029982
ESE	0.000975	0.006522	0.011141	0.003804	0.000000	0.000000	0.022442
SE	0.001287	0.006522	0.007337	0.004891	0.000543	0.000000	0.020580
SSE	0.001356	0.004891	0.008696	0.008152	0.000543	0.000272	0.023910
S	0.002942	0.009239	0.027174	0.028261	0.001902	0.000000	0.069518
SSW	0.000853	0.005707	0.010054	0.010326	0.000815	0.000000	0.027755
SW	0.001546	0.004076	0.006522	0.006250	0.000272	0.000000	0.018666
WSW	0.001640	0.006793	0.003261	0.006522	0.000272	0.000000	0.018488
W	0.002564	0.004620	0.003533	0.004076	0.000000	0.000000	0.014793
WNW	0.001112	0.003261	0.004076	0.005435	0.000543	0.000000	0.014427
NW	0.000759	0.002989	0.004620	0.005435	0.000000	0.000000	0.013802
NNW	0.000881	0.003804	0.005435	0.005707	0.000272	0.000000	0.016098
TOTAL	0.022011	0.086685	0.133967	0.111141	0.005435	0.000272	

RELATIVE FREQUENCY OF OCCURRENCE OF D STABILITY = 0.359511

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = 0.014130

TABLE 2.6-3 (Continued)

SEA= MAM RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

	SPEED(KTS)						
DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.006522	0.002446	0.000000	0.000000	0.000000	0.008967
NNE	0.000000	0.001630	0.001087	0.000000	0.000000	0.000000	0.002717
NE	0.000000	0.002446	0.001630	0.000000	0.000000	0.000000	0.004076
ENE	0.000000	0.004348	0.001630	0.000000	0.000000	0.000000	0.005978
E	0.000000	0.008967	0.001902	0.000000	0.000000	0.000000	0.010870
ESE	0.000000	0.007609	0.002717	0.000000	0.000000	0.000000	0.010326
SE	0.000000	0.004348	0.000543	0.000000	0.000000	0.000000	0.004891
SSE	0.000000	0.004891	0.000272	0.000000	0.000000	0.000000	0.005163
S	0.000000	0.010870	0.006793	0.000000	0.000000	0.000000	0.017663
SSW	0.000000	0.006250	0.001630	0.000000	0.000000	0.000000	0.007880
SW	0.000000	0.005163	0.002174	0.000000	0.000000	0.000000	0.007337
WSW	0.000000	0.006793	0.002989	0.000000	0.000000	0.000000	0.009783
W	0.000000	0.003261	0.001359	0.000000	0.000000	0.000000	0.004620
WNW	0.000000	0.002717	0.001630	0.000000	0.000000	0.000000	0.004348
NW	0.000000	0.004348	0.002174	0.000000	0.000000	0.000000	0.006522
NNW	0.000000	0.004076	0.003804	0.000000	0.000000	0.000000	0.007880
TOTAL	0.000000	0.084239	0.034783	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF E STABILITY = 0.119022

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = 0.000000

TABLE 2.6-3 (Continued)

SEA= MAM RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

	SPEED(KTS)						
DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.025803	0.015217	0.000000	0.000000	0.000000	0.000000	0.041020
NNE	0.005015	0.002174	0.000000	0.000000	0.000000	0.000000	0.007189
NE	0.004382	0.004076	0.000000	0.000000	0.000000	0.000000	0.008458
ENE	0.005771	0.003533	0.000000	0.000000	0.000000	0.000000	0.009304
E	0.010969	0.010598	0.000000	0.000000	0.000000	0.000000	0.021567
ESE	0.004200	0.002989	0.000000	0.000000	0.000000	0.000000	0.007189
SE	0.003172	0.001902	0.000000	0.000000	0.000000	0.000000	0.005075
SSE	0.001994	0.000543	0.000000	0.000000	0.000000	0.000000	0.002537
S	0.010514	0.005978	0.000000	0.000000	0.000000	0.000000	0.016493
SSW	0.008580	0.003261	0.000000	0.000000	0.000000	0.000000	0.011841
SW	0.013987	0.004620	0.000000	0.000000	0.000000	0.000000	0.018607
WSW	0.012479	0.009511	0.000000	0.000000	0.000000	0.000000	0.021990
W	0.018493	0.015761	0.000000	0.000000	0.000000	0.000000	0.034254
WNW	0.014806	0.011413	0.000000	0.000000	0.000000	0.000000	0.026219
NW	0.015349	0.010870	0.000000	0.000000	0.000000	0.000000	0.026219
NNW	0.011333	0.012772	0.000000	0.000000	0.000000	0.000000	0.024105
TOTAL	0.166848	0.115217	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF F STABILITY = 0.282065

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = 0.100815

TABLE 2.6-4

SEASONAL WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES FOR SUMMER (2)

SEA= JJA RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001121	0.003261	0.000000	0.000000	0.000000	0.000000	0.004382
NNE	0.000457	0.001902	0.000000	0.000000	0.000000	0.000000	0.002360
NE	0.001741	0.001630	0.000000	0.000000	0.000000	0.000000	0.003371
ENE	0.000196	0.000815	0.000000	0.000000	0.000000	0.000000	0.001011
E	0.000457	0.001902	0.000000	0.000000	0.000000	0.000000	0.002360
ESE	0.000261	0.001087	0.000000	0.000000	0.000000	0.000000	0.001348
SE	0.000196	0.000815	0.000000	0.000000	0.000000	0.000000	0.001011
SSE	0.000674	0.000000	0.000000	0.000000	0.000000	0.000000	0.000674
S	0.000261	0.001087	0.000000	0.000000	0.000000	0.000000	0.001348
SSW	0.000131	0.000543	0.000000	0.000000	0.000000	0.000000	0.000674
SW	0.000327	0.001359	0.000000	0.000000	0.000000	0.000000	0.001685
WSW	0.000468	0.000543	0.000000	0.000000	0.000000	0.000000	0.001011
W	0.000599	0.001087	0.000000	0.000000	0.000000	0.000000	0.001685
WNW	0.000261	0.001087	0.000000	0.000000	0.000000	0.000000	0.001348
NW	0.000805	0.000543	0.000000	0.000000	0.000000	0.000000	0.001348
NNW	0.000196	0.000815	0.000000	0.000000	0.000000	0.000000	0.001011
TOTAL	0.008152	0.018478	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF A STABILITY = 0.026630

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = 0.005163

TABLE 2.6-4 (Continued)

SEA= JJA   RELATIVE FREQUENCY DISTRIBUTION   STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

	SPEED(KTS)						
DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.003911	0.007609	0.005707	0.000000	0.000000	0.000000	0.017226
NNE	0.002395	0.007609	0.001902	0.000000	0.000000	0.000000	0.011906
NE	0.003576	0.007337	0.006522	0.000000	0.000000	0.000000	0.017435
ENE	0.001600	0.005978	0.003533	0.000000	0.000000	0.000000	0.011111
E	0.002761	0.008152	0.003533	0.000000	0.000000	0.000000	0.014446
ESE	0.001621	0.003533	0.002446	0.000000	0.000000	0.000000	0.007599
SE	0.001830	0.002717	0.000272	0.000000	0.000000	0.000000	0.004819
SSE	0.001893	0.003261	0.001630	0.000000	0.000000	0.000000	0.006784
S	0.003722	0.005978	0.004348	0.000000	0.000000	0.000000	0.014049
SSW	0.001161	0.002174	0.002446	0.000000	0.000000	0.000000	0.005780
SW	0.001172	0.004891	0.002174	0.000000	0.000000	0.000000	0.008237
WSW	0.001224	0.002717	0.001902	0.000000	0.000000	0.000000	0.005843
W	0.002280	0.009239	0.001630	0.000000	0.000000	0.000000	0.013150
WNW	0.001329	0.006250	0.003804	0.000000	0.000000	0.000000	0.011383
NW	0.002416	0.005163	0.004891	0.000000	0.000000	0.000000	0.012470
NNW	0.001077	0.004076	0.002717	0.000000	0.000000	0.000000	0.007871
TOTAL	0.033967	0.086685	0.049456	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF B STABILITY = 0.170109

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = 0.012500

TABLE 2.6-4 (Continued)

SEA= JJA RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.004508	0.002174	0.006793	0.002446	0.000000	0.000000	0.015921
NNE	0.002181	0.001902	0.005707	0.000543	0.000000	0.000000	0.010333
NE	0.001637	0.002446	0.006522	0.000815	0.000000	0.000000	0.011420
ENE	0.000398	0.001087	0.008424	0.001902	0.000000	0.000000	0.011811
E	0.003474	0.005435	0.005707	0.000000	0.000000	0.000000	0.014615
ESE	0.001465	0.002989	0.003261	0.000000	0.000000	0.000000	0.007715
SE	0.000670	0.000815	0.002717	0.000543	0.000000	0.000000	0.004746
SSE	0.001041	0.000815	0.004076	0.000272	0.000000	0.000000	0.006204
S	0.003348	0.004076	0.010326	0.002446	0.000000	0.000000	0.020196
SSW	0.002280	0.002174	0.004348	0.000815	0.000000	0.000000	0.009617
SW	0.002108	0.002717	0.003261	0.001087	0.000000	0.000000	0.009173
WSW	0.002234	0.004076	0.005978	0.000543	0.000000	0.000000	0.012832
W	0.002035	0.003533	0.003261	0.001359	0.000000	0.000000	0.010187
WNW	0.001710	0.001630	0.003261	0.000543	0.000000	0.000000	0.007145
NW	0.001737	0.002717	0.002989	0.000272	0.000000	0.000000	0.007715
NNW	0.000968	0.001630	0.001630	0.000543	0.000000	0.000000	0.004772
TOTAL	0.031793	0.040217	0.078261	0.014130	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF C STABILITY = 0.164402

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = 0.019293

TABLE 2.6-4 (Continued)

SEA= JJA RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000232	0.004891	0.002717	0.001630	0.000000	0.000000	0.009471
NNE	0.000413	0.002717	0.001630	0.002174	0.000272	0.000000	0.007207
NE	0.000763	0.004076	0.006793	0.002174	0.000000	0.000000	0.013806
ENE	0.000245	0.005163	0.007880	0.004620	0.000543	0.000000	0.018451
E	0.000671	0.008152	0.009783	0.004076	0.001087	0.000000	0.023769
ESE	0.000322	0.006793	0.004076	0.002446	0.000543	0.000000	0.014181
SE	0.000349	0.001359	0.003804	0.001630	0.000272	0.000543	0.007958
SSE	0.000621	0.001087	0.003533	0.003261	0.000000	0.000000	0.008501
S	0.000116	0.002446	0.008967	0.005978	0.000543	0.000272	0.018322
SSW	0.000439	0.003261	0.002717	0.003533	0.000272	0.000000	0.010222
SW	0.000439	0.003261	0.003533	0.002174	0.000272	0.000000	0.009678
WSW	0.001060	0.004348	0.004348	0.001630	0.000000	0.000000	0.011386
W	0.000439	0.003261	0.004620	0.001902	0.000000	0.000000	0.010222
WNW	0.000711	0.002989	0.001359	0.000272	0.000000	0.000000	0.005331
NW	0.000608	0.000815	0.001630	0.000543	0.000000	0.000000	0.003597
NNW	0.000724	0.003261	0.001087	0.000543	0.000000	0.000000	0.005615
TOTAL	0.008152	0.057880	0.068478	0.038587	0.003804	0.000815	

RELATIVE FREQUENCY OF OCCURRENCE OF D STABILITY = 0.177717

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = 0.002989

TABLE 2.6-4 (Continued)

SEA= JJA RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

	SPEED(KTS)						
DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.011141	0.000543	0.000000	0.000000	0.000000	0.011685
NNE	0.000000	0.005163	0.000272	0.000000	0.000000	0.000000	0.005435
NE	0.000000	0.002446	0.000815	0.000000	0.000000	0.000000	0.003261
ENE	0.000000	0.007609	0.002446	0.000000	0.000000	0.000000	0.010054
E	0.000000	0.011957	0.004348	0.000000	0.000000	0.000000	0.016304
ESE	0.000000	0.005163	0.001359	0.000000	0.000000	0.000000	0.006522
SE	0.000000	0.004348	0.000543	0.000000	0.000000	0.000000	0.004891
SSE	0.000000	0.002989	0.001359	0.000000	0.000000	0.000000	0.004348
S	0.000000	0.013043	0.002989	0.000000	0.000000	0.000000	0.016033
SSW	0.000000	0.009239	0.002446	0.000000	0.000000	0.000000	0.011685
SW	0.000000	0.010598	0.001359	0.000000	0.000000	0.000000	0.011957
WSW	0.000000	0.011957	0.000543	0.000000	0.000000	0.000000	0.012500
W	0.000000	0.008424	0.000543	0.000000	0.000000	0.000000	0.008967
WNW	0.000000	0.006522	0.000000	0.000000	0.000000	0.000000	0.006522
NW	0.000000	0.002174	0.000000	0.000000	0.000000	0.000000	0.002174
NNW	0.000000	0.004620	0.000272	0.000000	0.000000	0.000000	0.004891
TOTAL	0.000000	0.117391	0.019837	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF E STABILITY = 0.137228

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = 0.000000

TABLE 2.6-4 (Continued)

SEA= JJA   RELATIVE FREQUENCY DISTRIBUTION   STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

	SPEED(KTS)						
DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.023569	0.013587	0.000000	0.000000	0.000000	0.000000	0.037156
NNE	0.010361	0.006250	0.000000	0.000000	0.000000	0.000000	0.016611
NE	0.007785	0.004891	0.000000	0.000000	0.000000	0.000000	0.012677
ENE	0.011530	0.010326	0.000000	0.000000	0.000000	0.000000	0.021856
E	0.012192	0.011413	0.000000	0.000000	0.000000	0.000000	0.023605
ESE	0.004442	0.002989	0.000000	0.000000	0.000000	0.000000	0.007431
SE	0.006462	0.002717	0.000000	0.000000	0.000000	0.000000	0.009180
SSE	0.009026	0.001902	0.000000	0.000000	0.000000	0.000000	0.010928
S	0.026487	0.007609	0.000000	0.000000	0.000000	0.000000	0.034096
SSW	0.011330	0.003533	0.000000	0.000000	0.000000	0.000000	0.014862
SW	0.022707	0.005707	0.000000	0.000000	0.000000	0.000000	0.028413
WSW	0.022081	0.011141	0.000000	0.000000	0.000000	0.000000	0.033222
W	0.019434	0.006793	0.000000	0.000000	0.000000	0.000000	0.026228
WNW	0.010952	0.004348	0.000000	0.000000	0.000000	0.000000	0.015300
NW	0.012854	0.002446	0.000000	0.000000	0.000000	0.000000	0.015300
NNW	0.013787	0.003261	0.000000	0.000000	0.000000	0.000000	0.017048
TOTAL	0.225000	0.098913	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF F STABILITY = 0.323913

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = 0.122554

TABLE 2.6-5

SEASONAL WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES FOR AUTUMN (2)

SEA= SON   RELATIVE FREQUENCY DISTRIBUTION   STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

	SPEED(KTS)						
DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000674	0.000824	0.000000	0.000000	0.000000	0.000000	0.001499
ENE	0.000724	0.000275	0.000000	0.000000	0.000000	0.000000	0.000999
E	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ESE	0.000225	0.000275	0.000000	0.000000	0.000000	0.000000	0.000500
SE	0.000500	0.000000	0.000000	0.000000	0.000000	0.000000	0.000500
SSE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	0.000225	0.000275	0.000000	0.000000	0.000000	0.000000	0.000500
SSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WSW	0.000724	0.000275	0.000000	0.000000	0.000000	0.000000	0.000999
W	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NW	0.000225	0.000275	0.000000	0.000000	0.000000	0.000000	0.000500
NNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
TOTAL	0.003297	0.002198	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF A STABILITY = 0.005495

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = 0.002473

TABLE 2.6-5 (Continued)

SEA= SON RELATIVE FREQUENCY DISTRIBUTION STATION #93805 TALLAHASSEE, FLA. 8 OBS 69-73

	SPEED(KTS)						
DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000752	0.006319	0.003346	0.000000	0.000000	0.000000	0.010917
NNE	0.000421	0.004670	0.002198	0.000000	0.000000	0.000000	0.007289
NE	0.001068	0.007418	0.004396	0.000000	0.000000	0.000000	0.012881
ENE	0.001560	0.004945	0.003022	0.000000	0.000000	0.000000	0.009527
E	0.001593	0.006044	0.002473	0.000000	0.000000	0.000000	0.010109
ESE	0.000647	0.002747	0.001099	0.000000	0.000000	0.000000	0.004493
SE	0.000639	0.002473	0.000824	0.000000	0.000000	0.000000	0.003935
SSE	0.000041	0.001374	0.000549	0.000000	0.000000	0.000000	0.001964
S	0.001762	0.002198	0.000549	0.000000	0.000000	0.000000	0.004509
SSW	0.000008	0.000275	0.000275	0.000000	0.000000	0.000000	0.000558
SW	0.000024	0.000824	0.000275	0.000000	0.000000	0.000000	0.001123
WSW	0.000299	0.000549	0.000275	0.000000	0.000000	0.000000	0.001123
W	0.000598	0.001099	0.001374	0.000000	0.000000	0.000000	0.003071
WNW	0.000905	0.001923	0.000549	0.000000	0.000000	0.000000	0.003378
NW	0.000614	0.001648	0.000824	0.000000	0.000000	0.000000	0.003087
NNW	0.000332	0.001648	0.000824	0.000000	0.000000	0.000000	0.002804
TOTAL	0.011264	0.046154	0.023352	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF B STABILITY = 0.080769

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = 0.001648

TABLE 2.6-5 (Continued)

SEA= SON RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000791	0.007143	0.010165	0.000824	0.000000	0.000000	0.018923
NNE	0.000112	0.003571	0.007418	0.001099	0.000000	0.000000	0.012200
NE	0.000138	0.004396	0.013187	0.000275	0.000000	0.000000	0.017995
ENE	0.000199	0.006319	0.014286	0.000275	0.000000	0.000000	0.021078
E	0.000052	0.001648	0.010165	0.001374	0.000000	0.000000	0.013239
ESE	0.000060	0.001923	0.004396	0.000275	0.000000	0.000000	0.006654
SE	0.000026	0.000824	0.001923	0.000275	0.000000	0.000000	0.003048
SSE	0.000318	0.001099	0.001923	0.000275	0.000000	0.000000	0.003615
S	0.000378	0.003022	0.006319	0.000000	0.000000	0.000000	0.009719
SSW	0.000026	0.000824	0.001648	0.000000	0.000000	0.000000	0.002498
SW	0.000043	0.001374	0.001099	0.000275	0.000000	0.000000	0.002790
WSW	0.000035	0.001099	0.002198	0.000000	0.000000	0.000000	0.003331
W	0.000378	0.003022	0.001648	0.000000	0.000000	0.000000	0.005049
WNW	0.000052	0.001648	0.004396	0.000000	0.000000	0.000000	0.006096
NW	0.000086	0.002747	0.004121	0.000275	0.000000	0.000000	0.007229
NNW	0.000052	0.001648	0.003846	0.000275	0.000000	0.000000	0.005821
TOTAL	0.002747	0.042308	0.088736	0.005495	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF C STABILITY = 0.139286

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = 0.001374

TABLE 2.6-5 (Continued)

SEA= SON RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

	SPEED(KTS)						
DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001964	0.006044	0.013736	0.012363	0.000000	0.000000	0.034107
NNE	0.000684	0.004121	0.007418	0.005769	0.000000	0.000000	0.017992
NE	0.001004	0.004121	0.020604	0.014835	0.000000	0.000000	0.040565
ENE	0.000821	0.004945	0.021154	0.013736	0.000275	0.000000	0.040931
E	0.002834	0.005495	0.019505	0.007967	0.000549	0.000000	0.036350
ESE	0.001598	0.005769	0.005220	0.003022	0.000000	0.000275	0.015884
SE	0.001828	0.003297	0.004396	0.002747	0.000000	0.000000	0.012268
SSE	0.001370	0.004396	0.004670	0.003297	0.000000	0.000000	0.013733
S	0.001645	0.004121	0.008516	0.008516	0.000000	0.000000	0.022799
SSW	0.000137	0.000824	0.001648	0.001374	0.000000	0.000000	0.003983
SW	0.000182	0.001099	0.001374	0.000549	0.000000	0.000000	0.003204
WSW	0.000502	0.003022	0.001099	0.001099	0.000000	0.000000	0.005721
W	0.001051	0.002473	0.001923	0.000824	0.000000	0.000000	0.006271
WNW	0.000412	0.000549	0.002198	0.001923	0.000000	0.000000	0.005082
NW	0.001188	0.003297	0.004396	0.002747	0.000000	0.000000	0.011627
NNW	0.000913	0.003571	0.006868	0.003571	0.000000	0.000000	0.014924
TOTAL	0.018132	0.057143	0.124725	0.084340	0.000824	0.000275	

RELATIVE FREQUENCY OF OCCURRENCE OF D STABILITY = 0.285440

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = 0.010714

TABLE 2.6-5 (Continued)

SEA= SON RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.013736	0.006319	0.000000	0.000000	0.000000	0.020055
NNE	0.000000	0.004945	0.002747	0.000000	0.000000	0.000000	0.007692
NE	0.000000	0.006593	0.006044	0.000000	0.000000	0.000000	0.012637
ENE	0.000000	0.007692	0.007143	0.000000	0.000000	0.000000	0.014835
E	0.000000	0.009890	0.007967	0.000000	0.000000	0.000000	0.017857
ESE	0.000000	0.005769	0.000000	0.000000	0.000000	0.000000	0.005769
SE	0.000000	0.004396	0.000275	0.000000	0.000000	0.000000	0.004670
SSE	0.000000	0.002198	0.000275	0.000000	0.000000	0.000000	0.002473
S	0.000000	0.003846	0.000549	0.000000	0.000000	0.000000	0.004396
SSW	0.000000	0.001648	0.000549	0.000000	0.000000	0.000000	0.002198
SW	0.000000	0.002473	0.001099	0.000000	0.000000	0.000000	0.003571
WSW	0.000000	0.004670	0.000549	0.000000	0.000000	0.000000	0.005220
W	0.000000	0.003297	0.000549	0.000000	0.000000	0.000000	0.003846
WNW	0.000000	0.003297	0.000275	0.000000	0.000000	0.000000	0.003571
NW	0.000000	0.006044	0.000824	0.000000	0.000000	0.000000	0.006868
NNW	0.000000	0.004670	0.002198	0.000000	0.000000	0.000000	0.006868
TOTAL	0.000000	0.085165	0.037363	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF E STABILITY = 0.122527

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = 0.000000

TABLE 2.6-5 (Continued)

SEA= SON RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.059506	0.029396	0.000000	0.000000	0.000000	0.000000	0.088902
NNE	0.014425	0.010165	0.000000	0.000000	0.000000	0.000000	0.024590
NE	0.009773	0.009615	0.000000	0.000000	0.000000	0.000000	0.019388
ENE	0.017672	0.014011	0.000000	0.000000	0.000000	0.000000	0.031683
E	0.021960	0.012088	0.000000	0.000000	0.000000	0.000000	0.034048
ESE	0.004071	0.003022	0.000000	0.000000	0.000000	0.000000	0.007093
SE	0.001738	0.001099	0.000000	0.000000	0.000000	0.000000	0.002837
SSE	0.002959	0.000824	0.000000	0.000000	0.000000	0.000000	0.003783
S	0.012552	0.004945	0.000000	0.000000	0.000000	0.000000	0.017497
SSW	0.006238	0.002747	0.000000	0.000000	0.000000	0.000000	0.008985
SW	0.007809	0.001648	0.000000	0.000000	0.000000	0.000000	0.009458
WSW	0.011881	0.004670	0.000000	0.000000	0.000000	0.000000	0.016551
W	0.012507	0.003571	0.000000	0.000000	0.000000	0.000000	0.016078
WNW	0.017798	0.006319	0.000000	0.000000	0.000000	0.000000	0.024117
NW	0.019505	0.009341	0.000000	0.000000	0.000000	0.000000	0.028846
NNW	0.021365	0.011264	0.000000	0.000000	0.000000	0.000000	0.032629
TOTAL	0.241758	0.124725	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF F STABILITY = 0.366484

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = 0.153571

TABLE 2.6-6

ANNUAL WIND DISTRIBUTION BY PASQUILL STABILITY CLASSES (2)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
	SPEED(KTS)						
N	0.000553	0.000822	0.000000	0.000000	0.000000	0.000000	0.001375
NNE	0.000255	0.000753	0.000000	0.000000	0.000000	0.000000	0.001009
NE	0.000874	0.000685	0.000000	0.000000	0.000000	0.000000	0.001559
ENE	0.000254	0.000479	0.000000	0.000000	0.000000	0.000000	0.000734
E	0.000209	0.000616	0.000000	0.000000	0.000000	0.000000	0.000825
ESE	0.000300	0.000616	0.000000	0.000000	0.000000	0.000000	0.000917
SE	0.000208	0.000342	0.000000	0.000000	0.000000	0.000000	0.000550
SSE	0.000183	0.000000	0.000000	0.000000	0.000000	0.000000	0.000183
S	0.000231	0.000411	0.000000	0.000000	0.000000	0.000000	0.000642
SSW	0.000046	0.000137	0.000000	0.000000	0.000000	0.000000	0.000183
SW	0.000162	0.000479	0.000000	0.000000	0.000000	0.000000	0.000642
WSW	0.000299	0.000342	0.000000	0.000000	0.000000	0.000000	0.000642
W	0.000276	0.000274	0.000000	0.000000	0.000000	0.000000	0.000550
WNW	0.000093	0.000274	0.000000	0.000000	0.000000	0.000000	0.000367
NW	0.000391	0.000342	0.000000	0.000000	0.000000	0.000000	0.000734
NNW	0.000116	0.000342	0.000000	0.000000	0.000000	0.000000	0.000458
TOTAL	0.004452	0.006918	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF A STABILITY = 0.011370

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = 0.002877

TABLE 2.6-6 (Continued)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

	SPEED(KTS)						
DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001990	0.005548	0.003288	0.000000	0.000000	0.000000	0.010825
NNE	0.001064	0.004384	0.001918	0.000000	0.000000	0.000000	0.007366
NE	0.001909	0.005479	0.003836	0.000000	0.000000	0.000000	0.011224
ENE	0.001538	0.003836	0.002192	0.000000	0.000000	0.000000	0.007565
E	0.001866	0.005000	0.001986	0.000000	0.000000	0.000000	0.008852
ESE	0.000937	0.002123	0.001096	0.000000	0.000000	0.000000	0.004156
SE	0.001023	0.002260	0.000822	0.000000	0.000000	0.000000	0.004106
SSE	0.001148	0.001986	0.000959	0.000000	0.000000	0.000000	0.004093
S	0.001607	0.002945	0.002329	0.000000	0.000000	0.000000	0.006881
SSW	0.000347	0.001370	0.000822	0.000000	0.000000	0.000000	0.002538
SW	0.000626	0.001986	0.001096	0.000000	0.000000	0.000000	0.003708
WSW	0.000682	0.001781	0.001027	0.000000	0.000000	0.000000	0.003490
W	0.000966	0.003288	0.001438	0.000000	0.000000	0.000000	0.005692
WNW	0.000637	0.002945	0.001849	0.000000	0.000000	0.000000	0.005432
NW	0.000973	0.002534	0.002055	0.000000	0.000000	0.000000	0.005562
NNW	0.000632	0.002055	0.001575	0.000000	0.000000	0.000000	0.004262
TOTAL	0.017945	0.049521	0.028288	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF B STABILITY = 0.095753

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = 0.005548

TABLE 2.6-6 (Continued)

ANNUAL — RELATIVE FREQUENCY DISTRIBUTION — STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001951	0.003973	0.009932	0.001233	0.000000	0.000000	0.017088
NNE	0.001005	0.002808	0.005822	0.000753	0.000000	0.000000	0.010389
NE	0.000755	0.002329	0.007397	0.000548	0.000000	0.000000	0.011029
ENE	0.000600	0.002808	0.008425	0.000548	0.000000	0.000000	0.012381
E	0.001226	0.003562	0.005822	0.000411	0.000000	0.000000	0.011020
ESE	0.000511	0.002329	0.003562	0.000342	0.000000	0.000000	0.006744
SE	0.000258	0.000959	0.002808	0.000685	0.000000	0.000000	0.004710
SSE	0.000370	0.000685	0.003493	0.000685	0.000000	0.000000	0.005233
S	0.001454	0.002603	0.008699	0.002123	0.000000	0.000000	0.014879
SSW	0.000540	0.001164	0.003082	0.000685	0.000000	0.000000	0.005471
SW	0.000565	0.001301	0.001781	0.000753	0.000000	0.000000	0.004401
WSW	0.000560	0.001712	0.003630	0.000205	0.000000	0.000000	0.006108
W	0.000780	0.002466	0.003219	0.000616	0.000000	0.000000	0.007081
WNW	0.000828	0.001849	0.003356	0.000479	0.000000	0.000000	0.006513
NW	0.000572	0.001781	0.003562	0.001027	0.000000	0.000000	0.006942
NNW	0.000765	0.001507	0.003493	0.000753	0.000000	0.000000	0.006519
TOTAL	0.012740	0.033836	0.078082	0.011849	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF C STABILITY = 0.136507

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = 0.007260

TABLE 2.6-6 (Continued)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION #93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.002315	0.007329	0.013493	0.013219	0.000205	0.000000	0.036562
NNE	0.000534	0.003151	0.006644	0.004726	0.000137	0.000000	0.015192
NE	0.001085	0.004247	0.010890	0.006781	0.000000	0.000000	0.023003
ENE	0.001027	0.004932	0.011438	0.006370	0.000205	0.000000	0.023973
E	0.002159	0.007877	0.014863	0.005137	0.000479	0.000000	0.030515
ESE	0.001392	0.006370	0.007123	0.003014	0.000137	0.000068	0.018105
SE	0.001625	0.004726	0.005411	0.003151	0.000205	0.000137	0.015255
SSE	0.001743	0.005000	0.006781	0.006096	0.000548	0.000205	0.020373
S	0.002377	0.008836	0.018562	0.018356	0.001096	0.000068	0.049294
SSW	0.000967	0.003973	0.005342	0.005068	0.000411	0.000000	0.015762
SW	0.001103	0.003288	0.003699	0.002877	0.000137	0.000000	0.011103
WSW	0.001321	0.004795	0.003356	0.002740	0.000068	0.000000	0.012280
W	0.001408	0.003767	0.004110	0.002534	0.000068	0.000000	0.011887
WNW	0.001229	0.002534	0.002945	0.003356	0.000137	0.000000	0.010202
NW	0.001387	0.003082	0.004452	0.004795	0.000274	0.000000	0.013990
NNW	0.001409	0.004315	0.006301	0.005479	0.000068	0.000000	0.017573
TOTAL	0.023082	0.078219	0.125411	0.093698	0.004178	0.000479	

RELATIVE FREQUENCY OF OCCURRENCE OF D STABILITY = 0.325069

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = 0.012808

TABLE 2.6-6 (Continued)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.010616	0.004589	0.000000	0.000000	0.000000	0.015205
NNE	0.000000	0.003836	0.001507	0.000000	0.000000	0.000000	0.005342
NE	0.000000	0.003562	0.002671	0.000000	0.000000	0.000000	0.006233
ENE	0.000000	0.005890	0.003151	0.000000	0.000000	0.000000	0.009041
E	0.000000	0.009247	0.004110	0.000000	0.000000	0.000000	0.013356
ESE	0.000000	0.005342	0.001164	0.000000	0.000000	0.000000	0.006507
SE	0.000000	0.003904	0.000342	0.000000	0.000000	0.000000	0.004247
SSE	0.000000	0.003219	0.000548	0.000000	0.000000	0.000000	0.003767
S	0.000000	0.008288	0.003219	0.000000	0.000000	0.000000	0.011507
SSW	0.000000	0.004795	0.001301	0.000000	0.000000	0.000000	0.006096
SW	0.000000	0.004932	0.001233	0.000000	0.000000	0.000000	0.006164
WSW	0.000000	0.006301	0.001233	0.000000	0.000000	0.000000	0.007534
W	0.000000	0.004726	0.000753	0.000000	0.000000	0.000000	0.005479
WNW	0.000000	0.003699	0.000822	0.000000	0.000000	0.000000	0.004521
NW	0.000000	0.003973	0.002466	0.000000	0.000000	0.000000	0.006438
NNW	0.000000	0.004110	0.003973	0.000000	0.000000	0.000000	0.008082
TOTAL	0.000000	0.086438	0.033082	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF E STABILITY = 0.119521

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = 0.000000

TABLE 2.6-6 (Continued)

ANNUAL RELATIVE FREQUENCY DISTRIBUTION STATION =93805 TALLAHASSEE, FLA. 8 OBS 69-73

DIRECTION	SPEED(KTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.036445	0.019041	0.000000	0.000000	0.000000	0.000000	0.055486
NNE	0.009203	0.005616	0.000000	0.000000	0.000000	0.000000	0.014819
NE	0.006512	0.005205	0.000000	0.000000	0.000000	0.000000	0.011718
ENE	0.009673	0.007329	0.000000	0.000000	0.000000	0.000000	0.017002
E	0.012925	0.009247	0.000000	0.000000	0.000000	0.000000	0.022172
ESE	0.004522	0.002945	0.000000	0.000000	0.000000	0.000000	0.007467
SE	0.004032	0.001712	0.000000	0.000000	0.000000	0.000000	0.005744
SSE	0.004672	0.001301	0.000000	0.000000	0.000000	0.000000	0.005974
S	0.016582	0.006164	0.000000	0.000000	0.000000	0.000000	0.022746
SSW	0.008589	0.003014	0.000000	0.000000	0.000000	0.000000	0.011603
SW	0.013392	0.003151	0.000000	0.000000	0.000000	0.000000	0.016543
WSW	0.014567	0.007260	0.000000	0.000000	0.000000	0.000000	0.021827
W	0.016181	0.008288	0.000000	0.000000	0.000000	0.000000	0.024469
WNW	0.013992	0.007260	0.000000	0.000000	0.000000	0.000000	0.021253
NW	0.018090	0.008562	0.000000	0.000000	0.000000	0.000000	0.026652
NNW	0.016239	0.010068	0.000000	0.000000	0.000000	0.000000	0.026307
TOTAL	0.205616	0.106164	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF F STABILITY = 0.311781

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = 0.125890

TABLE 2.6-7

NORMALS AND EXTREMES OF TEMPERATURE FOR TALLAHASSEE, FLORIDA (1)

Month	Temperature °F						
	Normal			Extremes			
	Daily Maximum	Daily Minimum	Monthly	Record Highest	Year	Record Lowest	Year
J	64.2	41.0	52.6	82	1972	11	1971
F	66.5	43.0	54.8	85	1962	14	1971
M	72.1	48.4	60.3	90	1967	23	1971
A	80.1	55.7	67.9	95	1968	29	1971
M	86.7	62.8	74.8	98	1962	34	1971
J	90.4	69.6	80.0	100	1969	49	1972
J	90.6	71.6	81.1	100	1966	57	1967
A	90.5	71.7	81.1	100	1972	61	1969
S	87.4	68.7	78.1	99	1962	40	1967
O	80.6	57.9	69.3	93	1971	30	1973
N	71.4	46.4	58.9	88	1961	13	1970
D	65.1	41.3	53.2	84	1971	10	1962
Year	78.8	56.5	67.7	100	Aug. 1972	10	Dec. 1962

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TABLE 2.6-8

MEAN NUMBER OF DAYS FOR OCCURRENCE OF VARIOUS WEATHER CONDITIONS FOR 13 YEARS OF RECORD THROUGH 1974 (1)

Month	Mean Sky Cover, Sunrise to Sunset (Tenths)	MEAN NUMBER OF DAYS										
		Sunrise to Sunset			Precipitation 0.01 Inch or More	Snow, Inc Pellets 1.0 Inch or More	Thunderstorms	Heavy Fog, Visibility 0.25 Mile or Less	Temperature °F			
									Maximum		Minimum	
		Clear	Partly Cloudy	Cloudy					90° and Above	32° and Below	32° and Below	0° and Below
J	6.6	7	7	17	10	0	2	8	0	<0.5	9	0
F	5.9	8	7	13	10	0	2	4	0	0	8	0
M	5.8	9	9	13	9	0	4	6	<0.5	0	3	0
A	5.3	9	12	9	6	0	4	5	2	0	<0.5	0
M	5.5	9	13	9	8	0	8	5	9	0	0	0
J	5.9	5	16	9	12	0	13	3	19	0	0	0
J	6.5	2	18	11	18	0	20	2	22	0	0	0
A	6.2	4	17	10	15	0	18	2	21	0	0	0
S	5.8	7	13	10	9	0	8	2	15	0	0	0
O	4.4	14	8	9	5	0	2	2	2	0	<0.5	0
N	4.7	12	9	9	7	0	2	6	0	0	4	0
D	5.9	9	8	14	8	0	2	7	0	0	9	0
Year	5.7	95	137	133	117	0	85	53	89	<0.5	35	0

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TABLE 2.6-9

NORMALS AND EXTREMES OF PRECIPITATION AND AVERAGE RELATIVE HUMIDITY AT SIX-HOUR INTERVALS (1)

Month	Precipitation (Inches)											Relative Humidity (Percent)			
	Water Equivalent							Snow, Ice Pellets				Hour (Local Time)			
	Normal	Maximum Monthly	Year	Minimum Monthly	Year	Maximum in 24 Hours	Year	Maximum Monthly	Year	Maximum in 24 Hours	Year	0100** (1:00 a.m.)	0700** (7:00 a.m.)	1300** (1:00 p.m.)	1900** (7:00 p.m.)
		14*		14*		14*		14*		14*					
J	3.74	9.27	1964	0.40	1969	2.81	1963	T	1968	T	1968	87	88	61	74
F	4.77	11.50	1964	2.43	1962	5.60	1964	0.4	1973	0.4	1973	83	86	54	65
M	5.93	13.57	1973	1.29	1967	7.16	1962	0.0	NA	0.0	NA	86	88	52	61
A	4.07	13.13	1973	0.55	1972	4.73	1964	0.0	NA	0.0	NA	88	91	48	58
M	4.04	9.08	1972	T	1965	3.94	1972	0.0	NA	0.0	NA	87	89	49	59
J	6.62	12.62	1965	2.96	1968	6.75	1966	0.0	NA	0.0	NA	88	90	54	65
J	8.92	20.12	1964	4.13	1972	8.94	1964	0.0	NA	0.0	NA	91	93	61	74
A	6.89	10.78	1973	4.88	1969	3.39	1961	0.0	NA	0.0	NA	92	93	62	76
S	6.64	15.92	1969	0.11	1972	9.47	1969	0.0	NA	0.0	NA	89	93	58	73
O	2.93	10.48	1964	T	1961	5.95	1964	0.0	NA	0.0	NA	87	91	51	71
N	2.81	9.86	1972	0.88	1971	4.17	1972	0.0	NA	0.0	NA	87	89	53	76
D	4.22	12.65	1964	2.44	1962	9.26	1964	T	1962	T	1962	87	88	58	77
Year	61.58	20.12	July 1964	T	May 1965	9.47	Sept 1969	0.4	Feb. 1973	0.4	Feb. 1973	88	90	55	69

*Years of Record
**Shown in Military Time at Six Hour Intervals

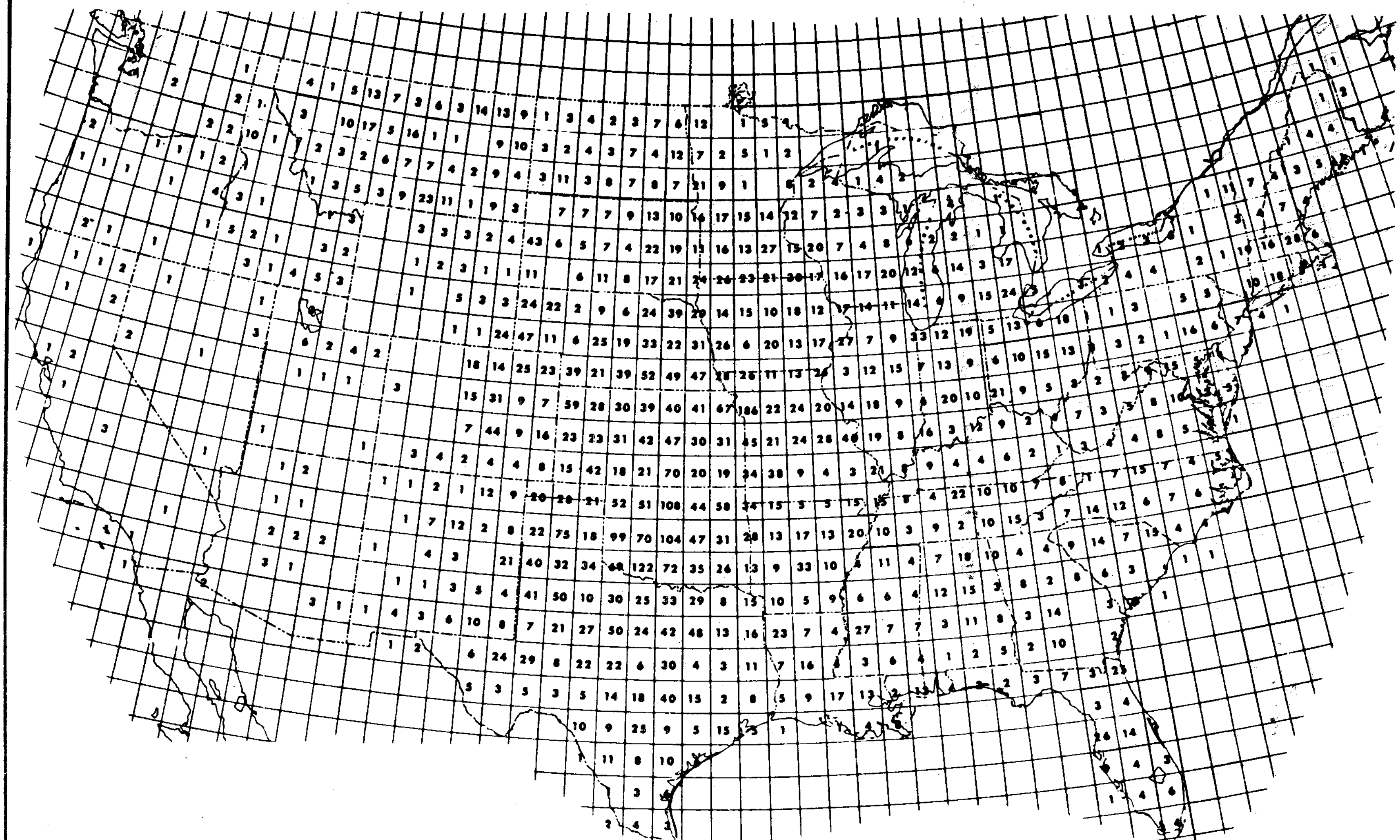
T= Trace
NA= Not Applicable

TABLE 2.6-10

ESTIMATE OF RECURRENCE INTERVALS FOR VARIOUS RAINFALL RATES FOR CARYVILLE, FLORIDA (IN INCHES) (3)

Period of Rainfall	Recurrence Interval (Years)					
	1	2	5	10	50	100
30 Min.	1.6	1.8	2.1	2.4	3.0	3.3
1 Hour	2.0	2.2	2.7	3.0	3.7	4.0
2 Hours	2.4	2.8	3.5	4.0	5.0	5.5
3 Hours	2.6	3.1	4.0	4.5	5.6	6.3
6 Hours	3.0	3.8	4.8	5.6	7.2	8.1
12 Hours	3.8	4.5	6.0	6.8	9.0	10.1
24 Hours	4.4	5.4	7.0	8.1	10.8	12.0
2 Days		6.0	8.0	9.2	12.0	13.6
4 Days		7.3	9.2	10.4	14.0	15.7
7 Days		8.5	10.4	11.8	15.6	16.8
10 Days		9.3	11.6	13.5	17.0	18.1

1

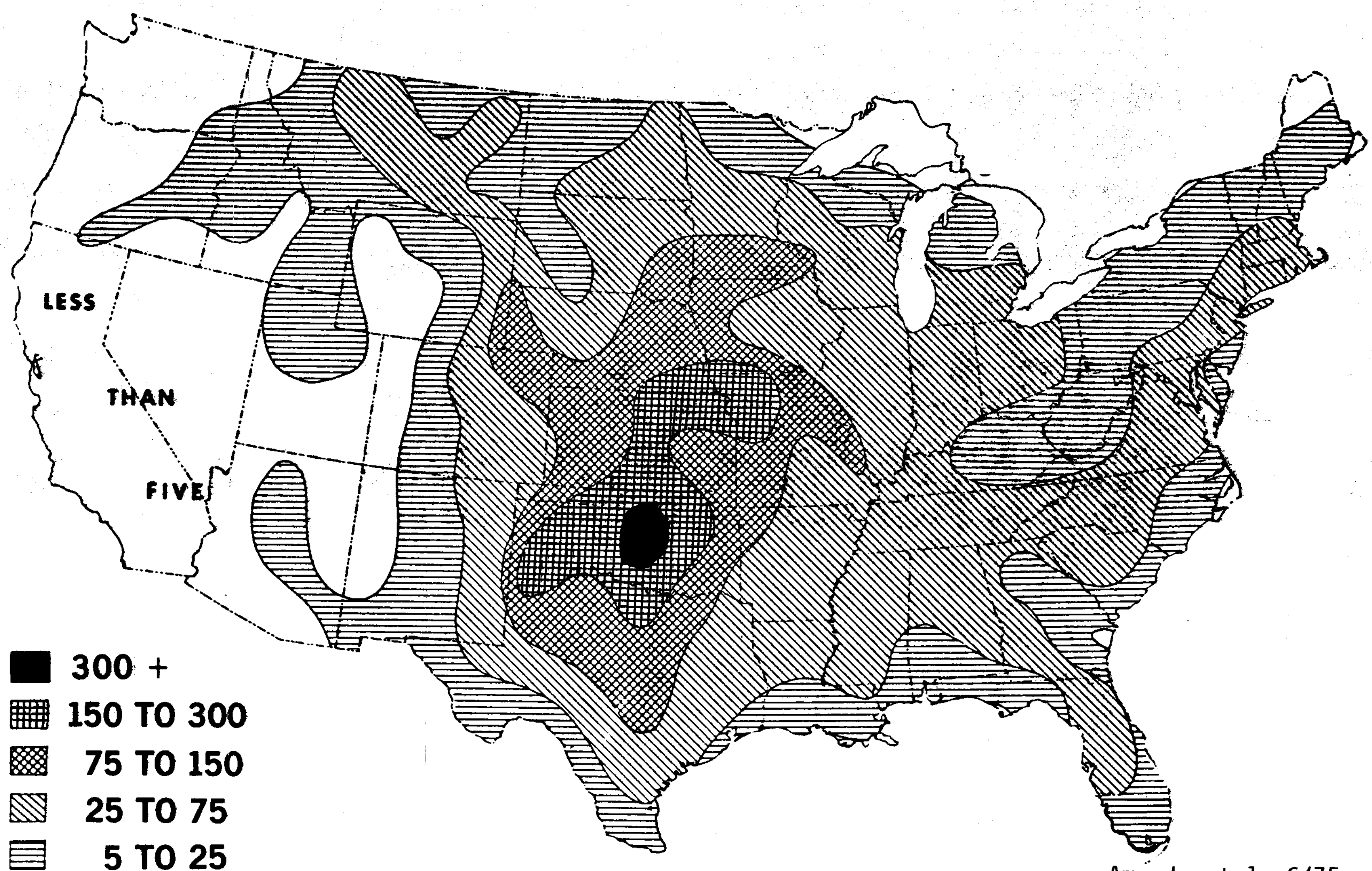


Amendment 1 6/75

GULF POWER CO.
CARYVILLE STEAM PLANT

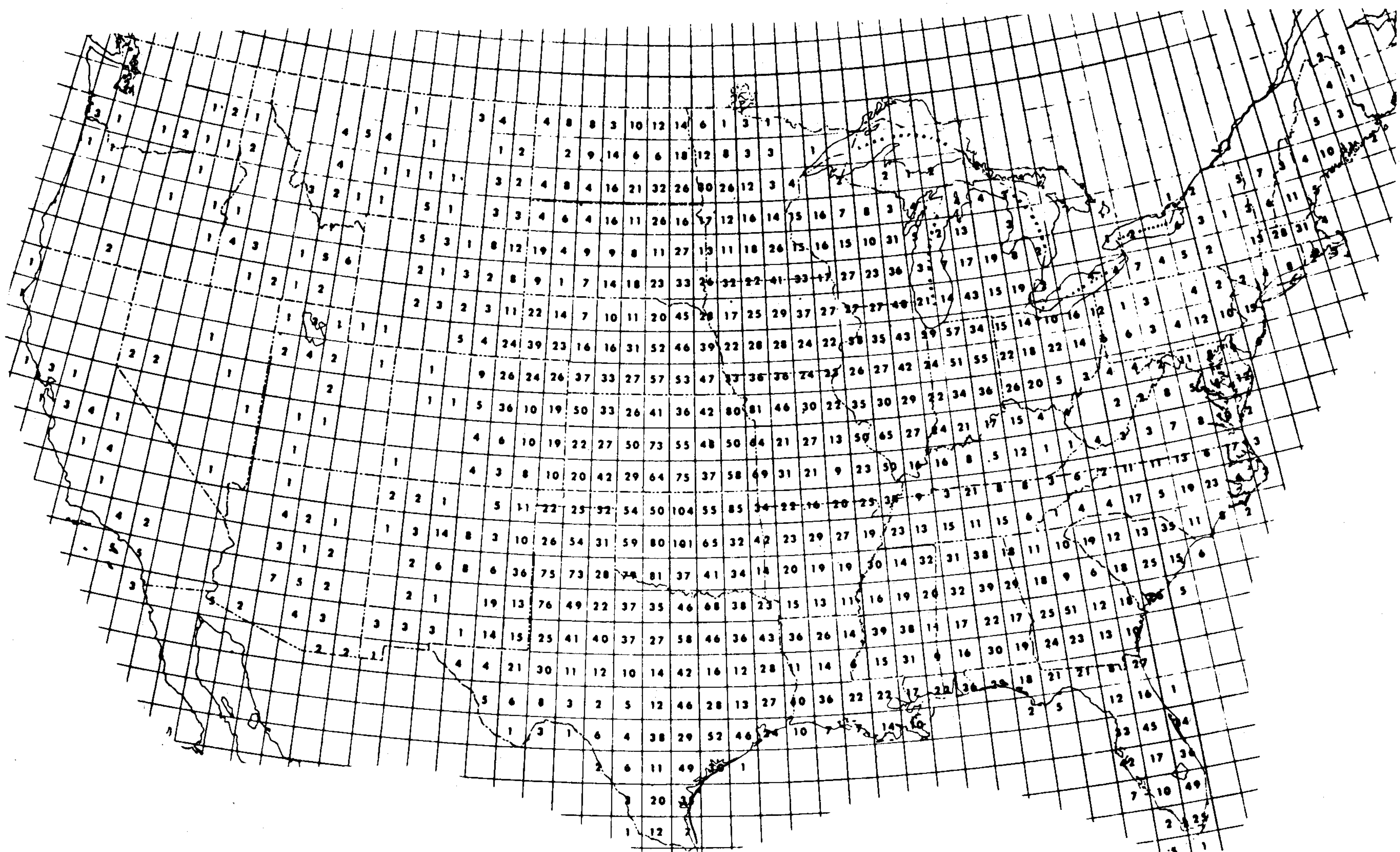
TOTAL NUMBER OF HAIL REPORTS 0.75 INCH AND GREATER, 1955 to 1967, BY 1° SQUARES

FIGURE 2.6-1



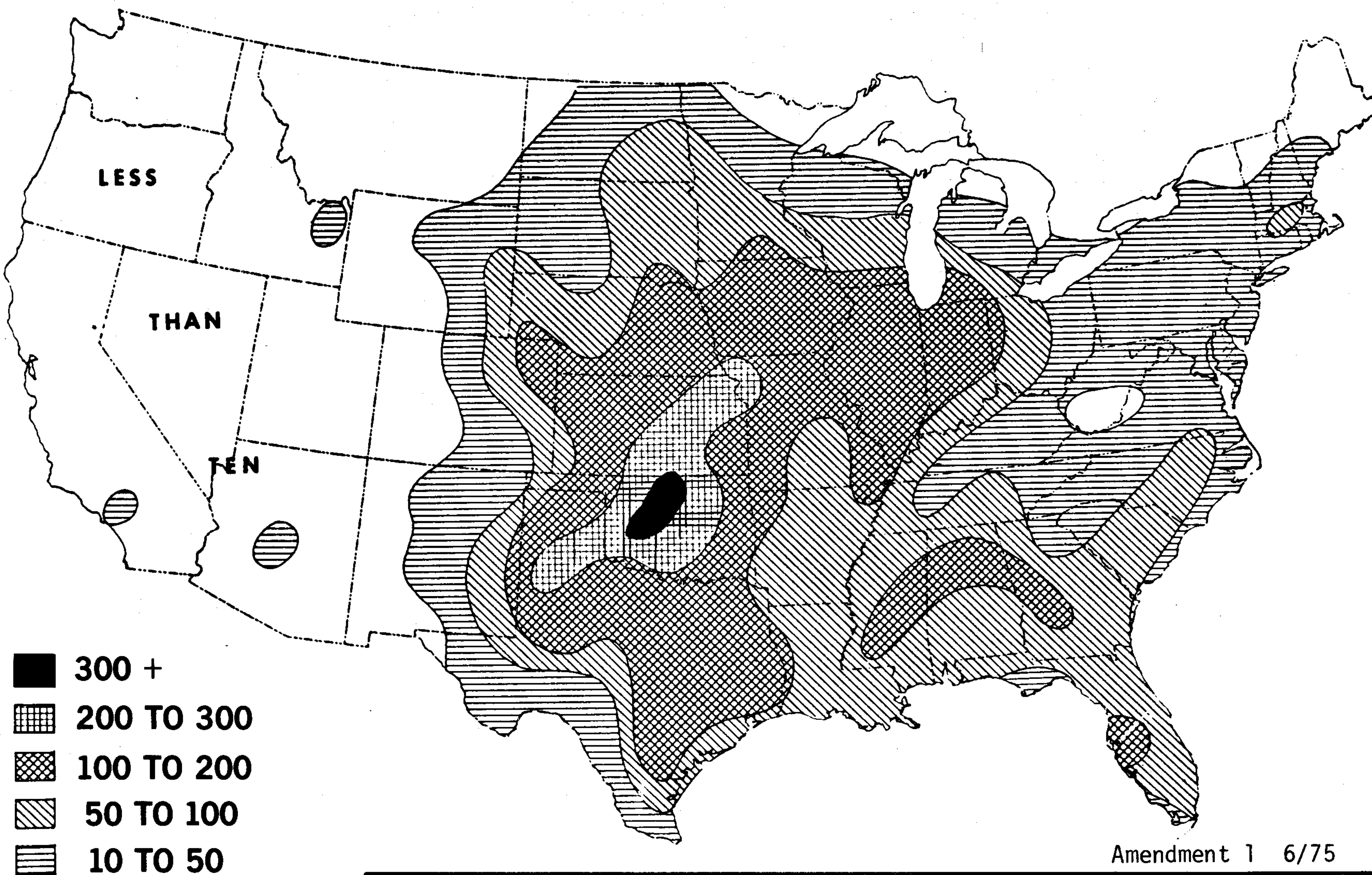
Amendment 1 6/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	TOTAL HAIL REPORTS 0.75 INCH AND GREATER, 1955 to 1967, BY 2° SQUARES FIGURE 2.6-2



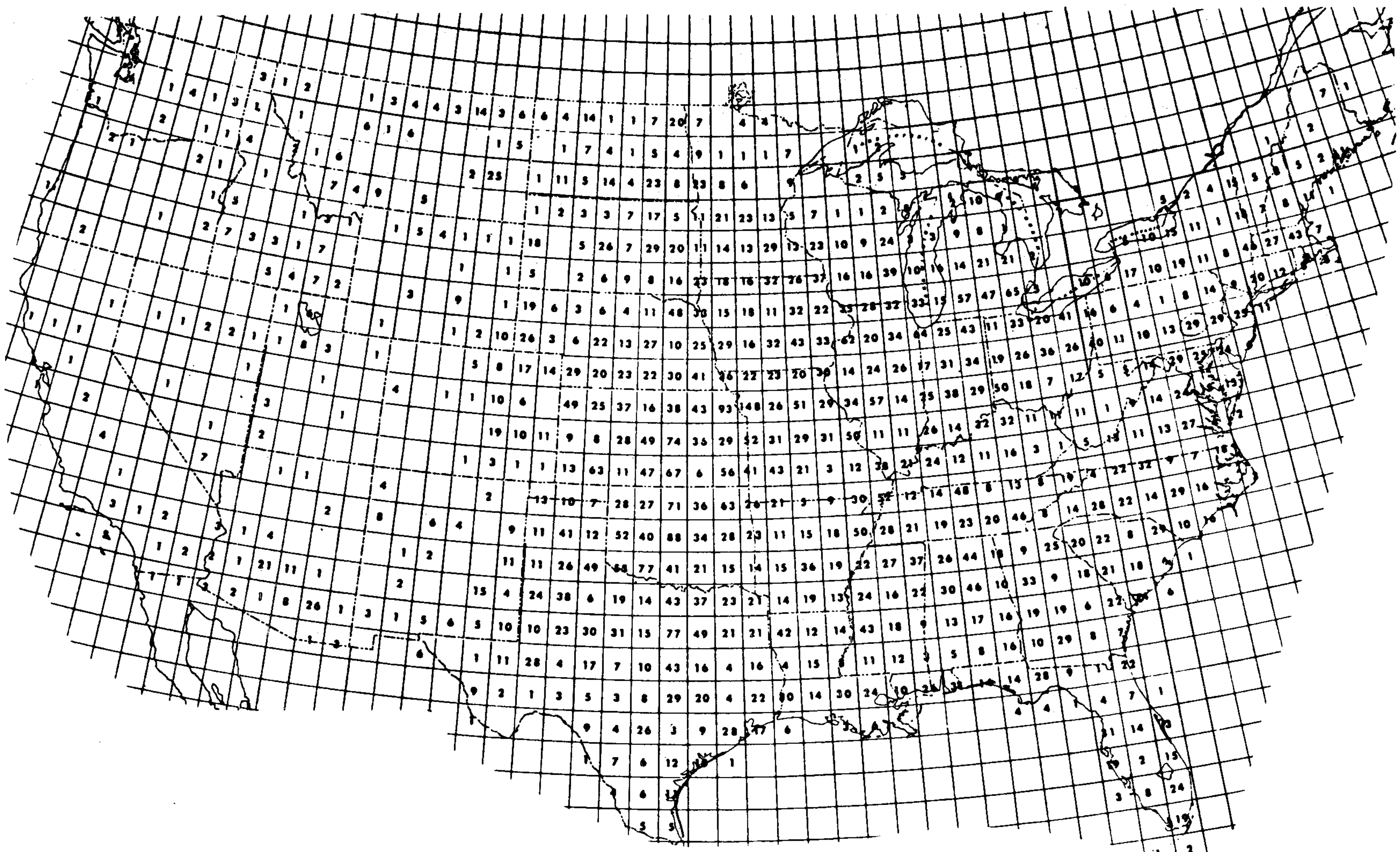
Amendment 1 6/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	TOTAL TORNADOES, 1955 to 1967, BY 1° SQUARES FIGURE 2.6-3



Amendment 1 6/75

GULF POWER COMPANY	GULF POWER CO CARYVILLE STEAM PLANT	TOTAL TORNADOES, 1955 to 1967, BY 2° SQUARES FIGURE 2.6-4



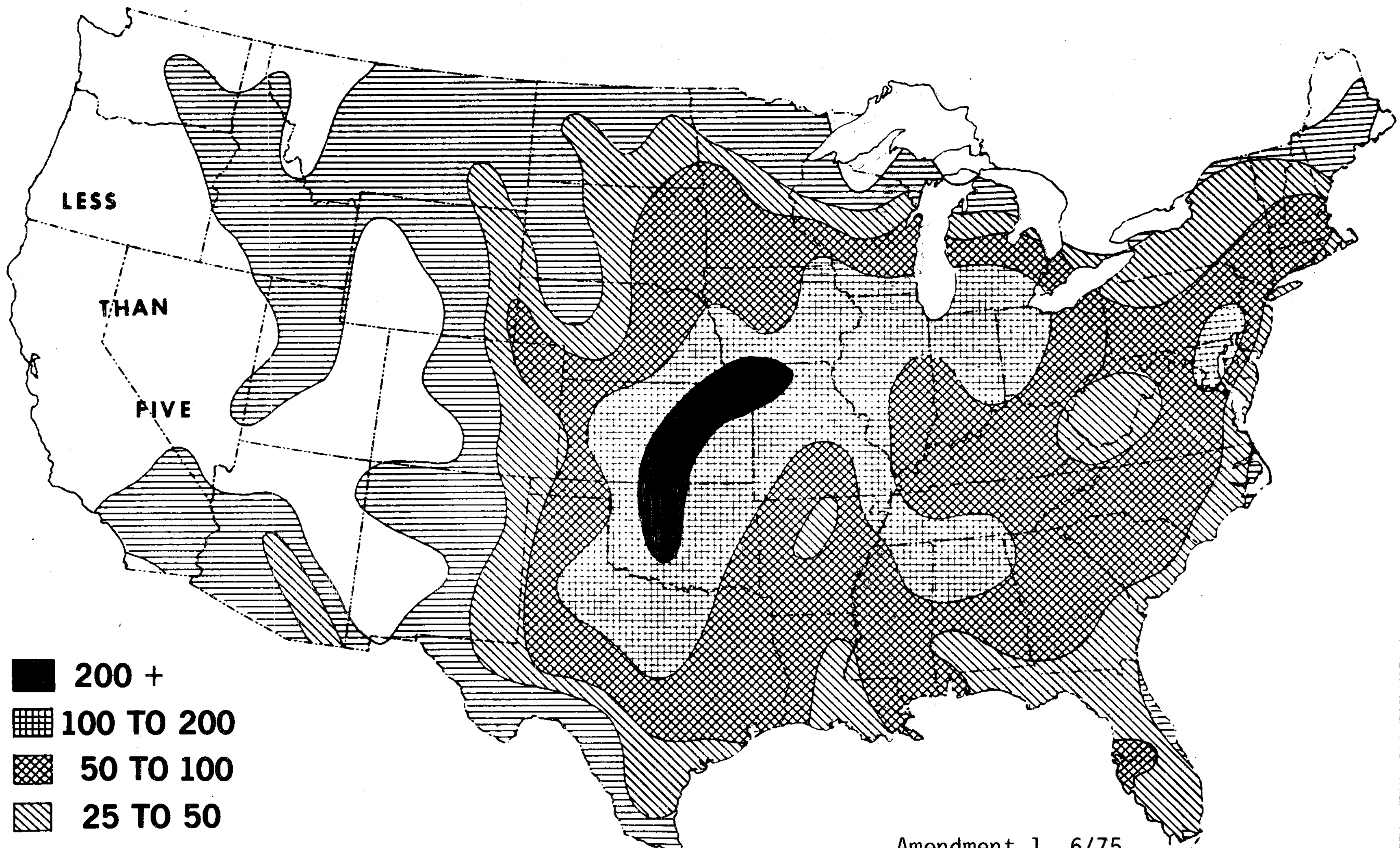
Amendment 1 6/75

GULF POWER Company

GULF POWER CO.
CARYVILLE STEAM PLANT

TOTAL NUMBER OF WINDSTORMS 50 KNOTS AND GREATER, 1955 to 1967, BY 1° SQUARES

FIGURE 2.6-5



Amendment 1 6/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TOTAL WINDSTORMS 50 KNOTS AND GREATER, 1955 to 1967, BY 2° SQUARES

FIGURE 2.6-6

2:7

2.7 Ecology

2.7.1 Terrestrial Ecology

2.7.1.1 Purpose of This Investigation - The purpose of this investigation was to develop background information on the terrestrial ecological systems of Gulf's proposed fossil fuel generating plant site near Caryville, Florida, as required by paragraph 2.7 of the State of Florida, Department of Pollution Control document, "Application of Certification of Proposed Fossil Fuel Electrical Power Generating Plant site." More specifically, this investigation was designed to develop basic and relevant information on biological systems that might reasonably be expected to be impacted by construction and later operation of the power plant. In addition, specific input recommendations were desired as early as possible to assist in developing plant layout and design alternatives.

2.7.1.2 Rationale of Approach - The rationale of approach employed in this investigation was to document characteristics of various terrestrial ecosystem components after giving consideration initially to various engineering activity schedules for site preparation and later to layout and design alternatives. These activities required both spatial and temporal evaluations. A hierarchical approach was employed to estimate types and extent of terrestrial systems which might be impacted by various decisions. Initially, for example, in the hierarchy of approach to study of the plant island proper, the following study steps were performed:

A. Study of site preparation (clearing and grubbing) schedule.

B. Study of plant layout and associated structural conceptions.

C. Study of site aerial photos:

1. Infrared (1 inch: 5,000 feet)
2. Black and White (1 inch: 500 feet)

D. Study of U.S. Geological Survey Quadrangle Map of the 7 and 1/2-minute series.

E. Defining those terrestrial systems for field study which would obviously be impacted by future engineerng activities.

This approach then allowed detailed decisions to be made regarding the design and conduct of field studies. During the course of these studies and as information was developed, sufficient flexibility was maintained in the system to allow continual feedback and updating. Sufficient flexibility in the investigative study process was desired such that as detailed information from field study became available, it could be evaluated for input to engineering activities.

2.7.1.3 Location and General Description of the Site Area, and Physiography - The proposed site is located in Northwest Florida, approximately one mile northeast of the town of Caryville. The upland plant site, bisected by the Holmes-Washington County line, represented approximately 1,500 acres in area at the time of this investigation.

A general appreciation of the physical environment of the region is necessary to develop and present information of various ecological systems and their components and interrelationships. Therefore, a brief description of the area physiography (1) is presented as follows for purposes of developing the necessary background.

The physiography of Washington County and Holmes County may be divided into roughly two units: (a) River Valley Province, including part of Cooke's (1939) Marianna Lowlands, or the Florida Geological Survey's Marianna Chipley Lowlands; and (b) Coastal Plains Province including parts of Cooke's (1939) Western Highlands and Coastal Lowlands Provinces.

The River Valley Province includes the floodplains of the Choctawhatchee River and its tributaries; four depositional alluvial terraces similiar in origin to the present floodplains and related to the present drainage; and tertiary sediments exposed along stream channels and escarpments separating terrace levels.

2.7.1.3.1 River Valley Province - The River Valley Province covers all but the western part of Holmes County and southern part of Washington County. It lies along the main drainage system of the Choctawhatchee River and its tributaries. The ~~Choctawhatchee River~~ marks the western boundary of Washington County and bisects Holmes County in the site area. The floodplain of the River consists of alluvium deposited in a shallow valley formed during an earlier period of downcutting.

The river's head is in ~~northern Alabama~~ and is ~~generally laden~~ with sediment. Sediment is deposited in the relatively still water of the Choctawhatchee Bay, forming a delta. The formation of the delta decreases the gradient and extends alluviation upstream.

Tributaries to the Choctawhatchee River head within the River Valley Province. They are spring fed and flow for the larger part of their courses across limestones. These streams, therefore, carry comparatively little sediment and fill their valleys much more slowly than does the Choctawhatchee River. The more rapid alluviation of the Choctawhatchee River thus dams Pinelog, Holmes, Wrights, and Sandy Creeks where they enter the main valley and form lakes in the lower part of each tributary valley.

2.7.1.3.2 Natural Levees Natural levees are poorly developed along the Choctawhatchee River. In flood periods, the stream tops the channel banks in may areas, spreads out over the floodplain, and deposits its sediment in size and proportion per unit area adjacent to the banks.

With distance from the channel, deposition proceeds slowly. This has produced a gentle slope away from the banks into the floodplain.

2.7.1.3.3 Rim Swamps - Natural levee backslope tends to concentrate water of the floodplain. These lowlands are referred to as rim swamps. The streams, if developed, are referred to as rim swamp streams.

2.7.1.3.4 Tributaries of the Choctawhatchee River - Major tributaries of the Choctawhatchee River are Holmes, Wrights, Sandy, and Pinelog Creeks. The valleys of these streams have been formed chiefly by solutioning of limestone. The streams are chiefly spring fed and, therefore, carry little sediment except during periods of heavy rainfall when surface drainage assumes a dominant role. A thin veneer of alluvium forms the banks. Flats occur on either side of these streams but they are extremely narrow and swamp vegetation may grow down to the banks. The only expression of natural alluviation is the presence of small sand ridges along the channel banks, with the densest swamp in the position of a rim swamp. Seepage into low lying areas often creates streamlets.

The floodplains of the tributary streams are being partially built by the Choctawhatchee River which floods the mouth of the tributary and builds deposits that extend into the tributary. The Choctawhatchee River floodplain may be built up as much as 15 feet higher than tributary floodplains at the same latitude. As a result, tributary streams tend to flow more or less parallel to the river for several miles before gaining entry to the river.

2.7.1.3.5 Stream Terraces - Patches of alluvial material well above the floodplain lie along the major streams of Washington and Holmes Counties. These sediments occur at four definite levels. Each level represents a period of alluvial drowning or river valleys following a period of valley cutting.

By connecting these patches along a projected slope, the longitudinal profile of the former river can be restored. Restoration of these four levels indicates that each has a definite elevation above the floodplain, and, if original surface irregularities and subsequent dissection are disregarded, all the levels are approximately parallel and slope approximately 1.3 feet per mile. These four terraces occur at 10 to 50 feet, 60 to 100 feet, and 145 to 165 feet above the present floodplain.

These valley terraces are remnants of formerly continuous floodplains prior to periods when valleys were cut in them. The older higher terraces are wider than the younger ones indicating a progressive decrease in the valley widths along any given valley cross section.

The 10 to 20 foot surface is the lowest level above the present floodplain of the river. During extremely high stages of the river (one in 20 years), this level is flooded. This surface merges downstream with similar surfaces of tributaries.

The surface is well preserved as discontinuous bands on both sides of the Choctawhatchee River. In central Holmes County a remnant 3.5 miles wide is preserved. Sikes Creek is an accentuated rim swamp stream marking the former position of the old rim swamp. It has little cutting power and drains the surface between the river and the creek.

2.7.1.4 Communities and Ecosystems - A biotic community is any assemblage of population living in a prescribed area or physical habitat; it is a loosely orgainzed unit to the extent that it has characteristics additional to its individual species and population components. Communities have functional unity with characteristic trophic structure and patterns of energy flow (2). This functionality between communities and the nonliving environment is referred to as an ecosystem. Although, the basic units or species of a community may differ from one ecosystem to another, certain basic functions are common to each other. Those species performing the same functions may be referred to as functional units. Different functional units within the same community are linked through energy flow and thus have an energetics base. This concept or unifying theme is represented structurally as a food web or chain. The organization of a food chain is complex but can be divided into general categories of organisms based upon their mode of nutrition. These categories may be referred to as producers, consumers, and decomposers.

2.7.1.4.1 Primary Producers - The primary producers of any ecosystem include all the chlorophyll-bearing plants. This group of organisms convert light energy into chemical energy via the process of photosynthesis. The photosynthetic process may be represented by the following generalized equation:

$$6H_2O + 6CO_2 \xrightarrow[\text{Chlorophyll}]{\text{Light energy}} C_6H_{12}O_6 + 6O_2$$

The reactants in the process -- water and carbon dioxide -- are inorganic compounds and are plentiful in nature. These two compounds are converted to simple sugar (end-product) in the presence of a chlorophyll catalyst and other biochemical machinery within plant cells. Energy for the process is supplied by sunlight. The simple sugar (end-product) is then converted to more complex carbohydrates and organic compounds necessary for plant tissues to perform various metabolic functions, including growth and reproduction. Oxygen, the remaining end-product, is necessary for respiratory reactions of the producers. The net organic material produced by plants is that portion remaining after satisfying those energy demands of the respiratory processes (energy-burning, work-producing step). This net production is then available to be used by various consumers.

2.7.1.4.2 Consumers - Consumers are those organisms which depend directly or indirectly upon plants for their nutritional needs. Plant tissues are eaten by consumers. Organic matter within the tissues of producers is converted by the interal metabolism of the consumer into organic products necessary for carrying out vital functions of growth

and reproduction and work. Oxygen, produced as a by-product of the photosynthetic process in producers, is consumed in the respiratory process (fuel-burning step) of consumers. Carbon dioxide is produced in this reaction which enters into the photosynthetic process as a reactant. Respiration may be represented as the reverse of the photosynthetic equation:

$$C_6H_{12}O_6 + O_2 \xrightarrow[\text{Enzymes}]{\text{Cellular}} 6H_2O + CO_2$$

2.7.1.4.3 Decomposers - Decomposers are those organisms which convert organic matter of both dead producers and consumers to basic organic and inorganic nutrients. This group includes primarily the bacteria and fungi.

2.7.1.5 Diversity - Diversity within biological communities is a measure of species richness. Regulatory mechanisms are numerous in a terrestrial ecosystem. Diversity increases with:

A. An increased variety of niches
B. Narrower niches
C. Environmental stability
D. Less rigorous environment
E. Succession
F. Increased productivity
G. Increased biomass accumulation (3)

The Shannon-Weiner function is a commonly used mathematical equation for expressing diversity (4). The function is:

$$\bar{H} = -\sum P_i \log_2 P_i$$

Where P_i is the ratio of species to individuals.

2.7.1.6 Succession - As vegetation develops on an area, over a period of time, the area becomes successively occupied by different and distinctive plant communities. This process is referred to as plant succession. Within a region, the final stage or climax stage results from this series of changes. A succession of plant communities occurs whether it was initiated on dry sandy soil, rock, water, or in some intermediate condition. A series in succession beginning in open water is referred to as a hydrosere. That beginning in dry conditions, as in bare sand, is referred to as a xerosere. The natural development of both is toward the mesosere or more intermediate condition. Seres on primary areas, i.e., those previously unoccupied by plants are referred to as primary or priseres; those on secondary areas such as lumbered, burned, flooded, or otherwise denuded areas are referred to as subseres. Since soil has already been formed in these areas, succession almost always occurs much more rapidly. Usually, only the medial stage and final stages in succession are repeated. Succession after lumbering in a mixed mesophytic hardwood stand may consist simply of a shrub stage

followed again by the climax forest stage which has reproduced from sprouts around the base of stumps. In burned pine forests, a liverwort-moss stage may quickly be replaced by herbs, and in two or three years by extensive shrub development, and finally by trees. As a consequence of man's use of the land and natural occurrence of fire, subseres in every possible stage of succession constitute the most abundant of all communities. This occurs most frequently in the form of the subclimax; this is partly because this stage persists for a longer period of time than earlier stages, and partly because it is quickly restored by trees and shrubs that form sprouts. In addition, pine tree farming, followed by harvest and replanting, is a means of maintaining subclimax in many areas. In areas that have been settled for long periods, subseres form practically the entire cover of vegetation. Old fields, logged, and burned areas furnish the great majority of subseral communities on the Caryville site. In these instances, they furnish indicators of the degree of disturbance and rate of succession.

2.7.1.7 Climax - Developmental processes have been occurring for such a long period that on well-formed soils, the major portion of an area, if undisturbed, may be covered with stabilized or climax vegetation. The climax system is relatively permanent because of its harmony with a stable habitat; however, the equilibrium is a dynamic one, not static. Superficial adjustments occur with the seasons, drought periods, disease, etc.

Each sere terminates in a climax when a point is reached where the occupation and reaction of the dominant species are such as to exclude the invasion by other dominants. Frequently, however, the climatic climax is not achieved in an area. The development of vegetation may be arrested in the sub-final stage of succession as a consequence of burning, logging, flooding, etc. This stage which is held either artificially or naturally by some factors other than climate is termed a subclimax. It is the stage immediately preceding the climax in all complete seres. These areas are numerous and many examples of subclimax occur on the Caryville site. These subclimaxes have resulted from fire, flooding, logging, and agricultural activities. In many instances, as in the case of pine plantations, these are maintained by periodic clearing of shrubs, followed by fire.

2.7.1.8 Description of the Study Area - The Caryville area lies within the ~~River Valley Province.~~ Sandhills of low relief (maximum elevation ca. 130 feet) occur on site. These are well dissected and, as suggested, may be remnant deposits of formerly continuous floodplains lain down prior to periods when valleys were cut in them. The landscape is dotted with depressions which may contain water only during the wet season or throughout the year. Extensive floodplains border the Choctawhatchee River and its tributary streams in the site area.

Apparent water movement on the site is indicated by observations made during a rainy portion of the year (July through October). Precipitation falls on the sand ridges and quickly percolates into this porous medium.

It apparently follows impervious substructural clay lenses toward lower areas on site. This groundwater may or may not emerge again on the surface. In cases where lateral seepage can accumulate, bayhead and swamp areas have developed. These wet areas may have additional water input from stream flooding if located in or contiguous to the floodplain as in the case of this site.

According to one classification source, vegetational communities on site may be generally referred to as lowlands (5). (See figure 2.7-1.) It is proposed, however, that vegetation be referred to for purposes of this study as the River Valley Lowland Communities since there are relationships which exist between vegetation structure and the physical systems in the site area. This classification is proposed for the following additional reasons:

A. It serves as a basis for relating the abrupt natural community structural differences which occur over a relatively small surface distance in this area.

B. It serves as a basis for understanding the development of this structure and clues to the future successional status.

C. It provides the basis for presenting the functional aspects of the various vegetational subsystems and their relation to one another.

2.7.1.9 Vegetation Communities and Wildlife: Analyses and Description, and Vegetational Community Classifications - Generally, plants within the River Valley Lowland Community have been classified in this study on the basis of adaptation to water availability in their habitat (6).

Vegetational species, through the course of evolution, have become adapted structurally and physiologically to habitats differing widely in moisture content. Hydrophytes, for example, are plants that live wholly or partly submerged in water. Plants inhabiting ponds, streams, and other bodies of water both fresh and marine, as well as those of swamps and wet meadows belong to this group. Plants that live in habitats that neither show an excess nor a deficiency are referred to as Mesophytes. Xerophytes are those plant species that grow where evaporation stress is high and water supply is low. This group is characterized by those species inhabiting sandhills in Florida.

Hydrophytes, mesophytes, and xerophytes are readily distinguishable as groups since they are found in definite habitats and possess characteristic appearances. There are, however, all gradations in form and various degrees of structural adaptation due to intermediate physical conditions which pass gradually one into the other, thus making an absolute correlation between each group and water content very difficult.

For purposes of this investigation, the classifications of hydrophytic, mesophytic, and xerophytic are relative and are used to emphasize and explain biological differences which exist between habitats and their respective communities. The three major vegetational communities on the Caryville site will be as given below:

A. Hydrophytic -
   1. Cypress Bayheads
   2. Bayhead
   3. Mixed Hardwood Swamps

B. Mesophytic -
   1. Mixed Mesophytic Hardwoods
   2. Mesophytic Pine Plantations (Unburned and Burned)

C. Xerophytic
   1. Sandhills
   2. Xerophytic Scrub
   3. Xerophytic Pine Plantations (Unburned and Burned)

Maps of these major vegetational community categories are shown in figures 2.7-2 through -5. These maps are provided for purposes of illustrating the communities relative to topography, figure 2.7-2, plant layout, figure 2.7-3, Florida 1,000 foot Grid System and terrestrial survey plots, figure 2.7-4, and location of rare, protected, or endangered species, figure 2.7-5, as determined during site survey work. Figure 2.7-6 was developed from an aerial photograph of the plant site to show early property boundaries, plant layout, and surrounding area with locations of terrestrial survey plots and the Florida Grid System. Present proposed property boundaries and "projected impact areas," together with terrestrial survey plots, are shown in this figure. The "projected impact area" consists of approximately 400 acres, and is southwest of the plant site proper and adjacent to the Choctawhatchee River within which a proposed intake - treated waste water discharge pipeline will be located. The influence of the pipeline is expected to occur only along a narrow corridor within this area and not over the entire area shown.

2.7.1.9.1 Hydrophytic (Hydric) - Hydrophytic communities are those communities whose species assemblages and structural characteristics are adapted for survival in soils subject to periodic or constant inundation by water (7). The soil substrate in Florida generally consists of heavy clays and organic soils which are poorly drained. According to one source (8), three major types of hydric forests exist in northcentral Florida: cypress swamps (cypress bayheads), bayheads, and mixed hardwood swamps.

2.7.1.9.1.1 Cypress Bayhead Vegetational Community - Cypress bayhead make up 6.1 percent of the property owned by Gulf and 6.8 percent of the projected impact area. (See table 2.7-1.) The area of impact would include the property owned by Gulf in addition to that area to be affected by associated construction activity outside the immediate plant island

area west to the Choctawhatchee River. (See figure 2.7-6.) Cypress bayheads generally are located over an impervious clay lens in areas of low topography (9). In the study area, they occurred as shallow depressions at elevations of 80 to 90 feet. (See figure 2.7-2.) Standing water 80 centimeters (cm) in depth was present with approximately five to 10 cm of organic material deposited on the surface of a solid sandy clay bottom. High water marks indicated depths to one meter (M) have occurred in the recent past. Water chemistry parameters measured in cypress bayhead communities included pH, dissolved oxygen (DO), and conductivity. These values averaged 5.3, 2.1 milligrams per liter (MG/L), and 42.5 micromhos/cm squared, respectively. Overall canopy cover was estimated to be 40 percent. (See figure 2.7-7.) Succession in cypress bayheads leads to either bayheads or mixed hardwood swamp, (7, 10). Except for the cutting of a few larger pond cypress trees (Taxodium ascendens), eight to 10 inches diameter at breast height (DBH), approximately 10 years ago, this area remains virtually undisturbed. The vegetational components are visible in figures 2.7-8 through -11.

The idealized vegetational profile, figure 2.7-12, was developed for the dominent trees i.e., taxa with importance values of 10 percent or greater (11).

2.7.1.9.1.1.1 Trees - The tree component was composed of three species, 138 individuals, and had a species diversity index (H) of 0.9590. The dominant trees were pond cypress (Taxodium ascendens), 53.9 percent; white titi (Cyrilla racemiflora), 28.1 percent; and swamp tupelo (Nyssa biflora), 18.0 percent. This information is given in table 2.7-2. (See also table 2.7-3.)

A. Pond cypress (Taxodium ascendens Brongn.) - Pond cypress is a tree of small to medium size, 10 to 20 feet in height, usually with a buttressed base and rounded or blunt "knees." It occurs throughout northern Florida in flatwood ponds and on lake margins (12). Pond cypress is usually found on sites with lower pH values and lower calcium concentrations than is bald cypress (Taxodium distichum) (8, 9). Pond cypress is a dominant of the cypress bayhead community (7, 9, 10).

B. White titi (cyrilla racemiflora L.) - White titi is a shrub or small tree up to 15 feet in height, and frequents the borders of swamps and bays throughout northern Florida (12).

C. Swamp tupelo (Black gum) (Nyssa biflora Walt.) - Swamp tupelo is a large three 30 to 90 feet in height, and occurs in swampy, low-lying areas. Buttressed trunks develop when growing in inundated areas. It is found in flatwoods, shallow ponds, non-alluvial swamps, and bays throughout northern Florida (12). Swamp tupelo has been shown to increase in importance in cypress bayhead communities as calcium increases in concentration (9). It is found in association with both pond cypress and bald cypress, although these two cypresses rarely occur together (9).

2.7.1.9.1.1.2 Shrubs and Small Trees - The shrub small tree component was composed of seven species, 29 individuals, and had a species diversity index of 1.6647. The dominant shrubs were seamp leucothoe (Leucothoe racemosa), 34.9 percent; fetterbush (Lyonia lucida), 31.2 percent; and vine wicky (Pieris phillyreifolia), 14.5 percent. This information is given in table 2.7-4. Shrubs were generally confined to buttresses of old pond cypress stumps.

A. Swamp leucothoe (Leucothoe racemosa (L.) Gray) - Swamp leucothoe is a medium sized deciduous shrub five to 12 feet in height. It grows along the banks of streams, ponds, and in swampy thickets south to Florida (13).

B. Fetterbush (Lyonis lucida (Lam.) K. Koch) - Fetterbush is a medium sized evergreen shrub, three to six feet in height, and is distinguished by its three-sided stems. It grows in moist pinelands, swamps, and peaty thickets south to Florida (13).

C. Vine wicky (Pieris phillyreifolia (Hook) D.C.) - Vine wicky is a vinelike evergreen shrub frequently growing beneath the outer bark on the trunks of cypress trees to heights of 20 to 30 feet. It grows in swampy areas and ponds in northern Florida (13).

2.7.1.9.1.1.3 Herbs and Grasses - The herb and grass component was absent due to the presence of standing water.

2.7.1.9.1.2 Cypress Bayhead Faunal Community - The following faunal components of cypress bayhead communities were captured and/or observed within the immediate Caryville site property boundaries:

2.7.1.9.1.2.1 Reptiles and Amphibians

A. Eastern cottonmouth (Agkistrodon piscivorus piscivorus) - A poisonous, thick-bodied, broad-headed snake with keeled scales, a loreal pit between each eye and nostril, and no rattle on the tail; average length of adults about one M; coloration may be olive, brown, or black above with a lighter belley. Cross-bands above are evident in young and sub-adults; old adults may be completely dark and unpatterned.

Young may be confused with young copperheads (Agkistrodon contortrix) because of similar coloration and pattern to the Eastern Cottonmouth, but possess a broad dark band through the eye. This band is lacking in copperheads. Adults are often confused in the field with water snakes (Natrix); behavior offers some of the best clues. Cottonmouths often stand their ground or crawl slowly away. Water snakes usually flee quickly or drop with a splash into the water. A thoroughly aroused cottonmouth throws it head upward and backward and holds its mouth wide open, revealing a white interior, thus origin of the name cottonmouth. The cottonmouth is a live bearer (ovoviviporous). Adults mate in March and the young are born in

late August through early September. The number in a brood varies from five to 15 with an average of about eight. Length of the young ranges from 150 to more than 250 mm (14). Foods of cottonmouth include fish, frogs, salamanders, snakes, lizards, small turtles, baby alligators, birds and small mammals. Predators of the Cottonmouth include predaceous birds, other snakes, and man.

Florida Range: Throughout wet areas of Mainland Florida.

B. Banded water snake (Natrix sipedon) - A non-poisonous, heavy-bodied, dark snake with obvious cross-bands along the entire length of the body above keeled scales, and no loreal pit between eye and nostril; average length of adults is about one M. This banded water snake is a live bearer (ovoviviporous). Adults mate in early spring and the young are born in late summer and early fall. Broods range from 16 to 40 young with an average of about 31; length of young at birth averages about 225 mm (14). Foods of banded water snakes include fish, frogs, tadpoles, and salamanders. Predators include predaceous birds, racoons, opossums, other snakes, and alligators.

Florida Range: Wet areas of Northern Florida reaching into the peninsula as far south as Marion County (15).

C. Yellow-bellied turtle (Pseudemys scripta scripta) - A short, rough, high-shelled, principally aquatic turtle. A yellow blotch behind the eye is the most conspicuous field mark, but this is strongly evident only in the young and females. Vertical yellow bands on the carapace show best when the shell is wet. Vertical stripes on "seat of the pants," narrow yellow stripes along the front surface of the forelegs, and yellow underside are good field characters.

Florida Range: Northeastern Florida from Alachua and Levy Counties westward to the Apalachicola drainage (15).

D. American alligator (Alligator mississippiensis) - A huge, rough-backed, lizard-shaped reptile with a broad rounded snout. The back is covered by several rows of keeled, bony scales placed end to end in longitudinal series; ventral scales are smooth and flexible. The tail is strongly compressed and crested dorsally. Adults attain a maximum length of between 4.5 and 5.5 M and an age of 56 years (14). Both adults and young are capable of audible sounds. This is particularly true in the case of the male, during the spring of the year when the deep dark and bellow of the mating call may be heard. A typical alligator habitat in the study area is shown in figure 2.7-13.

American alligators lay large, hard-shelled eggs. The female scoops up mud and vegetation with her jaws to build a mound about 90 cm high and 150 to 210 cm wide ~~wide~~ at the base. She deposits 20 to 70 eggs in a hollow in the center and covers them over with material

from the rim of the nest. She remains on guard nearby for nine to 10 weeks until the young are heard peeping loudly and ready to emerge. She then tears open the nest, allowing them to escape. Both males and females average a little more than one foot increase in length per year up to and including the fifth year. This annual increase in growth in the males will continue at least to the ninth year. After the fith year, the females grow much more slowly (16).

Foods of american alligators include fish, mammals, birds, frogs, tadpoles, and insects. Invertebrates comprised 98 percent by volume of the total stomach contents (17) of young alligators. The stomach of the alligator is muscular and functions much as does the gizzard of a bird and, like a bird, alligators swallow hard objects to aid in grinding up the stomach contents. Alligator stomachs have been found to contain Coca-Cola bottles, bottle tops, the brass portions of shotgun shells, and "lightered knots" (hard knots of resinous pine). Predators of the alligator include other alligators, racoons, water moccasins, and man.

Range and Status: The alligator is the most northern in distribution of all the crocodilians and is found in the southeastern United States and in southern China. Because the american alligator yields a very sturdy and beautiful leather, it has been widely hunted for its hide. Draining and filling of swamps has lead to the destruction of its habitat in the past. The american alligator has been classified as endangered in the U.S. "Endangered Species Act of 1973." In Florida, the american alligator is common in occurrence with an increasing population trend and statewide distribution. Retention of habitat and elimination of conflict with people are known conservation needs (18). Distribution of the alligator in the Caryville study area is shown in figure 2.7-5.

E. Southern leopard frog (Rana pipiens sphenocephala) - This is a slim, narrow-headed, long-legged, spotted frog with dorsolateral folds present. General coloration is green or brown or a combination of both with a whitish belly. Field characters which distinguish this species from the northern leopard frog (Rana pipiens pipiens) are: light spot in center of tympanum; longer, pointed head; and only a few spots on sides of body. Adult southern leopard frogs range from five to 10.0 cm in length. The breeding call is a very harsh and guttural croak. Croaks are suggestive of the sound made by rubbing the stretched rubber of a toy balloon. Adults breed during any month in the south.

Florida Range: State-wide (15).

F. Florida cricket frog (Acris gryllus dorsalis) - This is a tiny, active, sharp-headed frog with two distinct dark stripes on the back of the thigh. Adult length is less than two cm. Breeding call of adults is a rattle or metallic "click" in rapid succession. Adults breed during any month of the year.

Florida Range: State-wide, except for the western panhandle (15).

G. Common cricket frog (Acris gryllus gryllus) - This is a tiny, active, sharp-headed frog which may be separated in the field from the Florida cricket frog (Acris gryllus dorsalis) by the presence of a single dark stripe on the back of the thigh. Length of adults is two cm or slightly more. Breeding call of adults is a rattle or metallic "click" occurring in a rapid succession. Adults breed from February to October, the actual time depending largely upon rains.

Florida Range: The western panhandle from Leon County westward (15).

H. Dusky salamander (Desmognathus fuscus) - This is a rather small, brownish to blackish salamander with a light streak from the eye to the angle of the jaws, nasolabial grooves, and rounded snout and head. The body is moderately stout. Adult length is about 10 cm. Adults lay eggs on land rather than in water. The eggs are deposited in small clusters, in shallow excavations in soft earth, within beds of sphagnum moss, or beneath logs. Each egg cluster contains from nine to 19 eggs and is located generally 30 to 100 cm from the water. Young are 16 to 20 mm in total length upon hatching. They do not go to the water at once, but remain in the nest with the adult female, exhibiting definite terrestrial adpations. After one or two weeks, the new young enter the water to exist as aquatic larvae until they are seven to nine months old. They are about 45 mm in length at the time of metamorphosis (14).

Florida Range: West to Apalachicola River basin and southward to Alachua County. Often found near cypress ponds or in stagnant or nearly stagnant pools; the environment may be muddy and slightly acidic (15).

2.7.1.9.1.2.2 Birds

A. Rusty blackbird (Euphagus carolinus) - This is a medium sized blackbird with light eyes; base of bill more slender as compared to other blackbirds. The rusty blackbird is a winter visitor and confined almost entirely to the river swamps (19).

B. Pileated woodpecker (Dryocopus pileatus) - This is a large woodpecker with white on the sides of the neck, a black back as seen in repose, and a red crest on the head; distinguished from the almost extinct ivory-billed woodpecker by not having extensive white on the wings and a dark bill. The pileated woodpecker is a resident; formerly common, now uncommon, though good numbers can sometimes be found in the larger river swamps (19).

C. Great horned owl (Bubo virginianus) - This is a very large "eared" owl with a belly that is finely barred horizontally; carnivorous, preying principally on small mammals. The great horned owl is an uncommon-to-rare resident (19).

D. Little blue heron (Florida caerula) - This is a small dark heron with dark slatey-blue back and underparts. The head and neck are reddish brown. The little blue heron is an uncommon summer resident (19).

E. Great blue heron (Ardea herodias) - This is a very large dark heron with head largely white and with dark underparts. The top of the head also has a black streamer and the anterior portion of the neck has vertical bars or spots. When hunting, the great blue heron walks slowly through shallow water or stands perfectly still with its head hunched on its shoulders. The great blue heron is a resident, uncommon in summer and more numerous in winter (19).

F. Common egret (Casmerodium albus) - This is a large white egret with a yellow bill. The legs and feet are glossy black. The common egret is similar to the great blue heron (Ardea herodias) in size and stature. It differs in being white in color and holding its neck in an "s" shape. The common egret is primarily a resident of the coastal area; it is most common is spring, uncommon is summer, and rare in winter (19).

2.7.1.9.1.2.3 Mammals

A. Raccoon (Procyon lotor) - Yellowish-white rings on the tail and a black mask covering the eyes are distinguishing marks of this nocturnal mammal. Adults range in body length from about 430 to 615 mm for males and 385 to 500 mm for females (20). Raccoons may weigh (21) from 1.8 to 22.2 kilograms (KG). The black and buff-colored tail is about 42 to 52 percent of the body length. Raccoons are willing to eat almost anything they find (omnivorous); they usually dip their food in water before eating since the raccoon has very little saliva. Foods include fish, birds, terrestrial and aquatic invertebrates, vegetable matter, and various grains. Predators of the raccoon include larger carnivores such as dogs, bobcats, owls, hawks, and man; adult males raccoons have been known to eat the very young.

Florida Range: State-wide.

B. Opossum (Didelphis marsupialis) - This well known nocturnal mammal of the eastern United States is about the size of a housecat, has a grizzled gray pelage of long hair, a white head, black legs, relatively naked tail, naked ears and a piglike snout. Adults range from 380 to 500 mm in body length and weigh from 1.36 to 2.7 KG (22).

The opossum rarely prepares a den of its own but utilizes some natural cavity in the ground or other animal's burrow in which to build a nest of dried leaves and grasses. The nest material is gathered in a rather unique way: "The opossum gathers a mouthful of nest material, passes it under the body with its forefeet, then the curved tail grabs it and transports it to the den site" (23). Adults generally breed from January through October. The female comes into heat at 28-day intervals and bears two litters per year. After a gestation period of about 13 days, the young are born. They are so small that about 20 individuals can fit into a teaspoon. The average number of young born is about nine. The development rate is very slow. At the end of 30 days, the young are only about the size of a small mouse; after about 60 days, the young just begin to leave the pouch (23).

Opossums are willing to eat almost anything they can find. Foods include fruits, nuts, terrestrial and aquatic invertebrates, dead animals, birds, snakes, fish, and frogs. The opossum is preyed upon by larger carnivores such as dogs, owls, hawks, bobcats, and man. One of the worst enemies of the opossum is the automobile.

Florida Range: State-wide.

~~2.7.1.9.1.3 Bayhead Vegetational Community~~ - Bayheads make up 18.7 **percent of the property** owned by Gulf and 15.0 percent of the projected impact area. (See table 2.7-1.) Bayheads are located on seasonally flooded acidic soils high in organic matter (10). In the study area, these communities occurred at the lower elevations, usually less than 76 feet, figure 2.7-2. Water depth in these bayheads varied from zero to six feet. The bottom substrate was composed of coarse-grained sand with an upper layer of decaying leaves, 0.5 to 4.5 feet thick. Water chemistry parameters measured included ~~pH, DO, and conduc~~tivity. These values were ~~4.8, 0.60 MG/L, and 35~~ micromhos/cm squared, respectively. Bayheads occupy (24) sites of low calcium and magnesium concentrations. Calcium/magnesium and calcium/potassium ratio, pH, and depth of maximum flooding are documented (24) to be lower in bayheads than the mixed hardwood swamp community. Overall canopy cover was estimated to be 60 percent. (See figures 2.7-14 and -15.) Bayheads develop from bogs, marshes, swamps, and low pine flatwoods (10). They are normally dominated by broadleaved evergreen trees (25). Bayheads and mixed hardwood swamps are considered the climax communities in areas that are seasonally flooded (24). Bald cypress (*Taxodium distichum*) had been harvested from the bayhead community within the study area. Stumps indicated the trees were 12 to 18 inches DBH and 60 to 80 years old when cut. Other than these occasional cut stumps, the bayhead community is relatively undisturbed.

Vegetational components of the bayhead community are illustrated in figures 2.7-16, throuth -20. An idealized vegetational profile was developed for dominant trees and is shown in figure 2.7-21.

2.7.1.9.1.3.1 Trees - The tree component was composed of eight species, 198 individuals and had a species diversity index, ($\bar{H}$), of 1.5291. The dominant trees were swamp tupelo (Nyssa biflora), 47.0 percent; sweetbay magnolia (Magnolia virginiana), 21.2 percent; and white titi (Cyrilla racemiflora), 12.7 percent. (See table 2.7-2.)

A. Sweetbay magnolia (Magnolia virginiana L.) - Sweetbay magnolia is a large evergreen tree up to 90 feet in height. It is found in bays and swamps throughout northern Florida (12). Sweetbay magnolia is a dominant (10) of the bayhead community.

2.7.1.9.1.3.2 Shrubs and Small Trees - The shrub/small tree component was composed of 17 species, 575 individuals, and had a species diversity index, ($\bar{H}$), of 1.8108. The dominant shrubs were fetterbush (Lyonia lucida), 36.4 percent; white titi (Cyrilla racemiflora) 11.0 percent; virginia willow (Itea virginica), 10.4 percent; and swamp leucothoe (Leucothoe racemosa), 9.9 percent. (See table 2.7-4.)

A. Virginia Willow (Itea virginica L.) - Virginia willow is a medium sized deciduous shrub three to eight feet in height. It grows in swamps and along streams south to Florida (13).

2.7.1.9.1.3.3 Herbs and Grasses - The herb and grass component was absent due to the presence of standing water.

2.7.1.9.1.4 Bayhead Faunal Community - The following faunal components of the bayhead communities were captured and/or observed within the immediate Caryville site boundaries:

2.7.1.9.1.4.1 Reptiles and Amphibians

A. Rough green snake (Opheodrys aestivius) - This is a small, narrow, bright-green snake with keeled scales; average length about 700 mm. The rough green snake is an excellent climber. When foraging amid vines or shrubs, it blends well with its surroundings, making it very obscure. It is referred to as the "vine snake." Foods include crickets, grasshoppers, lepidopteran larvae, spiders, and small frogs.

Florida Range: State-wide (15)

B. Eastern cottonmouth (Agkistrodon piscivorus piscivorus)
C. Banded water snake (Natrix sipedon)
D. Southern leopard frog (Rana pipiens sphenocephala)
E. Florida cricket frog (Acris gryllus dorsalis)
F. Common cricket frog (Acris gryllus gryllus)

2.7.1.9.1.4.2 Birds

A. Common grackle (Quiscalus quiscula) - This is a medium to large sized blackbird with a green, blue, or violet irridescent head and a long keel-shaped tail, broad at the end. The common grackle is a frequent-to-abundant resident from March to September, uncommon from November through January (19).

B. Blue jay (Cyanocitta cristata) - This is a medium sized blue-winged jay with white on wing and tail; it has crested head feathers. The blue jay is an abundant resident common in oak and pine woods; it does migrate (19).

C. Rufous-sided towhee (Pipilo erythrophtalmus) - This is a colorful sparrow-sized bird with rufous or rusty coloration on its sides, white belly, black back, and large rounded tail with white spots; common in heavy brush and hardwood stands. The rufous-sided towhee is a summer and winter resident and is now present in reduced numbers in northwest Florida (19).

D. Rusty blackbird (Euphagus carolinus)
E. Pileated woodpecker (Dryocopus pileatus)
F. Great horned owl (Bubo virginianus)

G. Black vulture (Coragyps atratus) - This is a very large black bird with a black head and white patches on the underside of the wing tips; it feeds upon carrion. The black vulture is a year-round resident (19).

H. Little blue heron (Florida caerula)
J. Great blue heron (Ardea herodias)

2.7.1.9.1.4.3 Mammals

A. Raccoon (Procyon lotor)
B. Opossum (Didelphis marsupialis)

2.7.1.9.1.5 Mixed Hardwood Swamp Vegetational Community - Mixed hardwood swamps do not occur on the property owned by Gulf; however, they comprise 10.1 percent of the projected impact area. (See figure 2.7-6.) Mixed hardwood swamps are located along creeks, rivers, sloughs, and basins that are seasonally flooded (24). In the study area, this community occurred along the Choctawhatchee River eastward through the rim swamp to approximately the 50 feet elevation. Slow moving, shallow drainage streamlets, zero to eight inches in depth, are present near the rim swamp stream. The rim swamp stream was approximately one foot deep and filled with slow-moving stagnant water. High water marks on the trees indicated inundation to depths of six to seven feet have occurred in the recent past. The substrate was clay/sand with the water table frequently lying at or very near the surface as indicated by

seepage. Overall canopy cover was estimated to be 80 percent. (See figure 2.7-22.) Mixed hardwood swamps may develop from cypress bayheads, are dominated by broad-leaved deciduous trees, and, along with bayheads, are the climax community of seasonally flooded areas. This community is considered an "arrested subclimax" due to physical conditions rather than climate. Mixed hardwood swamps are characteristic of sites where peat does not accumulate, while bayheads are characteristic of peaty areas (10, 24). Other than the constuction of a logging road through this area 50 to 80 years ago, the mixed hardwood swamp community is undisturbed. Vegetational components of the hardwood community are illustrated in figures 2.7-23 through -28.

A vegetational transect of the mixed hardwood swamp was developed. An elevational profile of this community was prepared at 10 M intervals. Dominant tree taxa were recorded as shown in figure 2.7-29. This profile is indicative of relative moisture tolerance of the various component species within the hardwood swamp community.

2.7.1.9.1.5.1 Trees - The tree component was composed of 10 species, 83 individuals, and had a species diversity index, ($\overline{H}$), of 2.0438. The dominant trees were green ash (Fraxinus pennsylvanica), 22.3 percent; swamp tupelo (Nyssa biflora), 21.4 percent; and red maple (Acer rubrum), 10.7 percent. This information is shown in table 2.7-2.

A. Green ash (Franxinus pennsylvanica marsh) - Green ash is a large deciduous tree 30 to 60 feet in height, usually with a single trunk which is buttressed when growing where inundated for long periods (12). It is found on the rich soils of bottom lands and stream banks in northern Florida (12, 26).

B. Red maple (Acer rubrum L.) - Red maple is a small-to-large tree, 20 to 70 feet in height, which occurs in woodlands on moist to very wet sites throughout northern Florida (12). It is an important member in the developmental stage of many forest types (26).

2.7.1.9.1.5.2 Shrubs and Small Trees - The shrub component was not analyzed in this community.

2.7.1.9.1.5.3 Herbs and Grasses - The herb/grass component was not analyzed in this community.

2.7.1.9.1.6 Mixed Hardwood Swamp Faunal Community - The following faunal components of mixed hardwood swamp communities were captured and/or observed:

2.7.1.9.1.6.1 Reptiles and Amphibians

A. Eastern cottonmouth (Agkistrodon piscivorus piscivorus)

B. Ground skink (Lygosoma laterale) - This is a very small, smooth, golden-brown lizard with a dark stripe above, about 50 mm in length. This small skink also has a "window" in the lower eyelid in the form of a transparent disc through which it may see when the eye is closed. The ground skink quietly but nervously searches for small terrestrial invertebrates among leaves, decaying wood, and detritus. When running, it makes a lateral, snakelike movement. In taking refuge, when approached, the ground skink will dart beneath the nearest shelter or even enter shallow water to escape; it seldom climbs.

Florida Range: State-wide (15).

C. Carolina anole (Anolis carolinensis carolinensis) - This is a slender aboreal lizard capable of changing colors from a green hue to mottled green and brown or to brown altogether; average length is about 100 mm. The carolina anole is commonly referred to as the "chameleon" and may be found for sale in pet shops. Male carolina anoles extend a red dewlap or throat fan during courtship. Many softshelled eggs are laid from March through August (20). Food includes terrestrial invertebrates such as adult and larvae butterflies, crickets, and spiders.

Florida Range: State-wide (15).

D. Southern toad (Bufo terrestris terrestris) - This is a good sized, stubby, warty toad with pronounced knobs and high cranial crests giving the head a strongly sculptured appearance. Adults appear almost "horned" in profile; maximum length about 80 mm. General coloration is usually some shade of brown, but variable from red to black. A light mid-dorsal stripe may or may not be present. Southern toads become most active at twilight, foraging well into the night for food. Daylight hours are spent in burrows of the toad's own making. Breeding takes place from March to October in shallow water, depending on locality and weather conditions (27). The breeding call of males is a rapid shrill musical trill.

Florida Range: State-wide (15).

E. Southern leopard frog (Rana pipiens sphenocephala)
F. Common cricket frog (Acris gryllus gryllus)

G. Eastern narrow-mouth toad (Microhyla carolinensis carolinensis) - This is a small, rather squatty, smooth-skinned, narrow-headed frog with the underside strongly pigmented and a fold of skin across its nape; average size about 25 mm. Eastern narrow-mouth toads are fossorial, preferring areas which offer both shelter and moisture. The breeding call of the male sounds much like an electric buzzer and lasts for about one or two seconds. Breeding sites are chiefly in shallow water but deep-water situations also are used if covered by a dense floating mat of vegetation. Breeding usually occurs between early April and October, initiated by heavy rains (27).

Florida Range: State-wide (15).

H. Green tree frog (Hyla cinerea cinerea) - This is a generally lime green brightly colored slender frog with a lateral white or yellowish stripe usually extending from the head below the eye to the groin; average length about 40 mm. Coloration is quite variable from nearly yellow when the frog is calling to greenish or slate-gray when inactive during cooler months of the year. Green treefrogs rest during the day and forage at night. The resting sites they choose during the day are often exposed to broad daylight. They commonly feed on nocturnal insects swarming around artificial lights. The breeding call of males has a ringing twang much like plunking the last string on a banjo. Breeding calls generally begin in March and continue through October, particularly during periods of rain. A breeding chorus may be composed of several hundred males sounding much like a pack of baying hounds.

Florida Range: State-wide (15).

I. Common tree frog (Hyla versicolor versicolor) - This is a rather stocky, rugous-looking or warty frog; generally mottled gray with orange pigment on the back of the thighs; and average length about 50 mm. Like the green tree frog (Hyla cinera cinera), the common tree frog is quite variable in coloration from gray-brown to pearl-gray or even white. Common tree frogs are principally arboreal and nocturnal. They forage on flying insects in small trees and aquatic shrubs. Breeding occurs from April through August, particularly during periods of rainfall. The breeding call of males may be best described as a short trill, loud and resonant, of one to three seconds duration, and suggestive of the call of a redbellied woodpecker (27).

Florida Range: Southward to Marion County, Westward to Jackson County (15).

J. Dwarf salamander (Manculus quadridigitatus) - This is a small, slender, brownish salamander with four toes on the hind feet and possessing naso-labial grooves: adults about 100 mm in total length. Naso-labial grooves of males extend into cirri, resembling barbels. Dwarf salamanders forage in low swampy areas under logs and in decaying detritus in search of food. When mating, several males may be found with a single female.

Florida Range: Northern and western Florida, southward through the Gulf Hammock region to Dixie County (15).

K. Red-bellied snake (Storeria occysitomaculata) - This is a small, light brown snake with a light collar across the neck and plain pinkish to red underside; average length about 225 mm. The

red-bellied snake is very secretive, and is common in some areas and absent from other areas of identical habitat. The red-bellied snake is often found in or near open woods, but also occurs in or near sphagnum bogs from seal level to the mountains (27).

Florida Range: Northern to Central Florida (15).

L. Common glass snake (Ophisaurus ventralis) - This is a stubby, slick-looking, speckled snakelike lizard with no legs; total length from 45.5. cm to 92.5 cm; only the glass lizard may look green (27). No mid-dorsal dark stripe is present as in a similar species, the coastal glass snake (Ophisaurus compressus). Common glass snakes are very quick when pursued. They are characteristically an inhabitant of wet meadows, grasslands, and pine flatwoods (27).

Florida Range: State-wide (15).

M. Coastal glass snake (Ophisaurus compressus) - This is a stubby, slick-looking snakelike lizard with numerous distinct vertical bars on the neck, a dark mid-dorsal strip and no legs; total length from 37.5 to 60.0 cm.

Florida Range: Peninsular Florida (15).

N. Gulf coast box turtle (Terrapene carolina major) - This is a relatively large, high-domed, land turtle with variable markings above, usually reduced; length of adults about 160 to 170 mm. This box turtle is very similar to the common box turtle (Terrapene carolina carolina), with the exception of possessing a flared posterior margin of the carapace.

Florida Range: Coast of the Florida panhandle from about the region of Cape San Blas westward (15).

O. Three-toed box turtle (Terrapene carolina triunguis) - This is a generally small, narrow-shelled, sometimes colorful land turtle with orange or yellow spots conspicuous on both head and fore limbs; adult length about 140 mm. This species may or may not have three toes.

Florida Range: The Tallahassee area northward to the Georgia line (15).

P. Loggerhead musk turtle (Sternothaerus carinatus) - This is a small, bronwish, aquatic turtle with a relatively domed shell, spotted or mottled head, and barbels on the chin.

Florida Range: The panhandle and upper part of the peninsula southward to Lake County (15).

Q. Chicken turtle (Deirochelys reticularia) - This is a medium sized aquatic turtle with a dark shell; long, strongly stripped neck; and yellow vertically stripped front and rear legs; adult length about 130 mm.

Florida Range: State-wide except the Keys (15).

2.7.1.9.1.6.2 Birds

A. Common grackle (Quiscalus quiscula)
B. Blue jay (Cyanocitta cristata)
C. Pileated woodpecker (Dryocopus pileatus)

D. Red-bellied woodpecker (Centurus carolinus) - This is a medium sized woodpecker with a red cap and nape (not entire head) and horizontal black and white bars or "ladders" on the back. The red-bellied woodpecker is a common resident of woodlands; two broods are regularly reared in a season (19).

E. Great horned owl (Bubo virginianus)

2.7.1.9.1.6.3 Mammals

A. Raccoon (Procyon lotor)

B. Beaver (Castor canadensis) - This is a large aquatically adapted rodent with webbed feet and a wide dorsoventrally flattened tail; body length ranges from 550 to 860 mm (20). Beavers are aquatic, living in ponds streams and rivers near stands of woody vegetation. They often create "beaver ponds" by damming moving bodies of water with mud, sticks, trees, and debris. Beavers either construct dome-shaped mounds (lodges) of the same material upstream from the dam or simply dig a den into the bank of large lakes and rivers. The beaver does not make conspicuous sounds, but when excited or alarmed, he dives and makes a resounding splash with his tail, warning others of danger. A beaver can swim up to 750 M underwater and can remain submerged for slightly more than five minutes (30). Foods consist primarily of bark and leaves of woody vegetation. Predators include larger carnivores such as dogs, bobcats, and alligators. Man values the pelt of beavers for fur. This was particularly true in the past when beavers were more numerous and extensively hunted by fur traders. Beavers generally breed from January through February. The gestation period is from 42 to 128 days; they have one to six young per litter with three being the usual number. Beavers do not reach sexual maturity until the second year after birth. The maximum life span has been reported as 19 years (30).

Florida Range: State-wide.

C. Muskrat (Ondatra zibethica) - This is a large aquatic rodent with soft dense fur; short ears; and a more or less long, naked, laterally compressed tail; body length may exceed 300 mm. Muskrats build mounds of matted vegetation packed with mud near the water's edge on boggy ground or in shallow water. Mounds are made up of marsh grasses and sedges heaped up as high as 3.5 M. Muskrats also construct floating, feeding platforms of matted vegetation. Burrows into the bank may also be constructed for dens and/or temporary refuges. Foods include aquatic plants, roots, and mollusks. Muskrats are territorial and build scent posts of piled vegetation to mark territory. Breeding occurs from April through October. The gestation period lasts about 30 days. Generally there are two litters per year with seven young per litter; sexual maturity is reached at one year of age (30). The life expectancy of muskrats is very short. Predators include large carnivores such as bobcats, owls, and alligators. Man has also sought the muskrat for its fur. Only tracks and runways were observed in the Caryville site study area. Signs of the muskrat may be confused with those of the Florida water rat described below.

Florida Range: Unknown.

D. Florida water rat (Neofiber alleni) - This is a rather large semi-aquatic rodent with a long rounded tail and very small ears mostly hidden in fur; body length averages about 200 mm. Florida water rats build mounds from 30 to 60 cm high of matted vegetation for homes. These mounds are generally located on boggy ground and have two entrances. Paths or runways may also be seen between shallow bodies of water and in dense vegetation along the shore. Foods include stems and roots of aquatic vegetation.

Florida Range: Peninsular Florida west to Carrabelle,and north to Okefinokee Swamp (20).

2.~~7.1.9.2 Mesophytic (Mesic)~~ - Mesophytic communities are those communities which are characterized by soil that has a favorable and relatively stable moisture content. Floral components of mesophytic communities are a more evident product of successional status than hydrophytic or xerophytic community components. The soil may or may not have as great a capacity for retaining organic matter as either hydrophytic or xerophytic, but is subject to less environmental stress from flooding or temperature extremes. The soil substrate is characterized by mixed decaying organic matter overlain with loose leaf litter and detritus. Mesophytic communities generally have heavier ground cover, more complete canopy cover, and a higher diversity of flora and fauna than hydrophytic and xerophytic communities (10).

2.7.1.9.2.1 Mixed Mesophytic Hardwood Vegetational Community - Mixed mesophytic hardwood communities make up 15.7 percent of the property owned by Gulf and 19.5 percent of the projected impact area. (See table 2.7-1.) Mixed mesophytic hardwoods are located on soils ranging from relatively dry and sterile to those that are relatively wet and rich with the former supporting a greater percentage of xerophytic-type evergreen species, and the latter supporting mostly deciduous dominants (8). In the study area, mixed mesophytic hardwoods occurred at elevations of 72 to 90 feet. (See figure 2.7-2.) Overall canopy cover was estimated to be 60 percent (See figure 2.7-30.) This community is considered to be the climatic climax community of the Southern Mixed Hardwood Forest Region (8,11). Less fertile areas may support this climax community if fires are prevented long enough for development beyond the subclimax stages (10). Most of the mixed mesophytic hardwood communities sampled were relatively immature (eight to 15 years), with the exception of one plot near Hathaway Mill Creek. (See figure 2.7-6, plot No. 31.) This sample plot conformed to the magnolia-beech climax community (11). Other than those areas which had been cleared and planted in pine plantations, and other than some lumbering of bottomland areas, the mixed mesophytic community type may be considered undisturbed. Sample plots located during the study of this community group were frequently located in ecotones between more hydric and xeric conditions. The vegetational components are visible in figures 2.7-31 through -34. An idealized vegetational profile was developed using both importance values and ground truth profiles from several survey plots. (See figure 2.7-35.) This method of development was required due to high species diversity.

2.7.1.9.2.1.1 Trees - The tree component was composed of 33 species, 511 individuals, and had a species diversity index, $(\overline{H})$, of 2.7123. The dominant tree was live oak (Quercus virginiana), 23.6 percent. (See table 2.7-2.)

A. Live oak (Quercus virginiana Miller) - Live oak is a medium sized (20 to 50 foot in height) evergreen tree. Live oaks are intolerant of fire and occur throughout northern Florida in fire-free areas provided the soil is fertile and not excessively wet (12). Some of the trees recorded as live oak were at an immature stage of development and, therefore, may have been other oak species.

2.7.1.9.2.1.2 Shrubs and Small Trees - The shrub/small tree component was composed of 31 species, 358 individuals, and had a species diversity index, $(\overline{H})$, of 2.8061. The dominant shrubs were buckwheat tree (Cliftonia monophylla), 12.9 percent, and live oak (Quercus Virginiana), 10.8 percent. (See table 2.7-4.)

A. Buckwheat tree (Cliftonia monophylla (Lam.) Britt.) - Buckwheat tree is a small evergreen tree or shrub (five to 15 feet in

height), commonly occurring in dense stands. This plant inhabits bays, bayheads, and swamp borders from Jefferson County west ward in Florida (12).

2.7.1.9.2.1.3 Herbs and Grasses - The herb/grass component was composed of 31 species, 358 individuals, and had a species diversity index, ($\bar{H}$), of 2.7350. The dominant plants were fetterbush (Lyonia lucida), 14.8 percent, muscadine (Vitis rotundifolia), 13.2 percent; and blackberry (Rubus sp.), 10.2 percent.

2.7.1.9.2.2 Mixed Mesophytic Hardwood Faunal Community - The following faunal components of mixed mesophytic hardwood communities were captured and/or observed within the Caryville site study area:

2.7.1.9.2.2.1 Reptiles and Amphibians

A. Eastern cottonmouth (Agkistrodon piscivorus piscivorus)

B. Brown-chinned racer (Coluber constricter priapus) - This is a long, shiny, black, satiny-lustered snake with tannish pigmentation under the throat; adults reach lengths from 1.0 to 1.5 M. The brown-chinned racer is a very active snake, capable of fleeing very quickly through vegetational undergrowth when pursued, hence the name "racer." Foods include bird eggs, frogs, toads, and small rodents.

   Florida Range: State-wide, including the Keys, except the Everglades and Cape Canaveral, where another species occurs (15).

C. Eastern king snake (Lampropeltis getulus getulus) - This is a very docile, medium sized, shiny black snake with narrow yellow or white crossbands above; average length is about 1.5 M. Eastern kingsnakes are often locally referred to as the "chain snake," "thunder snake," or "swamp wamper." The eastern king snake is chiefly terrestrial, but may be found around borders of swamps and marshes, King snakes swim well. They are often secretive, foraging under logs and debris largely at night. Foods include other snakes, eggs, frogs, toads, and small mammals.

   Florida Range: Northern Florida southward to Orange and Lake Counties (15).

D. Southeastern five-lined skink (Eumeces inexpectatus) - This is a medium sized, shiny, often striped lizard sometimes with a

blue tail; length about 90 mm. Southeastern five-lined skinks are excellent climbers, but are equally at home on the ground when foraging for food such as ants, termites, and spiders.

Florida Range: State-wide, including Keys (15).

E. Ground skink (Lygosoma laterale)
F. Carolina anole (Anolis carolinensis carolinensis)
G. Southern toad (Bufo terrestris)
H. Southern leopard frog (Rana pipiens sphenocephala)
I. Florida cricket frog (Acris gryllus dorsalis)
J. Common cricket frog (Acris gryllus gryllus)

K. Barking tree frog (Hyla gratiosa) - This is a large, stout, variably colored but usually green tree frog with spots; average adult length about 55 mm. Barking tree frogs burrow as well as climb, taking refuge in sand or soil beneath roots, grass or other vegetation during climatic extremes. Breeding takes place near water from March to August. The male call is a loud raucous "barking." Barking tree frogs occasionally interbreed with the green tree frog (Hyla cinera cinera).

Florida Range: South to St. Lucie County westward to Leon County (15).

L. Common box turtle (Terrapene carolina carolina) - This is a medium sized land turtle with a domed, dark brown shell usually with yellow dots or lines; average size about 140 mm. Common box turtles sometimes soak themselves by the hour or day in mud or water (27). During periods of climatic extremes, they often burrow beneath rotting logs and vegetation to seek relief. Foods include terrestrial invertebrates and vegetable matter.

Florida Range: The northernmost counties of the Florida peninsula, occurring as variants as far south as Alachua County (15).

2.7.1.9.2.2.2 Birds

A. Bobwhite quail (Colinus virginianus) - A medium sized, chunky, reddish-brown bird with a brownish tail; males have distinctive white on the sides of the head, above the eye, and on the throat, and a blackish crown; females almost uniformly brown to brownish-red in color. Bobwhite quail nest and forage on the ground, seldomly flying unless alarmed. Habitat preference may vary from flatwoods in the spring to sandhills in the fall. Foods include both plant and animal matter. Laessel found 50 percent of the plant material eaten (29) was composed of acorns, wild beans, and legumes; animal matter was made up largely of grasshoppers and sawflies. Bobwhite quail are a common resident. Predators include hawks, owls, foxes, and skunks. Man also prizes the bobwhite quail as a game animal.

B. Cardinal (Pyrrhuloxia cardinalis) - This is a medium sized, bright red bird with a distinctive black patch on the throat; females yellow-brown; both sexes have conical shaped reddish-orange beaks. Cardinals are common residents in hedgerows and margins of woods.

C. Carolina chickadee (Parus carolinensis) - This is a very small bird with a distinctive black cap, white on sides of head separating cap from black patch on throat, and a short tail. The carolina chickadee is a resident; formerly fairly common, now much reduced in numbers; nonmigratory (19).

D. Common grackle (Quiscalus quiscula)

E. Carolina wren (Thryothorus ludovicianus) - This is a large wren with a broad, white eye stripe, rufous or reddish-brown back, and bright buffy underparts. The carolina wren is a common resident in thick underbrush; non-migratory; and breeds from late March to late August (19).

F. Blue/jay (Cyanocitta cristata)

G. Brown thrasher (Toxostoma rufum) - This is a medium sized bird with heavy streaked black on a white breast, rufous or reddish-brown above, and a relatively long tail. The brown thrasher is the only thrasher east of the Rockies (30). It is a common resident of brushy areas and wood margins; formerly abundant in fall and common at other seasons, now much less numerous; migratory (19).

H. Yellow-billed cuckoo (Coccyzus americanus) - This is a medium sized bird with large white spots contrasting with a black under-tail surface, bright rufous, a reddish-brown color on the upper side of the wing, white underside, and yellow lower bill. The yellow-billed cuckoo is a common resident of woods and brush, expecially during outbreaks of tent caterpillars (30).

I. Pileated woodpecker (Dryocopus pileatus)
J. Red-bellied woodpecker (Centurus carolinus)
K. Great horned owl (Bubo virginianus)

L. Red-shouldered hawk (Buteo lineatus) - This is a large carnivorous hawk with a rufous or reddish-brown shoulder patch and black and white horizontal stripes on wings and tail both above and below. Foods include insects, birds, and small mammals. The red-shouldered hawk has formerly been fairly common but is now a resident of much reduced numbers. It breeds principally in river swamps (19).

M. Black vulture (Coragyps atratus)

N. Cattle egret (Bubulcus ibis) - This is a medium sized white heron with a yellow or orange bill and a shorter, thicker neck as compared to other herons; buffy-orange crest, breast, and back evident in breeding plumage. The cattle egret is not native to the United States. It may be seen feeding in great numbers around grazing cattle. The cattle egret is a common resident; fairly common in summer, rare, or irregular in winter (19).

2.7.1.9.2.2.3 Mammals and Mammal Trapping

2.7.1.9.2.2.3.1 Mammals

A. Florida wood rat (Neotoma floridana) - This is a large, secretive rat with a long, round, tapering, scantily haired tail, large ears, and bulging black eyes; upper parts buffy gray; underparts and feet are white. Average body length of adults is about 150 mm. Florida wood rats generally do not build nests above ground as do other wood rats. Instead, they construct burrows at the bases of trees. In some areas, they may resort to a combination of surface nests and burrows, taking advantage of vacant burrows of other small mammals. Woodrats are commonly referred to as "pack rats" because of the strange array of garbage that may be deposited in the nest such as shiny pieces of metal, wire, glass, etc. Florida wood rats generally exhibit a small home range and are more or less colonial. Breeding is from around March through September; the number per litter usually is two. Food is principally vegetable matter such as acorns, oak leaves, french mulberry, and green briar (31). Predators include owls, skunks, and foxes.

Florida Range: State-wide (20).

B. Hispid cotton rat (Sigmodon hispidus) - This is a moderately large, robust rat with a relatively short, sparsely haired tail. The upper parts are brownish-black and the underparts grayish buff. Adults average about 120 mm in length. Hispid cotton rats are gregarious, generally nocturnal, and prefer areas of dense ground cover such as old fields and undisturbed road rights-of-way. In such situations, their runways form an extensive network of interconnective travel-ways or grass tunnels about three inches in diameter. Hispid cotton rats breed year round and build their nests in vacated burrows of other small rodents or in clumps of dense vegetation. Food consists almost exclusively of plant material; however, there is some evidence that they feed also on eggs of ground-nesting birds such as bobwhite quail and meadowlark (31). Predators include bobcats, skunks, owls, hawks, and foxes.

Florida Range: State-wide (20).

C. Eastern harvest mouse (Reighrodontomys humulis) - This is a small sized, short-tailed mouse with blackish-cinnamon color above. The belly is grayish-white and the upper incisors conspicuously grooved. Eastern harvest mice are nocturnal and secretive and are therefore seldom seen. Generally they construct a globular nest either on the ground or in dense vegetation.

Florida Range: Unknown.

D. Eastern cottontail (Sylvilagus floridanus) - This is a moderately large, rusty-brown cottontail with relatively short ears and large hind feet. Eastern cottontails are most active during twilight hours and at night when they venture out of heavy vegetation to forage. Foods principally consist of green herbs and grasses.

Breeding may be year round. As many as four or five litters of one to eight young (average four) may be reared yearly. The gestation period is from 26 to 27 days; young are blind at birth but grow rapidly. Young females born early in the year may mature sexually and produce young in their first summer (31). Predators include hawks, owls, foxes, and skunks.

The eastern cottontail is the most numerous herbivore in the mixed mesophytic hardwood community. It was primarily associated with the ecotone between this community and more xeric communities.

Florida Range: State-wide.

E. Raccoon (Procyon lotor)

F. Opossum (Didelphis marsupialis)

G. Gray squirrel (Sciurus carolinensis) - This is a medium sized rodent with upper parts gray to blackish and underparts gray to whitish; tail gray. Gray squirrels are very nervous, crepescular rodents. They den in hollow trees if available, but also construct leaf nests in the tops of trees. Gray squirrels breed throughout the year. Foods are chiefly plant in origin. Predators include birds of prey, bobcats, and foxes. Man also prizes the gray squirrel as game.

Florida Range: State-wide.

H. Gray fox (Urocyon cinereoargenteus) - This is a medium sized fox with reddish legs and grayish upper parts; its tail has a distinct blackish stripe on the upper side and has a black tip. Average adult total length about 970 mm; weight ordinarily is seven to 12 pounds, occasionally as much as 19 pounds (31).

The gray fox is the only fox which is adept at climbing trees, particularly if they are leaning or have branches near the ground. Dens are usually located in underground burrows or in hollow logs. In Texas, one such den was reported in a large hollow oak, some 10 meters above the ground (31). The gray fox is omnivorous; food varies with season and availability.

Florida Range: State-wide.

2.7.1.9.2.2.3.2 Mammal Trapping - On August 12, 1974, 30 Sherman live traps were set in a grid fashion at 10 M intervals within a mixed mesophytic hardwood community (ecotone between xerophytic pine plantation and bayhead communities). The traps were set for four nights (120 trap nights); weather was rainy. One male eastern harvest mouse (Rethrodontomys humulis) and one female eastern woodrat (Neotoma floridana) were captured. On August 13, 1974, eight large mammal live traps were set at approximately 50 M intervals in the same general areas as the 30 Sherman live traps. The traps were set for three nights (24 trap nights); weather was rainy. One female racoon (Procyon lotor) and six females and one male opossum (Didelphis marsupialis) were captured.

2.7.1.9.2.3 Mesophytic Pine Plantation Vegetation Community - Mesophytic pine plantations make up 19.6 percent of the property owned by Gulf and 13.2 percent of the projected impact area. (See table 2.7-1.) The mesophytic pine plantations have been planted in areas where the apparent natural community was a mixed pine flatwood (10, 11, 32). Soil substrate in the mesophytic pine plantations was well drained organically enriched sand overlain with pine straw, leaf litter, and detritus. Within the study area, mesophytic pine plantations were present at elevations of 76 to 100 feet. (See figure 2.7-2.) Overall canopy cover was estimated to be 60 percent. (See figure 2.7-36.) Succession of drier flatwoods is toward mesic noncalcareous southern mixed hardwoods, while succession of wetter and more acidic sites is toward bayheads (10). The mixed mesophytic pine plantations are an unnatural, human maintained community. In the study area, this community type fell into two catagories: burned and unburned. Periodic burns to remove shrub and small tree undergrowth are required to maintain these unnatural communities. Vegetational components of both catagories of the mesophytic pine plantation community are illustrated in figures 2.7-37, -38, and -39. An idealized vegetational profile was developed for the dominant trees of the unburned community and is shown in figure 2.7-40.

2.7.1.9.2.3.1 Trees of the Unburned Variant - The tree component of the unburned mesophytic pine plantation community was composed of seven species, 95 individuals, and had a species diversity index, ($\overline{H}$), of 0.7119. The dominant trees were live oak (Quercus virginiana), 39.5 percent; short needle pine (Pinus echinata), 19.3 percent; and slash pine (Pinus elliottii), 17.4 percent. (See table 2.7-3.)

A. Short needle pine (Pinus echinata Miller) - The short needle pine is a medium to large tree 80 to 100 feet in height occurring on well drained sandy soils throughout most of northern Florida. This tree frequently invades fertile old fields, forming stands which are ultimately invaded and overtaken by hardwoods.

B. Slash pine (Pinus elliottii Engelm.) - The slash pine is a medium to large evergreen tree 60 to 100 feet in height, naturally occurring in wet flatwoods and on the borders of shallow ponds throughout Florida (12, 26). Slash pine is frequently planted in reforestation projects, and is the most important tree of the Florida pine industry (33).

2.7.1.9.2.3.2 Shrubs and Small Trees of the Unburned Variant - The shrub/small tree component of the unburned mesophytic pine plantation community was composed of eight species, 57 individuals, and had a species diversity index, ($\overline{H}$), of 1.7779. The dominant plants were turkey oak (Quercus laevis), 20.4 percent; dwarf live oak (Quercus minima), 17.2 percent; live oak (Quercus virginiana), 16.4 percent; persimmon (Diospyros virginiana), 13.8 percent; short needle pine (Pinus echinata), 13.4 percent; and slash pine (Pinus elliottii), 12.8 percent. (See table 2.7-5.)

A. Turkey oak (Quercus laevis Walt.) - The turkey oak is a small tree 20 to 30 feet in height, commonly occurring mixed with long leaf pine on well drained sandy ridges and hills (12, 26.)

B. Dwarf live oak (Quercus minima Sarg. Small) - Dwarf live oak is a small evergreen shrub three to six feet in height, occurring in pine flatwoods and other sites subject to burning throughout northern Florida (12).

C. Persimmon (Diospyros virginiana L.) - The persimmon is a medium-sized tree 25 to 50 feet in height that has an environmental adaptability exceeding all other trees in northern Florida. It grows under conditions ranging from open, sandy woods to river bottom lands (12).

2.7.1.9.2.3.3 Herbs and Grasses of the Unburned Variant - The herb/grass component of the unburned mesophytic pine plantation community was composed of 23 species, 187 individuals, and had a species diversity index, ($\overline{H}$), of 2.4595. The dominant plants were huckleberry (Gaylussacia frondosa), 14.4 percent, and round bean (Rhychosia reniformis), 10.7 percent.

2.7.1.9.2.3.4 Trees of the Burned Variant - The tree component of the burned mesophytic pine plantation community was composed of three species, 28 individuals, and had a species diversity index, ($\overline{H}$), of 0.7119. The dominant trees were slash pine (Pinus elliottii), 70 percent; live oak (Quercus virginiana), 16.5 percent; and turkey oak (Quercus laevis), 13.5 percent. (See table 2.7-3.)

2.7.1.9.2.3.5 Shrubs and Small Trees of the Burned Variant - The shrub/small tree component of the burned mesophytic pine plantation community was composed of four species, 20 individuals, and had a species diversity index, $(\bar{H})$, of 0.7082. The dominant shrub/small tree was live oak (Quercus virginiana) 78.3 percent. (See table 2.7-5.)

2.7.1.9.2.3.6 Herbs and Grasses of the Burned Variant - The herb/grass component of the burned mesophytic pine plantation community was composed of 12 species, 259 individuals, and had a species diversity index, $(\bar{H})$, of 1.2532. The dominant herbs and grasses were gopher apple (Chrysobalanus oblongifolius), 34.6 percent; small bean (Galactica volublis), 23.6 percent; and blackberry (Rubus sp.), 18.0 percent.

2.7.1.9.2.4 Mesophytic Pine Plantation Faunal Community - The following faunal components of mesophytic pine plantation communities were captured and/or observed within the immediate Caryville site boundaries:

2.7.1.9.2.4.1 Reptiles and Amphibians

A. Eastern cottonmouth (Agkistrodon piscivorus piscivorus)

B. Eastern diamondback rattlesnake (Crotalus adamanteus) - This is a large, heavy, rough-scaled, poisonous terrestrial snake with a loreal pit between the nostril and the eye, diamond pattern above, and rattles on the tail; length of adults about two M. Eastern diamondback rattlesnakes generally buzz loudly the rattles on their tail when approached; some lay quietly coiled. They generally forage around palmettos and in dry pinelands taking refuge from climatic extremes in gopher tortoise holes or under logs. Foods include birds, rabbits and other small rodents. In some areas, rattlesnake meat is considered a delicacy.

   Florida Range: State-wide (15).

C. Florida ground rattlesnake (Sisturus miliarius barbouri) - This is a small blotched, rough scaled, poisonous, hot-tempered snake with a loreal pit between the nostril and the eye and rattles on the tail; adult length is about 500 mm. Florida ground rattlesnakes give a very high pitched buzz when threatened. They generally forage in a variety of habitats from woods to marshes. Foods include birds, toads, and small rodents.

   Florida Range: State-wide (15).

D. Brown-chinned racer (Coluber constrictor helvigularis)
E. Eastern kingsnake (Lampropeltis getulus getulus)
F. Southeastern five-lined skink (Eumeces inexpectatus)
G. Ground skink (Lygosoma laterale)
H. Southern fence lizard (Scelophorus undulatus undulatus)

I. Carolina anole (Anolis carolinensis)
J. Southern leopard frog (Rana pipiens sphenocephala)
K. Southern toad (Bufo terrestris)

2.7.1.9.2.4.2 Birds

A. Bobwhite quail (Colinus virginianus)
B. Cardinal (Pyrrhuloxia cardinalis)
C. Carolina chickadee (Parus carolinensis)

D. Chuck-will's-widow (Caprimulgus carolinensis) - This is a medium sized, swift bird with a uniformly brown and black mottled coloration and a white horizontal stripe across the throat; often called "goat-sucker." Chuck-will's-widow is nocturnal, feeding upon flying insects. They rest and nest on the ground, and are almost indistinguishable from the background of the forest floor. The chuck-will's-widow is a common summer resident (19).

E. Blue jay (Cyanocitta cristata)
F. Brown thrasher (Toxostoma rufum)

G. Common crow (Corvus brachyrhynchos) - This is a large, solidly black bird with a purple and black hue, black feet, and bill. It is quite gregarious. Foods include aquatic and terrestrial invertebrates, bird eggs, grain, and carrion. The crow is a common resident (19).

H. Mocking bird (Mimus polyglottis)
I. Yellow-billed Cuckoo (Coccyzus americanus)
J. Pileated woodpecker (Dryocopus pileatus)
K. Red-bellied woodpecker (Centurus carolinus)
L. Yellow-shafted flicker (Colaptes auratus)
M. Mourning dove (Zenaidura macroura)
N Red-shouldered hawk (Buteo lineatus)
O. Black vulture (Coragyps atratus)

2.7.1.9.2.4.3 Mammals

A. Eastern cottontail (Sylvilagus floridanus)
B. Raccoon (Procyon lotor)
C. Opossum (Didelphis marsupialis)
D. Gray squirrel (Sciurus carolinenis)

E. Eastern fox squirrel (Sciurus niger) - This is a relatively large squirrel, reddish-gray above and rusty colored below. It has a long, bushy, reddish tail. Eastern fox squirrels build dens in hollow trees, if available, and leaf nests high in trees. Mating generally occurs during two periods of the year: January and February, and May and June. Females usually breed once a year during either of these periods, depending on age. Foods include

acorns, grains, and occasionally bark. Predators include bobcats, foxes, owls, and hawks. Man prizes the eastern fox squirrel as a game animal.

Florida Range: State-wide.

F. Eastern mole (Scalopus aquaticus)

G. White-tailed deer (Odocoileus virginianus) - This is a medium sized deer with relatively short ears; major points of antlers coming off a main beam; and a broad, relatively long tail. White-tailed deer browse in hardwood and pine-hardwood stands. Acorns and live oak leaves are a favorite food. They are most active just before sunset and again at sunrise. During midday, they bed down in densely vegetated areas. When surprised, they quickly bound off. The observer may only see the white underneath the tail or "flag" clearly. Predators include dogs, panthers, and man who prizes the white-tailed deer as a game animal.

Florida Range: State-wide.

H. Florida Panther (Felis concolor coryi) - This is a very large unspotted cat with russet to grayish coloration above; dark colored eyes, upper muzzle, and front of mouth; lower flanks and belly offwhite; may be melanistic or all black. A full-grown adult male may be seven feet long and stand about two feet at the shoulder; females about two-thirds the size of the male. There are five toes on the forefoot and only four on the hind foot (34). Track signs of this cat were observed on site.

The Florida panther is very secretive and is solitary in nature; only the female is accompanied by young. Breeding generally occurs year-round; males are polygamus and breed with any available female. The gestation period varies from 91 to 96 days; two to four kittens may be born at one time, usually in the spring. The female may keep young with her for at least a year, sometimes longer (34). Adults have a large natural range of many miles. Foods include small mammals and especially deer.

Range and Status: The range of Felis concolor coryi is principally southern Florida. Man has considered it a threat to livestock and deer, thereby reducing its numbers through extensive hunting. The panther is classified as endangered in the "Endangered Species Act of 1973." The Florida subspecies (Felis concolor coyi) is considered rare with numbers decreasing. Protection from further shooting and habitat management are known conservation needs (18). Location of track sighting is shown in figure 2.7-5.

2.7.1.9.3 Xerophytic (Xeric) - Xerophytic vegetational communities are those in which the soil substrate is composed of loose deep sands low in organic matter, and which are acidic and well drained (7). Floral components of this community are typically tolerant of a hot dry environment. Xerophytic communities usually have an open canopy cover. Two xerophytic communities are found in Florida: scrubs and sandhills (35).

[redacted] - Sandhill communities make up 11.4 percent of the property owned by Gulf and 8.8 percent of the projected impact area. (See table 2.7-1.) Sandhill communities in the study area are located at elevations of 90 to 125 feet on loose sandy soils as in subsection 2.7.1.9.3 above. Overall canopy cover was estimated to be 40 percent. (See figure 2.7-41.) The sandhill community is usually considered to be a fire maintained sub-climax (35, 36). Succession progresses from a dominance of long leaf pine and turkey oak to that of mesophytic hardwoods in the absence of fire (35, 37). The sandhill communities sampled within the study area conformed to previous findings and descriptions (35, 37, 38). This community was undisturbed except for selected cutting of 30 to 40 year old long leaf pine trees (Pinus palustris) some 10 to 15 years ago. The vegetational components are visible in figures 2.7-42 and -43. An idealized vegetational profile was developed for the dominant trees and is shown in figure 2.7-44.

2.7.1.9.3.1.1 Trees - The tree component was composed of eight species, 46 individuals, and had a species diversity index , ($\bar{H}$), of 1.7748. The dominant trees were long leaf pine (Pinus palustris), 39.1 percent; live oak (Quercus virginiana), 20.1 percent; turkey oak (Quercus laevis), 11.1 percent; and persimmon (Diospyros virginiana) 10.9 percent. (See table 2.7-2.)

A. Long leaf pine (Pinus palustris Mill.) - The long leaf pine is a large evergreen tree 80 to 100 feet in height commonly occurring in flatwoods and with deciduous scrub oaks on sand ridges throughout northern Florida (12). Long leaf pine is more resistant to fire than any other indigenous tree species (36).

2.7.1.9.3.1.2 Shrubs and Small Trees - The shrub and small tree component was composed of 13 species, 148 individuals, and had a species diversity index, ($\bar{H}$), of 1,8878. The dominant plants of this community were live oak (Quercus virginiana), 29.3 percent; turkey oak (Quercus laevis), 15.6 percent dwarf live oak (Quercus minima), 10.4 percent; and persimmon (Diospyros virginiana) 10.2 percent. (See table 2.7-4.)

2.7.1.9.3.1.3 Herbs and Grasses - The herb and grass component was composed of 30 species, 292 individuals, and had a species diversity index, ($\bar{H}$), of 2.1282. The dominant herb in this community was gopher apply (Chrysobalanus oblongifolius), 28.7 percent.

2.7.1.9.3.2 Sandhill Faunal Community - The following faunal components of sandhill communities were captured and/or observed within the immediate Caryville site boundaries:

2.7.1.9.3.2.1 Reptiles and Amphibians

A. Gopher tortoise (Gopherus polyphemus) - This is a large terrestrial turtle with a rather large head, shovel-like front feet, and stubby, elephantine hind feet; adult length about 200 mm, or even larger. The gopher tortoise is an excellent burrower and generally inhabits sandy, well drained soils. Burrows slope downward from the surface and then level off underground. Excavations vary from 10 to 35 feet long, and have a "bedroom" large enough for the animal to turn around (27). Burrows enable the gopher tortoise to withstand climatic extremes by remaining at a relatively constant humidity, particularly during the hot, dryer months of the year. Many other animals take advantage of the gopher tortoise's burrow for either temporary or permanent shelter. These animals include rabbits, snakes, gopher frogs, burrowing owls, raccoons, and opossums. Gopher tortoises usually emerge and are most active during mild weather, early in the morning before the heat of the day increases. Foods of the gopher tortoise include plant matter such as grass, leaves, and wild fruit.

Florida Range: The range of gopher tortoises in Florida is state-wide (15). Distribution of gopher tortoise burrows on Caryville site are shown in figure 2.7-5.

B. Six-lined racerunner (Cnemidophorus sexlineatus) - This is a medium sized, nervous, fast moving lizard with a very long tail. Six light stripes occur above. Sometimes the tail is bluish. The adult head and body length is about 80 mm. Six-lined racerunners generally inhabit hot, dry, sandy areas and have a definite hibernation period that lasts throughout the winter regardless of weather conditions (14). They are very active and conspicuous. When pursued, six-lined racerunners never climb but run very swiftly and are difficult to apprehend, eventually taking refuge in dense vetetation or burrows. They are often referred to as "racerunners," "blue streaks," or "field streaks" by locals. Foods include terrestrial invertebrates such as grasshoppers, crickets, and especially ants. Predators include snakes, owls, and hawks.

Florida Range: State-wide (15).

C. Southern fence lizard (Sceloporus undulatus undulatus) - This is a small gray or brown, spiny lizard with curved, dark transverse marks above; adult head and body length about 80 mm. The southern fence lizard is diurnal with strong arboreal tendencies, but is also at home on the ground. When pursued, the animal will usually run

across the ground a short distance, then part way up a tree, remaining motionless on the opposite side. Each time approached, it will dodge limbs and move upward maintaining a position opposite the pursuer. Males have a bluish underside which they display during courtship. Southern fence lizards are egglayers (oviparous). The incubation period of eggs range from 10 to 12 weeks (14).

Florida Range: Northern Florida and the panhandle southward to Orange County (15).

D. Carolina anole (Anolis carolinensis)

2.7.1.9.3.2.2 Birds

A. Mourning dove (Zenaidura macrouia) - A medium sized dove with upper parts grayish-brown, sides of neck glossy bronze, and top of head and nape bluish slate. Mourning doves nest either on the ground or in trees and low woody shrubs. Long leaf pine is often selected as a nesting site (19). Nest construction usually begins around March; two broods are reared in a season. The mourning dove is a resident common in summer and more numerous in fall, and it migrates (19). Predators include raccoons, skunks, and hawks. Man also prizes the mourning dove as a game animal. Mourning doves generally are most common in dryer habitats, feeding upon small seeds, acorns, and various grains.

B. Ground dove (Columbigallina passerina) - A small sized dove with bright rufous or reddish-brown wing patches and a short, rounded dark tail. Upon first glance it may look like a miniature mourning dove (Zenaidura macroura). The ground dove is a relatively uncommon resident and is most abundant in the fall (19).

C. Red-shouldered hawk (Buteo lineatus)

2.7.1.9.3.2.3 Mammals - No mammals were captured or observed in this community.

~~2.7.1.9.3.3 Xerophytic Scrub Vegetation Community~~ - In addition to the sandhill community discussed in subsections 2.7.1.9.3.1 and 2.7.1.9.3.2 above, another xerophytic community was sampled in the study area. This community is apparently an early successional stage of the sandhill sub-climax. It was designated the xerophytic scrub community and made up 11.4 percent of the property owned by Gulf and 8.8 percent of the projected impact area. (See table 2.7-1.) This community was cut for timber approximately three to five years ago when 20 to 40 year old long leaf pine trees were removed. It appeared that the land was partially cleared at this same time. Clearing and cutting in the area has resulted in growth of small oak trees, primarily turkey oak, sand post oak, and live oak. The vegetational components are visible in figure 2.7-45. The idealized community profile is shown in figure 2.7-46.

2.7.1.9.3.3.1 Trees - The tree component was composed of four species, 10 individuals, and had a species diversity, ($\bar{H}$), of 1.1683. The dominant trees were turkey oak (Quercus laevis), 38.5 percent; long leaf pine (Pinus palustris), 25.4 percent; sand post oak (Quercus margaretta), 24.2 percent; and live oak (Quercus virginiana), 11.9 percent. (See 2.7-2.)

A. Sand post oak (Quercus margaretta Ashe) - Sand post oak is a small scrubby deciduous tree 10 to 20 feet in height, occurring on both well drained buff sandy soils and dry loamy soils in northern Florida (12).

2.7.1.9.3.3.2 Shrubs and Small Trees - The shrub and small tree component was composed of five species, 23 individuals, and had a species diversity index, ($\bar{H}$), of 1.3656. The dominant shrubs and small trees were turkey oak (Quercus laevis), 32.3 percent; huckleberry (Gaylussacia frondosa), 26.4 percent; persimmon (Diospyros virginiana), 20.5 percent; and live oak (Quercus virginiana), 13.9 percent. These are represented in table 2.7-4.

A. Huckleberry (Gaylussacia frondosa (L.)T. & G.) - Huckleberry is a medium-sized deciduous shrub two to ten feet in height occurring in sandy woods and bogs south to Florida (13).

2.7.1.9.3.3.3 Herbs and Grasses - The herb and grass component was presented in the sandhill community, subsection 2.7.1.9.3.1.3 above, and due to similarity is not repeated here.

2.7.1.9.3.4 Xerophytic Scrub Faunal Community - The following faunal components of Xerophytic scrub communities were captured and/or observed within the immediate Caryville site boundaries:

2.7.1.9.3.4.1 Reptiles and Amphibians

A. Eastern coachwip (Coluber flagellum flagellum) - This is a long, slender-bodied, terrestrial snake generally bi-colored from blackish anteriorly to brownish posteriorly; length of adults about two M. Eastern coachwips are very active and fast moving, often moving with their head elevated above the ground. When pursued, they exhibit a burst of speed and react savagely when cornered. Eastern coachwhips may be found in a variety of habitats, excluding wetlands. They are egglayers (oviparous) and carnivorous. Foods include small rodents, frogs, birds, and toads.

Florida Range: State-wide except for the Keys (15).

B. Six-lined racerunner (Cnemidophorus sexlineatus)

C. Southern fence lizard (Scelophorus undulatus undulatus)

D. Carolina anole (Anolis carolinensis)

E. Oak toad (Bufo quercicus) - This is a small diurnal toad with a light mid-dorsal stripe, weak cranial crests, and somewhat oval parotid glands; adult length about 30 mm. The oak toad is one of the few toads active during the day, feeding on terrestrial invertebrates. It is the smallest of the toads, breeding at 20 to 33 mm in length (15). Breeding voice of males is like the peeping of newly hatched chicks. Mating occurs in shallow standing water from April to October, depending on arrival of heavy rains (27).

Florida Range: State-wide (15).

F. Southern Toad (Bufo terrestris)

2.7.1.9.3.4.2 Birds

A. Bobwhite quail (Colinus virginianus)
B. Cardinal (Pyrrhuloxia cardinalis)

C. Loggerhead shrike (Lanius ludovicianus) - This is a medium sized bird with gray above and white below, black on wing above, heavy hooked bill, and a black mask. Foods include small snakes, lizards, various terrestrial invertebrates, and carrion. The loggerhead shrike is a common resident (19).

D. Blue jay (Cyanocitta cristata)

E. Mocking bird (Mimus polyglottos) - This is a slender, medium sized bird with white underparts, slate-gray above and white wing patches. The tail is dark above and white below. The song mimics a variety of other birds, hence the name "mocking bird." The mocking bird is an abundant resident (19).

F. Red-bellied woodpecker (Centurus carolinus)

G. Yellow-shafted flicker (Colaptes auiatus) - This is a medium sized woodpecker with undersurface of wing and tail feathers golden in color. The belly is whitish-brown with black spots. A black stripe runs posteriorly from the angle of the jaw. The nape of the neck is red. The yellow-shafted flicker is a common resident, nesting in April and May (19).

H. Mourning dove (Zenaidura macroura)
I. Ground dove (Columbigallina passerina)
J. Red-shouldered hawk (Buteo lineatus)

2.7.1.9.3.4.3 Mammals and Mammal Trapping

2.7.1.9.3.4.3.1 Mammals

A. Eastern cottontail (Sylvilagus aquaticus)

B. Eastern mole (Scalopus aquaticus) - This is a relatively small, robust, short-tailed, burrowing mammal with shovel-like feet webbed to the base of its claws, no visible eyes or ears, sharp pointed nose, and soft dense fur. The adult body length reaches about 125 mm. Eastern moles spend the majority of their life in underground burrows that they excavate for themselves. Because of this, they are restricted to sand and sandy loam soils. Two types of underground burrows are excavated: (a) shallow surface runs which are associated with food gathering, and (b) deep burrows for protection and rearing of young which are marked by conical mounds of earth that have been pushed up to the surface, whereas the shallow burrow is marked by a meandering ridge of earth pushed up as the mole "swims" through loose topsoil (31). Foods consist of earthworms and larval stages of terrestrial invertebrates which reside in the ground. Eastern moles breed in March and June. Gestation is about 42 days with two to five young in a litter (30).

Florida Range: State-wide in sandy or moist, loamy soils.

2.7.1.9.3.4.3.2 Mammal Trapping - On August 8, 1974, 36 Sherman small mammal live-traps were set in a 36 point, 50 M by 50 M grid within the xerophytic scrub community. The traps were set for three nights (108 trap nights); weather was rainy. No small mammals were captured.

2.7.1.9.3.5 Xerophytic Pine Plantation Vegetation Community - One additional man-maintained community type was encountered in this study the xerophytic pine plantation. This community makes up 15.2 percent of the property owned by Gulf and 10.2 percent of the projected impact area. (See table 2.7-1.) The xerophytic pine plantations have been planted in areas where the apparent natural community was the sandhill community. Sandhills are commonly cleared for planting of pine plantations. Usually this is accomplished by burning to remove scrub oaks and wire grass which would otherwise inhibit growth and development of the planted trees (39). As with the mesophytic pine plantation, periodic fires are required to maintain this community. Canopy cover was estimated at 50 percent. (See figure 2.7-47.) The vegetational components of the unburned xerophytic pine plantation community are illustrated in figures 2.7-48 through -51. Those of the burned area shown in figures 2.7-52 and -53. An idealized vegetational profile was developed for the dominant trees of the unburned community, figure 2.7-54.

2.7.1.9.3.5.1 Trees of the Unburned Variant - The tree component of the unburned xerophytic pine plantation community was composed of 11 species, 273 individuals, and had a species diversity index, ($\overline{H}$), of

1.5143. The dominant trees were slash pine (Pinus elliottii), 39.7 percent, and live oak (Quercus virginiana), 28.0 percent. (See table 2.7-3.)

2.7.1.9.3.5.2 Shrubs and Small Trees of the Unburned Variant - The shrub and small tree component of the unburned xerophytic pine plantation was composed of 17 species, 221 individuals, and had a species diversity index, ($\overline{H}$), of 2.0089. The dominant shrub and small tree plants were huckleberry (Gaylussacia frondosa), 22.4 percent; live oak (Quercus Virginiana), 21.0 percent; elliott blueberry (Vaccinium elliottii), 16.1 percent; and deerberry (Vaccinium stamineum), 10.2 percent.

A. Elliott blueberry (Vaccinium elliottii Chapman) - Elliott blueberry is a medium sized deciduous shrub three to eight feet in height, commonly occurring in sandy woods and along streams south to Florida (13).

B. Deerberry (Vaccinium stamineum L.) - Deerberry is a medium sized deciduous shrub two to 10 feet in height, growing in dry, rocky, or sandy woods and thickets south to Florida (13).

2.7.1.9.3.5.3 Herbs and Grasses of the Unburned Variant - The herb and grass component of the unburned xerophytic pine plantation community was composed of 33 species, 266 individuals, and has a species diversity index, ($\overline{H}$), of 2.5193. The dominant herb-grass plant was blackberry (Rubus sp.), 27.3 percent.

2.7.1.9.3.5.4 Trees of the Burned Variant - The tree component of the burned xerophytic pine plantation community was composed of nine species, 170 individuals, and had a species diversity index, ($\overline{H}$), of 1.5569. The dominant trees were slash pine (Pinus elliottii), 37.1 percent; live oak (Quercus virginiana), 21.0 percent; and short needle pine (Pinus echinata), 19.4 percent. (See table 2.7-3.)

2.7.1.9.3.5.5 Shrubs and Small Trees of the Burned Variant - The shrub and small tree component of the burned xerophytic pine plantation community was composed of 11 species, 75 individuals, and had a species diversity index, ($\overline{H}$), of 1.8964. The dominant plants were live oak (Quercus viginiana), 26.3 percent; elliott blueberry (Vaccinium elliottii), 23.6 percent; turkey oak (Quercus laevis), 12.4 percent; and inkberry (Ilex glabra), 12.0 percent. (See table 2.7-5.)

A. Inkberry (Ilex glabra (L.) Gray) - Inkberry is a small evergreen shrub one to four feet in height, occurring in low sandy woods south to Florida (13).

2.7.1.9.3.5.6 Herbs and Grasses of the Burned Variant - The herb and grass component of the burned xerophytic pine plantation community was composed of 33 species, 235 individuals, and had a species diversity index, ($\overline{H}$), of 2.9054. The dominant plants were blackberry (Rubus sp.), at 15.8 percent, and winged sumac (Rhus copallina), 12.5 percent.

2.7.1.9.3.6 Xerophytic Pine Plantation Faunal Community - The following faunal components of xerophytic pine plantation communities were captured and/or observed within the immediate Caryville site boundaries:

2.7.1.9.3.6.1 Reptiles and Amphibians

A. Eastern cottonmouth (Agkistrodon piscivorus piscivorus)
B. Brown-chinned racer (Coluber constrictor helvigularis)
C. Gopher tortoise (Gopherus polyphemus)
D. Ground skink (Lygosoma laterale)
E. Six-lined racerunner (Cnemidophorus sexlineatus)
F. Southern fence lizard (Scelophorus undulatus undulatus)
G. Southern leopard frog (Rana pipiens sphenocephala)
H. Southern toad (Bufo terrestris)

2.7.1.9.3.6.2 Birds

A. Great crested flycatcher (Myiarchus crinitus) - This is a medium sized bird with slate-olive head and back, gray throat, yellow belly, broad yellowish bill, and a long rusty tail. The great crested flycatcher is a common summer resident of deciduous and mixed hardwoods (19).

B. Ovenbird (Seiurus aurocapillus) - This is a small bird with plain olive upperparts, heavily black on a white streaked breast, and black stripes on the crown; males have orange between the black crown stripes. The ovenbird is an irregular transient of the decidious forest (19).

C. Yellow-bellied flycatcher (Empidonax flaviventris) - This is a very small flycatcher with slate-olive coloration above and a yellow throat. The flycatcher is an uncommon resident of coniferous forests and is migratory (19).

D. Wood thrush (Hylocichla mustelina) - This is a small sized thrush with rufous or brownish-red above and large black spots on a white breast. The wood thrush is a summer resident; it breeds principally in the river swamps and is migratory (19).

E. Bobwhite quail (Colinus virgianus)
F. Cardinal (pyrrhuloxia cardinalis)
G. Carolina chickadee (Parus carolinensis)
H. Chuck-will's-widow (Caprimulgus carolinensis)
I. Loggerhead shrike (Lanius ludovicianus)
J. Blue jay (Cyanocitta cristata)
K. Common crow (Corvus brachyrhyncos)

2.7.1.9.3.6.3 Mammals and Mammal Trapping -

2.7.1.9.3.6.3.1 Mammals -

A. Eastern cottontail (Sylvilagus floridanus)
B. Gray squirrel (Sciurus carolinensis)
C. Eastern mole (Scalopus aquaticus)

2.7.1.9.3.6.3.2 Mammal Trapping - On August 4, 1974, 30 Sherman small mammal live traps were set at random within the xerophytic pine plantation community. The traps were set for one night (30 trap nights); weather was rainy. No small mammals were captured. On August 13, 1974, five medium live traps were set randomly at 20 m intervals within the xerophytic pine plantation community. The traps were set for three nights (15 trap nights); weather was rainy. One eastern cottontail (Sylvilagus floridana) was captured.

2.7.1.9.4 Ruderal Areas - In addition to the plant communities discussed thus far, one final grouping is required, the ruderal areas. Included within this grouping are old fields, pasture land, homesteads, roads, and cleared, or otherwise disturbed lands. Ruderal areas make up 13.2 percent. of the property owned by Gulf and 16.4 percent of the projected impact area. (See table 2.7-1.) The vegetation components of the ruderal areas are illustrated in figures 2.7-55 through -58.

2.7.1.9.4.1 Reptiles and Amphibians

A. Florida box turtle (Terrapene carolina bauri) - This is a medium sized box turtle with a narrow highly domed shell (highest point back of the middle); shell is black to olive; and radiating yellow lines are present on the shell and usually two complete yellow stripes occur on the side of the head.

Florida Range: Northeastern Florida were it intergraded with the common box turtle (Terrapene carolina carolina) and southward through the Keys, intergrading with the gulf coast box turtle (Terrapene carolina major) of the gulf counties in the upper part of the peninsula through an area not well defined (15).

2.7.1.9.4.2 Birds

A. Ground dove (Columbigallina passerina)

2.7.1.9.4.3 Mammals and Mammal Trapping

2.7.1.9.4.3.1 Mammals -

A. Nine-banded armadillo (Casypus novemcinctus) - This is a moderately large, armored, omnivorous animal with nine movable bands or plates dorsally, long sparsely haired tail, and a pig-like snout; adult body length about 425 mm. Nine-banded armadillos are terrestrial burrowers. Foods include terrestrial invertebrates, plant matter, and carrion (28).

Florida Range: State-wide.

2.7.1.9.4.3.2 Mammal Trapping - On August 25, 1974, 20 Sherman live traps were set at random within a ruderal community. The traps were set for two nights (40 trap nights); intermittent rain occurred. Seven male and 10 female hispid cotton rats (Sigmodon hispidus) were captured. On August 25, 1974, five medium live mammal traps were set at random within a ruderal community. The traps were set for two nights (10 trap nights), intermittent rain occurred. One male and one female opossum (Didelphis marsupialis) were captured. On September 30, 1974, 30 Sherman live traps were set in a 30 point, 50 M by 40 M grid within a ruderal community. The traps were set for four nights (120 trap nights). Eight male and nine female hispid cotton rats (Sigmodon hispidus) were captured.

2.7.1.10 Ecosystems of the Caryville Site (Diversity and Successional Status of the Site Area) - Diversity is the ratio between number of species and number of individuals in a community, while ecological succession is the slow, orderly progression of changes in community composition during development of vegetation in any area, accompanied by changes in the associated animal communities (40). See also subsections 2.7.1.5, 2.7.1.6, and 2.7.1.7 above. The floral and faunal inventories for the study area are shown on tables 2.7-6 and -7, respectively. Differences in diversity in the community types reflect, in part, variation within respective environments. Those communities developing in areas where extremes in moisture exist are less diverse than the communities developing in areas of middle moisture conditions. This decrease in diversity from the mesic condition to more xeric or hydric condition is well illustrated in figures 2.7-59 and -60. Diversity in wildlife also decreases toward extremes in moisture conditions. This is illustrated by a larger number of species in the more mesic communities as shown on tables 2.7-8, -9, and -10. Cypress bayheads, bayheads, and mixed hardwood swamps occupy poorly drained sites subject to periodic flooding, while sandhills and xerophytic scrub exist on excessively drained portions of the study area. Successional status of each community type was discussed earlier within the descriptive subsections and is illustrated in figure 2.7-61. Cypress bayhead succession leads to either bayheads or mixed hardwood swamps. Bayheads and mixed hardwood swamps may be considered an arrested climax as long as the area remains seasonally flooded; removal of this aspect would reduce the successional status of these communities to a sub-climax of the climatic climax. The mixed mesophytic hardwood community is the climatic climax in the more mesic areas on the Caryville site. Sandhills may be considered a sub-climax of the more

xeric areas on site as long as periodic fires occur; without fire, this community would proceed to the climatic climax community dominated by live oak.

2.7.1.11 Related Ornithological Studies - The three major vegetational communities on the Caryville site are hydrophytic, mesophytic, and xerophytic. Previous subsections -- 2.7.1.9.1, 2.7.1.9.2, and 2.7.1.9.3 -- describe the birds native to those vegetational communities.

The following discussion gives the results of an area bird study conducted in the vicinity of Caryville. Information from the area bird study has been used to supplement the vegetational community study to give a composite picture of birds in the proposed plant site area.

Since many of the bird species at the Caryville site are seasonal migrants, the number of species and their abundance are in a seasonal state of flux. For the area study, both a road survey and an aerial survey were conducted. The results are reported in tables 2.7-11 and -12.

2.7.1.11.1 Methods and Materials - A detailed discussion of the the methods and materials employed in the aerial survey and road survey are given in section 6.3, "Ecological Parameters".

2.7.1.11.2 Results of Studies - No eagle or osprey nests were observed during a reconnaisance flight made in a 25-mile radius of Caryville on July 27, 1974, although three wading-bird colonies were found present. These wading-bird locations are shown in figure 2.7-62. Data from a bird road survey are given in a summary of bird area counts, table 2.7-11. (See figure 2.7-63.) Individual sheets are also given for birds of the general area and other specific locations in table 2.7A-1 in Section 1 of Appendix D. These two survey methods -- bird area road survey counts, and general area and other specific location counts -- are compared in a summary of road survey and composite area count data in table 2.7-12. Table 2.7-13 is a summary of bird area counts. 2

2.7.1.11.3 Summary and Conclusions - No rare endangered, or threatened species were found during the area survey. Bird densities determined from the area survey were not especially high. The road survey and area counts produced about the same number of species (road survey 45; area counts 47) and about the same number of individuals (road survey 668; area counts 632).

2.7.2 Regional and Site Specific Aquatic Ecology

2.7.2.1 Regional Aquatic Ecology

2.7.2.1.1 Historical Fisheries Ecology

2.7.2.1.1.1 Introduction - The purpose of the following subsections 2.7.2.1.1.2 through 2.7.2.1.1.2.2., is to identify the important species of aquatic flora and fauna of the Choctawhatchee River in the region of the proposed plant site; to document the habitats and distribution of these species; and, subsequently, to establish a basis of knowledge to determine whether the intake of cooling water makeup and discharge of waste water and cooling tower blowdown can be conducted with minimal adverse effects on the biota of the Choctahatchee River. 2

References to the biology and ecology of the various species are of necessity drawn from many sources. For this reason, the application of data from one body of water to another should be made with full recognition of possible variation.

2.7.2.1.1.2 Studies of the Choctawhatchee River Basin, 1957 to 1970 - Most of the historical data presented with reference to the presence of important fish species and their population composition has of necessity been drawn from studies conducted in past years primarily outside of the plant site area and thus should be reviewed as regional rather than site specific in nature. This data should be used as a guide to indicate the types of fish which could be expected to occur in the area. (See figure 2.7-64 for a map showing historical sampling stations in the area.)

Gulf reviewed results of the two major fishery surveys of the Choctawhatchee basin that were conducted in past years: Federal Aid Project F-6-R, Dingell-Johnson Project (41) and A Survey of the fishes of the Choctawhatchee Bay drainage in Alabama and Florida (42). Other literature sources were reviewed for information on fish distributions (43,44,45). Of the 34 families and 117 taxa reported to have been collected (species and subspecies), 80 species are freshwater and 37 species are euryhaline (wide salinity tolerance).

As a general guide, table 2.7-14 lists the species expected to occur in waters near the site and table 2.7-15 shows the results of the Florida Game and Freshwater Fish Commission Survey. Percentage composition by numbers and weights from the state survey are included in the species narratives when appropriate. The discussions on individual species ecology, temperature requirements, and tolerances are confined to dominant forms.

No fishery records were found for the Choctawhatchee River prior to 1957 (46). During July of that year, the Alabama Polytechnic Institute (now Auburn University), assisted by Alabama and Florida State Fishery Biologists, conducted a fishery study near the Florida/Alabama state line (approximately 30 miles upstream from the plant site) (47). At that time, carpsucker was the dominant species by weight in this section of the river with channel catfish ranking second in the total weight. The most abundant gamefish collected was spotted bass. Two species of anadromous fish were taken: one four-inch sturgeon and several one-to-five-inch skipjack herring.

The Florida Game and Freshwater Fish Commission conducted a lake and stream survey of the Choctawhatchee watershed from 1957 through 1959 (41). The Florida Anadromous Fish Project assisted with the survey during the latter two years to obtain information on Alabama shad, striped bass, sturgeon, and skipjack herring. Gill, trammel, and sturgeon nets, rotenone, and electrofishing gear were employed to collect fish.

2.7.2.1.1.2.1 Important Species - Important species of the region as derived from the Game abd Freshwater Fish Commission Survey are included in the following caregories:

A. Commercial or Recreational

1. pickerel: redfin, chain
2. suckers: spotted, blacktail redhorse
3. catfish: white, yellow bullhead, brown bullhead, channel
4. sunfish: flier, warmouth, redbreast, bluegill, longear, redear, spotted, rockbass
5. crappie: black
6. black bass: spotted, largemouth
7. stocked striped bass

B. Rare, Endangered, or Protected (48) - No rare, endangered, or protected species have been observed to occur in the immediate area of the site. The Okaloosa darter *Etheostoma okaloosae*, is found in several small streams draining into the western side of Choctawhatchee Bay (approximately 90 miles downstream from the plant site) (42,49). 1

2.7.2.1.1.2.2 Life History Discussions of Species Found to Inhabit the Caryville Region of the Choctawhatchee River (41,42,43)

A. Southern Brook Lamprey, *Ichthyomyzon gagei* - This species is uncommonly collected. The lamprey is not discussed because it is not a dominant form.

B. Atlantic Sturgeon, *Acipenser oxyrhynchus* - This species rarely travels up the Choctawhatchee River to or above the Caryville site (42); therefore, it is not discussed. This species was recorded only once in 1957 (47).

C. Gars, *Lepisosteus spp*. - Gars, in general, can withstand high temperature and degraded aquatic habitats, and are surface air breathers (50,51,). They are usually the last species to die in drying canals, swamps, and oxbow lakes because of their tolerance (52). Three species are found in the Choctawhatchee Basin: longnose gar, *L. osseus*; spotted gar, *L. oculatus*; and the alligator gar, *L. spatula*. The following data show that gars comprised a large percentage of the catch by weight in the state survey (41):

Gar Species	Percentage Composition	
	By Number	By Weight
Spotted	1.4	6.1
Longnose	1.3	28.1
Alligator	0.1	15.6
	2.8	49.8

Fecundity (egg numbers) for longnose gar ranges from 4,000 to 60,000 eggs per female, which is probably typical of the genus. All gar are scavengers and predators: they feed on crustaceans (crabs), aquatic birds, and fish, primarily shad. The alligator gar grows to a large size (nine feet, eight and one-half inches, 302 pounds), and individuals (six feet, three inches, 115 pounds; and five feet, nine inches, 85 pounds) were caught during the state survey near the mouth of the Choctawhatchee River (41). Although the flesh is edible, gars are disdained by both commercial and sport fishermen. The eggs are highly toxic.

D. Bowfin, *Amia calva* - This species lives in sluggish rivers, lakes
and backwaters, generally among abundant vegetation (53,54). The breeding
season ranges from April to July. Males build nests in colonies by
clearing out vegetation in sheltered areas. It guards the nest until the
eggs hatch in approximately nine days. The offspring remain in the nest 1
for seven to nine days. Fecundity ranges around 30,000 to 60,000 eggs
per female. The main diet of juveniles consists of dipteran larvae and
microcrustaceans. Adults eat mainly crayfish and fin-fish, while occasionally
consuming insects, molluscs, earthworms, leeches, and frogs. The bowfin
catch in the state survey (41) comprised 0.7 percent by number and 6.6
percent by weight of all species.

E. Shads, *Alosa* spp., and *Dorosoma* spp. - The Alabama shad, *Alosa alabamae*, from the Apalachicola River, spawns in April at water temperature of 66.2°F to 71.6°F (55). It lays pelagic, nonadhesive eggs. Fecundity ranges from 60,000 to 250,000 eggs per female depending on size and weight. Juveniles were collected in June through December. Food consists of aquatic dipterans and small fishes, but adults do not take food during their spawning run. This species comprised 3.6 percent by number and 0.1 percent by weight of the state survey catch (41).

Scant information is available on the skipjack herring, *Alosa chrysochloris*, (53). It is probably anadromous in most of the Gulf drainages. At Keokuh, Iowa, spawning occurred from early May to early June. Skipjack herring are carnivorous: the young feed on insects and the adults on fish.

Both the gizzard shad, *Dorosoma cepedianum*, and the threadfin shad, *D. petenense*, are abundant and are very important at all life stages as forage for predatory fish and other aquatic carnivores (53,56). Both species form large schools in surface waters and are attracted to outdoor lights during evening hours. Peak spawning for the gizzard shad in

Florida is during late March to early April at water temperatures of 60.8°F to 62.6°F. Fecundity ranges from 22,000 to 350,000 eggs per female. The adhesive eggs attach to various stationary and floating substrates, usually in the littoral zone. During the first weeks of life, gizzard shad eat mainly protozoa, rotifers, and entomostraca.

Throughout the rest of life, the dominant food is plankton. The gizzard shad comprised 2.0 percent by number and 2.1 percent by weight of the state survey catch (41). The upper lethal temperature for *Dorosoma cepedianum* was found to be 96.8°F (57).

The threadfin shad is a temperature-sensitive species and suffers extensive winter kills where the water temperature drops below 45°F, thus limiting its northern distribution (58). This species spawns at 66°F to 68°F. Mortality of spawned and spawning fish has been reported in Florida during April. A four-inch female may contain from 1,700 to 12,400 eggs. This species has a short life span, with few individuals reaching two years of age. Plankton is the principal food supplemented with chironomid larvae (53). The threadfin shad comprised 0.8 percent by number and 0.2 percent by weight of the state survey catch (41).

F. Pickerel, *Esox* spp. - The redfin pickerel, *E. americanus*, lives
in sluggish streams and backwaters (53). Fecundity ranges from 700 to 1
4,000 eggs per female. Spawning occurs at 50°F with eggs hatching in 12 to 14 days. One week after hatching, the fry begin feeding on plankton. Up to three inches in size, the fingerlings feed on cladocera, amphipods, and immature insects. Above three inches, they switch to dragonfly nymphs, crayfish, and fish. This species amounted to 0.1 percent by number of the state survey catch (41).

The chain pickerel, *E. niger*, is a solitary species, residing in shallow areas during the evening and migrating to deeper water during the day (53). In Alabama, spawning occurs around 61°F during the second or third year of age. Fecundity ranges from 3,000 to 8,000 eggs per female. Ripe females enter swampy or flooded areas that produce extensive beds of aquatic vegetation where the glutinous strings of adhesive eggs are laid and fertilized. Depending on water temperature, eggs hatch in six to twelve days. Sac fry remain inactive for six to eight days, hiding in debris and vegetation for protection. The chain pickerel feeds and grows throughout the year. Up to a length of four inches, invertebrates are its main food. Above four inches, the diet is changed to fish. Less important in the diet are crayfish, frogs, salamanders, and snakes. This species comprised 0.6 percent by number and 1.1 percent by weight of the state survey catch (41).

G. Carpsuckers, *Carpiodes* spp. - Life history information on the quillback, *C. cyprinus*, and the highfin carpsucker, *C. velifer*, from the Southeast is scant (53). More information is available for the river carpsucker, *C. carpio*, which is discussed (59). Carpsuckers are considered to be a "rough" species by most fishery biologists but have commercial

value in certain areas of the U. S. when taken at market acceptable sizes and sold under an assumed name. This genus feeds mostly on diatoms, copepods, ostracods, rotifers, midge larvae, and filamentous algae. Spawning occurs between early April to early August at temperatures from 67°F to 75°F, with spawning peak occurring at approximately 70°F. Fecundity ranges from 4,000 to 154,000 eggs per female depending on combination of length, weight, and age. Carpsuckers are shallow water spawners and the eggs are broadcast and left unattended. Spawning occurs over sand, silty shoals, bays, or deltas in flowing water at depths of one to three feet. The quillback comprised 0.3 percent by number and 0.7 percent by weight, while the highfin carpsucker amounted to 0.1 percent by number and 0.4 percent by weight of the state survey catch (41).

H. Chubsucker, Erimzon spp. - Two species occur in the Choctawhatchee drainage: lake chubsucker, *E. sucetta*, and sharpfin chubsucker., *E. tennis* (53). Scant information is available on the life history of this genus. In Illinois streams, the lake chubsucker spawns from March to April. The male cleans an area among gravel for the nest. Fecundity (8,000 to 72,000 eggs per female) varies considerably by species and size group. Food items include small crustaceans, insect larvae, and algae. Lake chubsuckers comprised 0.5 percent by number and 0.2 percent by weight of the state survey catch (41). *E. sucetta* has been observed in waters having a temperature of 100.4°F (57). 1

I. Spotted Sucker, Minytrema melanops, and Blacktail Redhorse, Moxostoma poecilurum - The general life history of these suckers is discussed collectively because of the paucity of information (53,60).

They live in large streams and rivers having current, riffles, and pools. Breeding occurs over riffles at a water temperature of 59°F to 64.5°F with two males usually fertilizing one female over the gravel nest. Fecundity data was not readily available. Preferred foods include periphyton, benthos, and worms which are consumed with its extensive protrusible mouth off submerged objects and off the bottom. Spotted suckers were 0.8 percent by number and 4.7 percent by weight, while blacktail redhorse comprised 1.0 percent by numbers and 2.2 percent by weight of the species collected on the state survey (41).

J. Family Cyprinidae - The common carp, *Cyprinus carpio*, is uncommon in this drainage so it is not discussed. Life history information is scant on other cyprinids from the South of the genera *Ericymba*, *Hybopsis*, *Notropis*, and *Semotilus* spp. These forms inhabit primarily streams and tributaries, and are not dominant as forage species in the river proper. Representative species are discussed when information is available. All minnows of the genus *Notropis* spp. comprised 5.3 percent by numbers and less than 0.1 percent by weight of the species collected in the state survey (41).

K. Redeye chub, Hybopsis harperia - In northern Florida and adjacent Alabama, redeye chub often live in springs and underground caves where the temperature is fairly constant at 64°F to 77°F (53). Ripe fish have been taken throughout the year in these constant temperature environments. Fecundity ranges from 65 to 126 eggs per female. This species feeds on insects, crustacea, and small fish. Chubs, Hybopsis spp., comprised 0.6 percent by number of the species collected in the state survey (41).

L. Golden shiner, Notemigonus crycoleucas - The golden shiner is an important bait minnow and has been introduced into many areas (53,61). In Alabama, spawning begins when the water temperature reaches 68°F and continues throughout the summer. Fecundity data were not available. Under natural conditions, the eggs are laid in shallow water on weeds, trash, filamentous algae, or in largemouth bass nests. No protection is given the eggs or recently hatched fry by the parents. Food of the young includes algae and microcrustaceans. Adults are omnivorous, feeding on young fish, insects, plankton, crustaceans, protozoans, algae, diatoms, and molluscs. This species is preyed upon by basses and other predators, and is cultured extensively as a forage and bait species. This species has been observed in waters having a temperature of 100.4°F (57). The golden shiner comprised 3.1 percent by number and 0.2 percent by weight for species collected in the state survey (41).

M. Ironcolor shiner, Notropis chalybaeous - The breeding season in 1
Florida is from early April through September (53). Fecundity data were not available. Fertilized eggs sink to the bottom and adhere to sand or other attachment objects without parental protection. Eggs hatch in 54 hours at 62°F. These minnows tend to school throughout the year. They feed by sight on entomostraca and insects. This species comprised 0.1 percent by number of the species in the state survey (41).

N. Coastal shiner, Notropis petersoni - This species has been studied extensively in North Carolina (62). Its food consists principally of crustaceans with plant material being ingested incidentally. The pH range in its habitat was 5.3 to 6.9 with a minimum pH tolerance limit under laboratory conditions of 4.9. Dissolved oxygen ranged from 1.4 to 7.0 parts per million (ppm) under field conditions with minimum tolerance limit of 0.9 ppm under laboratory conditions. The highest water temperature was 84°F in rapid-flowing streams and 89°F in Lake Waccamaw. When water temperature declines below 52°F, this species moves to deeper water. The breeding season extends from April through July with water temperatures of 62°F to 65°F. In streams, the breeding season is somewhat later because of cooler springtime stream temperatures. The young fish reach a total length of eight millimeters (mm) by the end of the first month and 14 mm by the end of the second month after hatching. At approximately 18 mm, they join the adult population, becoming sexually mature at 45 mm total length. The life span averages three years. This species appears to adapt to a lacustrine existence under heavy predation.

O. Blacktail shiner, Notropis venustus - Scant information was available on this species from Mississippi (63). This shiner prefers the deep water of the creeks and rivers. Breeding specimens have been taken from the first of April through August. Upon hatching, the young develop in the quieter shallow shoal waters of larger streams. It is used extensively as a bait minnow.

P. White catfish, Ictalurus catus - This species is a flowing water inhabitant and also it frequents brackish water (53,64,65). The white catfish prefers intermediate current conditions. Like other catfish species, it is omnivorous. Major food items include fish (shad and small sunfishes) and to a lesser extent aquatic insects, pond weed, crustaceans, fish eggs, algae, and organic debris. Spawning occurs while nesting on sand or gravel bars when the water temperature reaches 70°F. In Virginia, two females, 300 to 320 mm total length, contained 3,200 and 3,500 eggs, respectively. Both sexes construct the nest by removing pebbles with their mouths and brushing out a depression with their fins. The adhesive eggs are deposited on the bottom of the nest and may be covered with gravel. Both parents guard the nest but the male cares for the young. The white catfish comprised 0.2 percent by number of the species collected during the state survey (41). When acclimated to 45°F, Ictalurus catus was reported to have an LD_{50} of 92°F (57). (LD is the common acronym for "lethal dose." The subscript 50 is the percent of test fish which die after a specific time period 1
(66). The length of acclimation time and exposure is omitted where this input is lacking in the reference material.)

Q. Black bullhead, Ictalurus melas - This species has been commonly collected in other drainages, primarily in Alabama. It is not a common species in the Choctawhatchee drainage (45); therefore it is not discussed.

R. Yellow bullhead, Ictalurus natalis - This yellow bullhead is most abundant in the shallow portions of large bays, lakes, ponds, and low gradient streams where the water is clear and vegetation abundant (53,64). Principal foods are insects, crustaceans, molluscs, and small fishes. Plant material often forms a large portion of its diet. Spawning probably occurs in late spring or early summer. Fecundity ranges from 1,600 to 4,270 eggs per female. Nests are constructed in water one and one-half to four feet deep. Spawning habits resemble those of other bullheads. The eggs hatch in five to ten days. Males guard the young until they are about two inches long. This species is preyed upon by the largemouth bass and declines in abundance or remains in low numbers where aquatic vegetation is reduced and turbidity increases. Yellow bullheand were 0.4 percent by number and 0.5 percent by weight of the species collected in the state survey (41). This species has been observed living in waters having a temperature of 100.4°F (57).

S. Brown bullhead, Ictalurus nebulosus - In river habitats, the brown bullhead is most common in sloughs and backwaters (53,67,68). Deep water with weed beds and bottom of sand, gravel, or muck is preferred.

This species prefers warm water. The brown bullhead usually feeds near the bottom, foraging most actively in the evening and at night. Fry and fingerlings eat zooplankton and chironomids; adults feed on insects, fish, fish eggs, molluscs, and aquatic plants. In Florida, it spawns from March to May when the water temperature exceeds 70°F. Fecundity ranges from 2,000 to 13,800 eggs per female. Both parents may be involved in nest building and guarding of eggs and young. Apparently, eggs hatch when water temperature reaches 80°F. Incubation requires five to fourteen days. The brown bullhead comprised 0.1 percent by weight of the species collected in the state survey (41). This species has been observed living in a lagoon having a thermal gradient of 89°F to 104°F (57).

T. Channel catfish, Ictalurus punctatus - Channel catfish are found mainly in moderate- to swift-flowing water (53,64,69). Sand, gravel, and rubble occasionally mixed with mud are preferred bottom habitats. Turbidity apparently has little effect on its distribution, but it is rarely found among aquatic vegetation areas. Warm waters are preferred; slow growth occurs below 70°F. Nests are usually constructed in secluded, semi-dark areas such as under rocks, in log jams, holes, and in other protected sites. Spawning occurs at water temperatures between 70°F and 85°F. Fecundity ranges from 2,000 to 70,000 eggs per female. The male protects the nest after spawning, aerating, and cleaning the eggs by fanning with the pelvic fins -- a behavior common to all 1
catfishes. The channel catfish usually feeds on the bottom. Fingerlings and juveniles feed mainly on benthos, minnows, and small shad. Large fish feed almost exclusively on forage fish. The channel catfish comprised 4.5 percent by number and 1.1 percent by weight of the state survey catch (41). When acclimated to 86°F, this species of fish had no mortality within 24 hours at 95°F (57).

U. Madtoms, Noturus spp. - Scant information is available on the life history of southern species (53). These miniature catfish comprised 1.3 percent by number of the state survey catch (41).

V. Topminnows, Fundulus spp. - Scant information is available on the life history of southern species (53). The topminnows comprised 0.7 percent by number of the state survey catch (41).

W. Mosquitofish, Gambusia affinis - It spawns from May to September, and matures at 30 to 36 mm total length (53,70). Fecundity ranges from one to 315 eggs per female. Principal foods are mosquito larvae and pupae, copepods, algae, and occasionally shall fish. Up to 225 larvae and pupae have been eaten by an individual mosquitofish in one hour. The following lethal temperatures have been recorded for the species (53):

Lethal Temperatures (°F) for Mosquitofish

Acclimation	Lethal Low	Lethal High
59	34.7	95.7
68	41.9	99.14
95	58.1	99.14

The mosquitofish comprised 1.3 percent by number of the species collected by the state survey (41).

X. Pirate perch, *Aphredoderus sayanus* - Scant information is available on the biology of this species (53). The pirate perch prefers swampy or weed-choked areas in slack water. Insects are the main food. No information is available on the reproduction of this fish. This species comprised 4.0 percent by number and 0.1 percent by weight of the state survey catch (41).

Y. Brook silverside, *Labidesthes sicculus* - This fish is an annual (short life span) species (71,72). It schools near the surface, jumping out of the water, especially at dusk. Primary foods include dance flies (Empididae) in stream habitats, and chironomids and zooplankton in lakes and reservoirs. In Indiana, it spawns from June to August. The eggs 1
are commonly found attached to floating objects and emergent vegetation in shallow area. The brook silverside comprised 0.4 percent by number of the state survey catch (41).

Z. Striped bass, *Morone saxatilis* - The striped bass is an estuarine species, migrating into coastal rivers to spawn (73,74).

The U. S. Fish and Wildlife Service has stocked hatchery-reared fingerlings in Choctawhatchee Bay with the goal of establishing a sport fishery in the bay and rivers.

Net tows were made by the U.S. Fish and Wildlife Service (75) to collect striped bass eggs. These tows were performed at multiple depths in the Choctawhatchee River near U.S. Highway No. 90 bridge during March 1973. No eggs were collected. This suggests that striped bass were not spawning near the plant site area during the early part of the spawning period of this species.

Striped bass in the Apalachicola River spawn in March and April. Spawning probably extends into May during some years. This species has strict spawning requirements. Natural spawning is reported to occur only in flowing water at temperatures of 58°F to 71°F. The fertilized egg must remain suspended by currents during the period of incubation (44 hours at 65°F). The ova and larvae must be maintained in water temperatures between 54°F and 72°F. When delicate larvae are hatched, they have little chance for survival if water currents are insufficient to keep

them from settling to the bottom. The larvae become fry five to seven days after hatching, and their chances of survival increase following this stage of development if suitable food is available. The fry begin feeding when they are five to eight days old an early instars of copepods and cladocerans. When about 15 days old, their mouths are large enough to eat the adult copepods and cladocerans which they consume until they are about one-half inch long. At this length and until about three and one-half inches long, they continue feeding on adult copepods, especially Cyclops, but they eat fewer cladocerans. Between three and one-half and four inches in length, this phenomenon is reversed with fewer copepods and more cladocerans consumed. Insect larvae are also consumed at the size range. At four to five inches in length, insect larvae compose the majority of the diet. Above five inches in length, insect larvae are less significant in the diet and fish are consumed. Larger striped bass and adults are free-swimming pelagic predators that consume forage fish species, especially the shads and herrings.

AA. Rock bass, Ambloplites repestris - The rock bass is usually found in cool, weedy lakes and rocky streams (76,77). Spawning is initiated when water temperature reaches 69°F to 70°F, and may continue until 79°F. Fecundity ranges from 2,000 to 11,000 eggs per female. The nest is usually built over gravel near vegetation. Fry and fingerlings feed on zooplankton, crustaceans, insects, chironomids, and algae. Above three inches in length, small forage fish (clupeids, minnows, and 1
darters) become important in the diet. Adults show a preference for crayfish and insects. It comprised 0.1 percent by number of the state survey catch in Holmes Creek (41), south of the site. This species has been observed living in water having a temperature of 100.4°F (57).

AB. Flier, Centrarchus macropterus - The flier is a common inhabitant of sluggish streams, overflow ponds, and swamps (76). Spawning occurs from late February to May when the water temperature reaches 62°F. The nests are in colonies and very close together, and the eggs and fry are guarded by the males. Fecundity ranges from 1,000 to 37,000 eggs per female. Survival to 112 days from potential egg deposits was established at 0.9 percent. The main foods are zooplankton, insect larvae, and other aquatic invertebrates. It comprised 0.4 percent by number and 0.3 percent by weight of the state survey catch in Holmes Creek (41).

AC. Pygmy sunfishes, Elassoma spp. - Scant information is available on the life history of these species (76). The pygmy sunfishes inhabit swamps and weedy ponds and spawn at 73°F to 78°F. Fecundity ranges from 96 to 970 eggs per female. In captivity, these sunfishes would eat only live food, namely brine shrimp. The males are territorial during breeding season and the behavior is similar to other sunfishes. Two of these sunfish comprised 0.6 percent by number of the state survey catches (41).

AD. Sunfishes, Enneacanthus spp. - Scant information is available on the life histories of these species in the South (76). These sunfishes

prefer slow-flowing coastal streams, backwaters, and ponds. Small crustaceans and aquatic insects are the main food items. Spawning temperatures and habits would be similar to other sunfishes. Fecundity reproductive data are not readily available. Two of those species comprised 1.8 percent by number of the state survey catch (41).

AE. Redbreast sunfish, Lepomis auritus - This sunfish is primarily a stream inhabitant (50,76). The redbreast sunfish spawns during June at water temperatures of 71°F to 78°F. In one study, mean egg counts for age II through VI fish ranged from 963 to 8,250 per female. The preferred bottom substrate for spawning appears to be a sheltered, sandgravel situation under 14 to 15 inches of water and in water velocity of approximately 0.59 feet per second. Aquatic insects are the mainstay of its diet. It comprised 0.1 percent by weight of the species collected in the state survey catch (41). When acclimated to 70°F, this species was reported to have had a LD_{50} of 101°F (57).

AF. Green sunfish, Lepomis cyanellus - The green sunfish is an uncommon species in the Choctawhatchee drainage; therefore, its life history is not discussed.

AG. Warmouth, Lepomis gulosus - Warmouth usually occur in waters having little or no gradient, soft bottom, and abundant aquatic vegetation or other cover (76,78,79). Like other centrarchids, the warmouth spawns in late spring and early summer when water temperatures approaches 70°F. 1
Nests are built on a variety of bottom types, preferable rubble lightly covered with silt or detritus and near stationary cover. This species nests either singly or in colonies in water less than five feet deep. Hatching occurs in about 35 hours at temperatures berween 77°F and 80°F. Females spawn an indefinite number of times throughout the reproductive season with fecundity (4,500 to 63,200 eggs per female) positively correlated to size. Post-larval individuals feed on protozoa and bacteria, with insects, zooplankton, snails, and small crustaceans becoming increasingly important as the fish grows. Warmouths are considerably more piscivorous than other sunfishes, and small fishes of other species at times comprises a large part of the diet of those over five inches. This species comprised 5.0 percent by number and 1.7 percent by weight of the state survey catch (41).

AH. Bluegill, Lepomis macrochirus - This species is abundant in ponds, lakes, and sluggish streams where shelter is available (67,76,80). The bluegill prefer clear quiet waters, scattered beds of vegetation, and bottom composed of sand, gravel, or muck. In Florida, spawning occurs from February through October, when the waters temperatures are between 70°F to 80°F. Fecundity ranges from 3,000 to 81,000 eggs per female. Males build their nests in colonies by fanning out shallow depressions in water from two to six feet deep; the nests are usually exposed to direct sunlight. Zooplankton and aquatic insects are the dominant foods, insects becoming more important as the fish matures. When available, small fish, fish eggs, snails, molluscs, crustaceans,

and benthos are consumed. It comprised 5.4 percent by number and 2.0 percent by weight of the state survey catch (41). Acclimated to 79°F, this species was reported to have had an LD_{50} of 103°F (57).

AI. Dollar sunfish, Lepomis marginatus (76) - It prefers small ponds and streams. Very scant information is available on its life history. This sunfish comprised 0.8 percent by number of the state survey catch (41).

AJ. Longear sunfish, Lepomis megalotis - In the South, the longear sunfish is primarily an inhabitant of streams (76). Males defend territories and build nests over gravel areas in water depths of six inches to ten feet. Spawning occurs at water temperatures of 75°F to 86°F. Fecundity ranges from 200 to 1,000 eggs per female. A typical nesting cycle lasts almost two weeks and most eggs in a colony hatch within a week. Fingerlings less than two inches long prefer aquatic insects and zooplankton. Terrestrial insects are preferred by fish greater than four inches long, but aquatic insects and fish eggs are also eaten. It comprised 0.9 percent by number and 0.1 percent by weight of the state survey catch (41).

AK. Redear sunfish, Lepomis microlophus - The redear or shell-cracker is commonly found in large warm rivers, bayous, lakes, and
occasionally in brackish waters (67,76,80). Spawning occurs in the 1
spring and fall when the water temperature reaches 75°F. Very little spawning occurs during the summer months. Fecundity ranges from 2,000 to 10,000 eggs per female. Nests are usually located in water 17 to 35 inches deep, in colonies, and around submerged vegetation. Reproduction is not adequate to maintain good fishing in combination with bass, and a buffer species in necessary. Sudden cold spells may kill an entire population in shallow ponds in Alabama. Annual mortality rates have been estimated from 55 percent to 82 percent. Snails are the main food, but aquatic insect larvae are also eaten. It comprised 5.0 percent by number and 1.3 percent by weight of the state survey catch (41).

AL. Spotted sunfish, Lepomis punctatus - The spotted sunfish or stumpknocker is found throughout Florida, but prefers small streams with clear flowing water and plenty of hiding places (76). In Florida, they spawn from early spring to November, peaking at water temperatures of 80°F to 84°F. Fecundity estimates were not readily available. Males are more pugnacious in guarding nests than other sunfishes. Food includes zooplankton and aquatic invertebrates. It comprised 1.3 percent by number and 0.2 percent by weight of the species collected in the state survey catch (41).

AM. Spotted Bass, Micropterus punctatus - The spotted bass lives predominantly in streams but also resides in reservoirs (61,76,81). In streams, it is intermediate in habitat preferance to smallmouth and largemouth bass. Spotted bass are less tolerant of heat and mud than the largemouth. Adults tend to school and avoid weedy areas. Spawning

occurs at temperatures of 68°F to 70°F in conjunction with or later than the largemouth. Nests are built on mud bottoms or gravel. Spotted bass deposit fewer eggs than other members of the genus. The eggs hatch in four to five days producing 2,000 to 2,500 fry per nest. Fry feed on zooplankton, midge larvae, and small aquatic insects while fingerlings graduate to small crustaceans, medium-size aquatic insects, and fish fry. Adults feed on crayfish, shad, and minnows. It comprised 0.2 percent by number and 0.1 percent by weight of the species collected in the state survey catch (41).

AN. Largemouth bass, Micropterus salmoides - This species was commonly collected by Federal biologists electroshocking near the plant site (75). Turbidity is detrimental to growth and reproduction. Weedy or bushy mudbottom bayous, backwaters, and sluggish streams are favorite habitats. In rivers and streams, they take shelter near bank indentations, submerged trees, and other obstructions. Fry feed largely upon Cyclops, Daphnia, and other small crustaceans; larger young consume insects. Adults eat mainly fish, but they also take worms, mussels, frogs, crayfish, snails, and large insects. In Florida, age 1 fish have been reported to successfully spawn. Preferred spawning temperatures in the South range from 68°F to 75°F. A substrate such as sand, gravel, roots, or aquatic vegetation is required for successful spawning. Egg production varies from 2,000 to 94,157 per female and is positively correlated with age, weight, and length (67,76). This species comprised 2.3 percent by number and 2.9 percent by weight of the species collected in the state survey catch (41). Acclimated to 80°F, this species has been found to have an LD_{50} of 100°F to 102°F (57).

AO. White crappie, Pomoxis annularis - The white crappie has been recently collected in the Choctawhatchee drainage (42). At the present time, it does not contribute to sport fishery because of low population density; therefore, it is not discussed.

AP. Black crappie, Pomoxis nigromaculatus - The black crappie or speckled perch is indigenous to flowing waters and has been stocked extensively in lentic (standing) waters (80,82,83,84). Where the black and white crappie live together, one usually predominates. In Florida, this species attains sexual maturity at two to three years, and spawning occurs between 58°F to 64°F. Fecundity ranges from 11,000 to 188,000 eggs per female. The black crappie may nest in gravel areas or on bottom material softer and muddier than is acceptable to other sunfishes. The male selects the nest site, usually in water three to eight feet deep. After spawning, the male guards the nest. Generally, crappie are considered predators which compete more with largemouth bass than with other sunfishes. At first, the young eat largely zooplankton, then small larval and adult acquatic insects become very important. Fish ultimately become the most important food. Even crappie two to three inches long consume small fish. This species comprised 2.2 percent by number and 1.0 percent by weight of the species collected in the state survey catch (41).

AQ. Darters, Ammocrypta, Etheostoma, and Percina spp. - These darters are primarily stream dwellers and require high-quality flowing water. Several coastal forms are adapted to swamp and backwater conditions. They comprised 0.9 percent by numbers of the species collected during the state survey catch (41).

AR. Swamp darter, Etheostoma fusiforme - This species inhabits swamps, backwaters of streams, sloughs, and lakes (85). The swamp darter eats microcrustaceans and chironomids. It is preyed upon by gar, black bass, and crappie. The spawning period varies between populations from October through May as shown by male breeding color and tubercles on fin rays and spines.

AS. Brown darter, Etheostoma edwini - The brown darter usually
lives in clear to slightly turbid streams varying in depth from six
inches to two or three feet with moderate current (49). The bottom
consists chiefly of sand with an occasional light overlay of fine silt
or some gravel, and occasionally rock outcrops. The vegetation varies
from sparse to dense. The pH varies from 6.4 to 7.8; the more alkaline
readings have been recorded in spring runs with limestone outcrops.
These darters are most frequently found beneath the leaves of scattered
clumps of vegetation towards the margins of the steams rather than in
the main current. Breeding season is at its height from February to
early April. The males are considerably larger than the females. Food 1
habits are similar to other darters. The brown darter is not recorded
in state catches.

AT. Blackbanded darter, Percina nigrofasciata - This common species is found in streams and rivers over various substrates in association with slow to moderate current and aquatic vegetation (86,87). In Louisiana, the species spawns from mid-February to mid-April. Fecundity ranges from 38 to 250 eggs per female. The blackbanded darter shows two distinct feeding peaks: morning and late afternoon. Immature forms of Diptera, Ephemeroptera, and Trichoptera are dominant in the diet. In an Alabama study, a concurrent 24-hour feeding investigation on cohabiting species of minnows, Notropis baileyi, N. zonistius, and Ericymba buccata, revealed that interspecific competition for food is minimal. Unlike the blackbanded darter, the cohabiting species showed a maximal feeding peak at night. N. baileyi were found to be quiet versatile feeders, while E. buccata depended mostly on benthic organisms. Differential in time of maximal feeding and the nature of foods eaten are probably two of the many factors in reducing potential interspecific competition. The blackbanded darter is not recorded in state catches.

2.7.2.1.2 Historical Benthic Ecology

2.7.2.1.2.1 Introduction - The listing of important species of macroscopic benthic invertebrates and periphyton which inhabit the Choctawhatchee River near the proposed plant site is not possible due to limited historical data. No studies of periphyton (attached algae) have

been conducted in this river (88). Rather sparse and dated studies of macroscopic benthic invertebrate populations have been conducted on the Choctawhatchee River, of which very little pertains to the proposed plant site area. There is no mention or suggestion in the historical data of preexisting, man-induced, environmental stresses in this river near Caryville. Likewise, conclusive historical baseline data is not available relative to macroinvertebrate population characteristics within the proposed plant site area.

2.7.2.1.2.2 Studies (Choctawhatchee River Basin, 1961 to 1968) - During August 1968, the Federal Water Pollution Control Administration made a biological survey of the Choctawhatchee River subbasin in Alabama (89). No sampling was conducted downstream from the Alabama state line. At that time, the conditions found in the Choctawhatchee River two miles southwest of Geneva, Alabama (Station No. 018510), near the Florida state line, were diagnosed as being in a balanced (healthy) condition. No further studies have been conducted by the U. S. Environmental Protection Agency on the Choctawhatchee River within Alabama or Florida (90).

The Florida Department of Pollution Control (FDPC) provided Gulf a limited amount of biological water quality monitoring data (91). Benthic macroscopic invertebrate communities were sampled irregularly at three locations on the Choctawhatchee River during the period of 1961 to 1968. 1
The location of these sampling stations were:

A. Florida State Highway No. 2 bridge in Holmes County, approximately 15 to 20 miles upstream from Caryville.

B. U. S. Highway No. 90 at Caryville.

C. Florida State Highway No. 20 near Ebro, approximately 25 to 30 miles downstream from Caryville on the Walton/Washington County line.

The qualitative data collected at these three stations was interpreted by the FDPC by using a system referred to as the Biotic Index (92). Under this system, streams receiving little or no waste will have values over 10. FDPC records (91) show that during 1966 and 1968, Biotic Index values of 22 and 23, respectively, were found at U. S. Highway No. 90 bridge. In addition, no values less than 10 were found at either State Highway Nos. 2 or 20 during the period of 1961 to 1968. No further data were available from the FDPC.

The most recent biological data obtained by Gulf is part of a continuing study by the FDPC of the macroinvertebrates inhabiting waters which enter the Choctawhatchee Bay, Florida (93).

One of the 50 localities sampled was the U. S. Highway No. 90 bridge near Caryville. The data consists of a species list with no distinction made regarding location. In its present form, interpretation is limited.

2.7.2.2 Site Specific Aquatic Ecology - As shown in figure 2.7-65, Gulf chose nine sampling stations which encompass the proposed plant site area and tributary streams feeding through it. Two of these stations are located upstream from Wrights Creek; one is located in the mouth of Wrights Creek; four are located a relatively short distance below the proposed plant site; and two are located below the confluence of Dram Branch. The sampling stations' identification numbers and locations are as follows:

Station Identification	Location
(1) C1L*	Choctawhatchee River; approximately 200 yards above confluence with Wrights Creek; right side, looking downstream.
(2) C1R*	Choctawhatchee River, approximately 250 yards above confluence with Wrights Creek; right side, looking downstream.
(3) W1C	Wrights Creek; approximately 30 yards upstream from confluence with Choctawhatchee River; center.
(4) C2L*	Choctawhatchee River; approximately 80 yards upstream from the Louisville and Nashville (L&N) railroad trestle near U. S. Highway No. 90 bridge; left side, looking downstream.
(5) C2R*	Choctawhatchee River; approximately 80 yards upstream from the Louisville and Nashville (L&N) railroad trestle near U. S. Highway No. 90 bridge; right side, looking downstream.
(6) C3L	Choctawhatchee River; approximately 150 yards below Interstate Highway No. 10 bridge; left side, looking downstream.
(7) C3R	Choctawhatchee River; approximately 200 yards below Interstate Highway No. 10 bridge; right side, looking downstream.
(8) C4L	Choctawhatchee River; approximately 200 yards below confluence with Dram Branch; left side, looking downstream.
(9) C4R	Choctawhatchee River; approximately 200 yards below confluence with Dram Branch; right side, looking downstream.

*Denotes general area of fish sampling locations used by the U. S. Fish and Wildlife Service.

2.7.2.2.1 Recent Fisheries Ecology - The Choctawhatchee River in the Caryville area is a stream of relatively high energy whose bed is characterized by unstable, shifting sand interspresed with fallen trees, driftwood, and pilings. Rooted aquatic vegetation is essentially absent. Water quality characteristics are summarized in table 3.4-1, "Choctawhatchee River Water Analysis Variation."

2.7.2.2.1.1 Introduction - Fish occupy the upper levels of the aquatic food chain and are both directly and indirectly affected by chemical and physical changes in the environment. Water quality conditions that significantly affect the lower levels of the food chain will affect the abundance, species composition, and conditions of the fish population (94). The condition of the fishery is commonly used as an index of water quality (94). However, realistically, fish population are least satisfactory primarily because fish are difficult to catch, very motile, and less abundant than smaller creatures (95). Gulf reviewed the literature for existing information on the fisheries of the Choctawhatchee River in the area of the proposed plant site. From this search, Gulf determined that the U. S. Fish and Wildlife Service, Panama City, Florida, is engaged in a long-term fish population sampling program in connection with an effort to establish a striped bass, Morone saxatilis, fishery in the Choctawhatchee Bay and River. The information presented below in 2.7.2.2.1.2 through 2.7.2.2.1.4 is taken from this program.

2.7.2.2.1.2 Methods and Materials - A detailed discussion covering methods and materials used in the U. S. Fish and Wildlife Service program (2.7.2.2.1.1 above) is presented in section 6.3, "Ecological Parameters."

2.7.2.2.1.3 Results of Studies

2.7.2.2.1.3.1 Important Fish Species - Table 2.7-16 lists the fish species collected recently from the Choctawhatchee River by the U. S. Fish and Wildlife Service. (For more specific fish data, see tables 2.7A-2 and 2.7A-3 in Section 1 of Appendix D.) Specific information regarding species' life histories, habitat requirements, and thermal tolerances are discussed in subsection 2.7.2.1.1.2.2 above. 2

2.7.2.2.1.3.2 Population Characteristics - The sampling results derived from electroshocking are tabulated in table 2.7A-2 in Section 1 of Appendix D. The average species diversity ($\bar{D}$) values for the 1974 summer period, table 2.7-17, were found to range from 2.76, near the Wrights Creek confluence area, to 2.05 in the U. S. Highway No. 90 bridge area. Sampling accuracy in terms of percent coefficient of variance was ±5.1 percent for monthly samples collected in the Wrights Creek area, and was ±41.7 percent for monthly samples collected in the 2

U. S. Highway No. 90 bridge area. Average values derived from replicate samples (monthly samples in this case) which have a present coefficient of variance greater than 25 percent are not considered by Gulf to be truly representative; therefore, such data presented within this subsection should be considered with this perspective (96). Water quality conditions in the Wrights Creek confluence area, as reflected by the average species diversity ($\bar{D}$) value, appeared to be relatively high (97). The average species diversity ($\bar{D}$) value determined for the U. S. Highway No. 90 bridge area is somewhat doubtful due to the wide variance between replicate samples.

During the time period June 26, 1974, to August 12, 1974, the average standing crop (abundance) of fish in terms of total number per unit effort, table 2.7-17, was found to range from 11.5 (with ±6.2 percent coefficient of variance) in the Wrights Creek confluence area to 15.5 (with ±51.2 percent coefficient of variance) in the U. S. Highway No. 90 bridge area. (For more specific data, see table 2.7A-2 in Section 1 of 2
Appendix D.) Here again, the average standing crop (total number) determined for the U. S. Highway No. 90 bridge area is somewhat doubtful due to the wide variance between replicate samples. The average standing crop (abundance) of fish in terms of net weight per unit effort, table 2.7-17, was found to range from 7,335 grams in the Wright Creek confluence area to 5,885 grams in the U. S. Highway No. 90 bridge area. The average wet weight values derived for each sampling area are somewhat doubtful due to the wide variance of 54.8 percent and 85.0 percent, respectively, between replicate samples. The species composition of fish populations in terms of percent by number and percent by weight is presented in table 2.7-18. (Specific species' numbers and weights are found in table 2
2.7A-2 in Section 1 of Appendix D.) In general, the Centrarachidae (Sunfish Family), Catostomidae (Sucker Family), and the Cyprinidae (Minnow Family) dominate both sampling areas. See table 2.7-18 and see table 2.7A-2 in Section 1 of Appendix D. The condition index, K(TL), of 2
inidividual fish species was calculated from data given in table 2.7A-2 in Section 1 of Appendix D, and is presented in table 2.7-19 and in table 2.7A-2 in Section 1 of Appendix D. The average K(TL) values computed for each species was found to fall with K(TL) values recorded in the literature (76). This gives some indication that the fish species collected in the study area were in a healthy condition.

2.7.2.2.1.4 <u>Summary of Results of Studies</u> - Fisheries data provided by the U. S. Fish and Wildlife Service indicate a relatively wide variety of species inhabit the study area. Of these 29 percent were recreational, 40 percent were commercial, and 31 percent were rough and forage types. No abnormalities were indicated by the computer average conditions index, K(TL), of each fish species. To data, no striped bass or eggs have been collected in the vicinity of the proposed plant site area.

2.7.2.2.2 Recent Benthic Ecology

2.7.2.2.2.1 Introduction - Benthic macroscopic invertebrate animals are those forms retained by a U. S. Standard No. 30 mesh sieve (98), such as shrimp, snails, clams, and aquatic insects, and which form the important intermediate link between fish at the top of the food chain and microscopic forms such as bacteria, algae, and zooplankton at the bottom of the food chain. These fish-food organisms are restricted to relatively small areas of the stream bed during at least a portion of their life cycle, and, unlike fish, are not capable of moving from one area to another quickly to avoid adverse conditions. No two species of benthic organisms have the same tolerance to adverse water quality conditions. For these reasons, benthic animal populations were used primarily to biologically assess water quality conditions. The use of benthic organisms in water quality assessments, in preference to others, is well documented in the literature (99,100).

Truly aquatic benthic animals are totally dependent upon the chemical and physical characteristics of their environment for survival and propagation. It thus follows that the characteristics of benthic populations (such as the variety and number of animals and the species composition within a unit area) are reflective of past and prevailing water quality conditions. Therefore, any significant change in water quality conditions results in a corresponding change in benthic population characteristics. 1

A general rule of thumb in water pollution ecology is that a relatively healthy body of water supports a wide variety of organisms (101).

2.7.2.2.2.2 Methods and Materials- A detailed discussion concerning the methods used for aquatic benthic organisms is presented in section 6.3, "Ecological Parameters."

2.7.2.2.2.3 Results of Studies

2.7.2.2.2.3.1 Macroinvertebrate Species Found - Listed in table 2.7-20 are those species of macroinvertebrate benthic invertebrates found to inhabit the Choctawhatchee River in the area of the proposed plant site. Readily available species distribution information (other than that provided herein) is referenced. References to the biology and ecology of the various species are cited from many sources. For this reason, application of data from one body of water to another should be made with full recognition of possible variation.

2.7.2.2.2.3.2 Population Characteristics - The following discussion deals primarily with the study area and sampling areas in general and less specifically with individual sampling stations. Sampling results derived from multiple - plate samplers are tabulated on tables 2.7-21, -22, and -23. Fifty-seven species of benthic invertebrates were found in the study area, table 2.7-21, of which midge larvae (Diptera) and mayflies

(Ephemeroptera) comprised approximately 70 percent and 18 percent of the population by number, respectively. The percent composition of benthic populations, by weight, was dominated by mayflies (Ephemeropters), 31.2 percent; operculate snails (Mesogostropoda), 18.0 percent; dragonflies and damselflies (Odonta), 18.0 percent; stoneflies (Plecoptera), 11.1 percent; and midges (Chironomidae), 9.6 percent. (See table 2.7-23.)

The standing crop of benthic fish-food organisms, in terms of total number and wet weight per unit area, was found to be relatively low on multiple - plate samplers. The average number of animals found in the study area was 72 per 0.09 (abbreviated 72/0.09) square meter (one square foot), with a range span of 42.5 to 125.3. (See table 2.7-22.) The average sampling accuracy attained within sampling stations, expressed as percent coefficient of variance, was ± 32 percent of mean values obtained, with a range span of 1.2 to 90.2 percent. The average wet weight of animals found in the study area was 0.2404 grams/0.09 square meter (one square foot), with a range span of 0.0237 to 1.2049. (See table 2.7-22.) The average sampling accuracy obtained within sampling stations, expressed as percent coefficient of variance, was ± 63 percent of mean values obtained, with a range span of 8.0 to 126.1 percent. (See table 2.7-22.)

While the standing crop of benthic fishfood organisms was found to be relatively low, species diversity values reflected relatively high water-quality conditions. One study (97) indicated the species diversity ($\overline{D}$) in unpolluted waters ranged between 2.60 and 4.61, while ($\overline{D}$) in polluted water ranged between 0.49 to 1.60. This study was made of $\overline{D}$ values calculated from the data which numerous authors had collected from a variety of polluted and unpolluted waters. 1

The average species diversity ($\overline{D}$) value of benthic populations found in the Caryville study area was 3.03, with a range span of 2.20 to 3.52. (See table 2.7-22.) The average sampling accuracy attained within sampling stations, expressed as percent coefficient of variance, was ±8.3 percent of mean values obtained, with a range span of 0.0 to 20.9 percent. (See table 2.7-22.)

Four species of mussels, clams, and snails were collected in tow-dredges made along sandbars in the study area. (See table 2.7-24.) The quantitative distribution of mollusks, in terms of number and wet weight, was found to vary greatly within the study area. The average number of mollusks found within the study area was 18.9 per 50-yard dredge tow, with a range span of 1.5 to 65.5. The average sampling accuracy attained within sampling stations, expressed as percent coefficient of variance, was ± 49.7 percent of mean values obtained, with a range span of 12.9 to 91.8. The average wet weight of mollusks found within the study area was 48.746 grams per 50-yard dredge tow, with a range span of 1.457 to 174.423. The average sampling accuracy attained within sampling stations, expressed as percent coefficient of variance, was ± 58.6 percent, with a

range span of 15.4 to 95.6 percent. Of the four species collected, the clam Corbicula malinensis (Philippi) was found to be the dominant form both by number and by weight (82.8 percent and 95.0 percent respectively). This clam, in addition to being a nuisance organism (102) which can clog industrial and water treatment plant pumps, is itself a pollutant. Corbicula poses a threat to the native shell fauna as a competitor for space, because of its ability to exploit virtually any substrate (103).

Quantitative sampling of shell animals, particularly mussels, is most difficult and, consequently, correlation with environmental conditions is rare (104). Population distribution is often seemingly erratic due to their mass movement. There is disagreement about what inspires mussels, ordinarily very sedentary, to move about. Such movement had been ascribed to such things as water depth, season, temperature, light, and starvation (103).

2.7.2.2.2.4 Summary of Results of Studies - Data collected by Gulf indicates that water quality conditions are relatively high in the study area, as was reflected by the species diversity ($\bar{D}$) of benthic fish-food populations found to inhabit the area (97). Dominant fish-food organisms were midgeflies (70 percent) and mayflies (18 percent). The asiatic clam, Corbicula, was the dominant mollusk (83 percent by number and 95 percent by weight) in the study area. 1

2.7.2.2.3 Recent Periphyton Ecology

2.7.2.2.3.1 Introduction -Periphyton, or attached algae, form the principal base of the food chain in streams such as the Choctawhatchee River in the area of the Caryville site (94). Truly planktonic, or freefloating, forms originate in the backwaters, oxbows, and ponds which might feed into the system and diminish in number with relation to the distance from their source (105).

Periphyton populations can establish themselves very rapidly due to their high reproductive capacity; therefore, the study of this biological parameter is best used where continuous, rather than intermittent, adverse water quality conditions might be encountered (94). At best, they are secondary in importance to benthos populations in biologically assessing water-quality conditions, primarily because of their position in the energy flow of the food chain and their reproductive capacity (94).

2.7.2.2.3.2 Methods and Materials - A detailed discussion concerning the methods and materials used to study periphyton in the Caryville area is presented in section 6.3, "Ecological Parameters."

2.7.2.2.3.3 Results of Studies

2.7.2.2.3.3.1 Periphyton Species Found - Listed below are the species of periphyton (attached algae) found to inhabit the glass slides suspended in the sampling area during the period of August 1 to 29, 1974 (106).

Chlorophyta (Phylum) green algae

Closterium dianae Ehrbg. var. minus (Will) Schroder

Cyanophyta (Phylum) bluegreen algae

Lyngbya diguetii Gomont
Oscillatoria chalybea Mertins
Plectonema gracillimum (Zopf) Hansg.
Schizothrix calcicola (Ag.) Heurck

Chrysophyta (Phylum) diatom algae

Bacillaria paradoxa Gemlin
Caloneis bacillum (Grun.) Cl.
Cocconeis placentula Ehrbg.
Cymbella amphicephala Naeg.
Cymbella tumida (Breb.) Heurck 1
Fragilaria capucina Desmazieres
Gomphonema olivaceum (Lyngbye) Ktz.
Gyrosigma spencerii (W.Smith) Cl. var. nodifera Grun.
Melosira varians C.A.Ag.
Navicula confervacea Ktz.
Navicula cryptocephala Ktz.
Navicula rhyncocephala Ktz.
Neidium affine (Ehr.) Pfitz.
Nitzschia acicularia (Ktz.) Wm Smith
Nitzschia filiformis (Wm Smith) Hustedt
Nitzschia igncrata Kraiike
Nitzschia palea (Ktz.) Wm Smith
Nitzschia tryblionella Hantz var. victoriae Grun.
Pinnularia mormonorum (Grun.) Patr.
Stauroneis obtusa Lagerst.
Surirella elegans Ehr.
Surirella linearis Wm Smith
Surirella saxonica Auersw.
Synedra ulna (Nitzsch.) Ehr.
Synedra ulna (Nitzsch.) Ehr. var. aequalis (Ktz.) Hust.

The biology, ecology, habitat requirements, and thermal tolerances are discussed in general terms for the types of algae found rather than individual species, as follows:

A. Algae are simple, one-celled microscopic plants which form the principal base of the food chain (94). Generally speaking, the size of phytoplankton populations is controlled by the amount of sunlight, temperature, and dissolved nutrients available (107). The seizure and storage of energy is effected only by algae through photosynthesis in the presence of sunlight, water, and carbon dioxide. Oxygen is a by-product of photosynthesis (108).

B. The algal community of rivers is essentially sessile, grows on solid bodies, and can develop only where these are present. In muddy reaches, the steady rain of silt can smother algal growth. In addition, silt can greatly lower the light intensity and render algal growth less possible (95). The periphyton of natural or healthy streams are reported to be largely made up of diatoms with a few greens and bluegreens present (109).

C. According to one source, "A review of the literature indicates that moderate increases in temperature toward the optimum range for the growth of species increases algal growth. Temperature shifts toward the upper limits of the tolerance range and beyond bring about a shift in species composition usually from diatom-dominated communities to those dominated by bluegreen algae" (110). In
general, the diatoms are represented by the largest number of 1
species with relatively low temperature tolerances, that is, below 30°C (86°F) (111). Between the temperature of 30°C to 35°C (86° to 95°F), green algae become dominant; above 35°C (95°F), blue-green algae become dominant (111).

<u>2.7.2.2.3.3.2 Population Characteristics</u> - Sampling results derived from glass slide samplers are tabulated on table 2.7-25. The following discussion deals primarily with the study area and sampling areas in general and less specifically with individual sampling stations. Thirty species of algae were found to inhabit the study area, of which 83.3 percent were diatoms, followed by bluegreens (10.3 percent) and greens (3.3 percent) (123).

The average standing crop of periphyton in the study area, in terms of total number per milliliter of water, was 8,557, with a range span of 3,060 to 14,280. The percent composition, by number, was 86.1 percent diatoms and 13.9 percent bluegreens. Relatively identical results were obtained when comparing sampling stations within sampling areas. The average percent coefficient of variance between right and left banks was ± 11.6 percent.

The average standing crop of periphyton in the study area, in terms of total standard areal units (volume) per milliliter of water, was 7,273, with a range span of 2,157 to 14,807, of which 98.2 percent were diatoms and 1.8 percent bluegreen algae.

2.7.2.2.3.4 Summary of Results of Studies - Data collected by Gulf indicated that water quality conditions are relatively high in the study area, as was reflected particularly in the species number and composition of the periphyton populations (attached algae). The populations of attached algae, which form the base of the aquatic food chain, were dominated by diatoms (86 percent by number and 98 percent by volume) in the study area. 1

2.7.2.2.4 Summary of Recent Fisheries, Benthic, and Periphyton Ecology - Recent biological studies made of the Choctawhatchee River in the proposed Caryville plant site indicate that water quality conditions are relatively high, while the biological productivity of the river is relatively low. Biologically, the study area is characterized by (proceeding from the base of the food chain to fish): a dominance of diatom algae; a dominance of midge and mayflies; and a relatively even distribution of recreational, commercial, rough, and forage type fish. No striped bass or eggs have been collected. The asiatic clam, Corbicula, is the dominant mollusk in the area and poses a threat to the native mollusk fauna, as well as to potential industrial and municipal water users.

2.7.3 Additional Detailed Ecological Data 3

Refer to Section 2 of Appendix D for additional detailed ecological data supplementary to that contained in 2.7.1 and 2.7.2 above.

2.7.4 References

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TABLE 2.7-20 (Continued)

TAXONOMIC NAME (Collected by Gulf Except as noted)	PHYSICAL HABITAT			LIFE HISTORIES (Species Specific Only)	RANGES OF CERTAIN WATER QUALITY PARAMETERS AT WHICH SPECIES HAVE BEEN FOUND (Reference 103 Except as Noted)					
	Type Bottom	Lentic	Lotic		Temp.	pH	Alkalinity (mg/l)	Dissolved Oxygen (mg/l)	Total Hardness (mg/l)	Turbidity
Oecetis cinerascens (Hagen)	Submerged Logs, etc. (119)		x	Not Available	62.6 to 95°F (120)	6.8 to 8.4	20 to 107	5 to 10	13 to 176	6 to 52
Heureclipsis sp. (McLachlan)	Submerged Logs, etc. (119)		x	Not Available	53.6 to 95°F (120)	5.5 to 8.5	4 to 116	6 to 14	8 to 800	7 to 259
Cyrnellus fraternus (Banks)	Submerged Logs, etc. (119)	x	x	Omniverous; construct net-like retreat; adults emerge May through October (119)		7.3 to 7.7	40 to 58	5 to 10	54 to 75	8 to 126
Cheumatopsyche sp. (Wallengren)	Submerged Vegetation etc. (103)		x	Not Available	53.6 to 95°F (120)	3 to 9 (120)	2 to 180	1 to 15 (120)	10 to 5,000 (120)	4 to >72,000
Nais barbata (Müller)	Silt and Mud (121)	x		Asexual reproduction, forming chains of individuals (122)						
Nais variabilis (Piquet)	Silt and Mud (121)	x		Same as Nais barbata						
Nais pseudobtusa (Piquet)	Silt and Mud (121)	x		Same as Nais barbata						
Acroneuria arenosa (Pictet)	Submerged Logs, etc. (123)		x	Carnivorous; 2 to 3 year life cycle (124)						
Paragnetina sp. (Klapalek)	Submerged Logs, etc. (103)		x	Not Available		7.6	86	10	5,000	3
Perlesta placida (Hagen) (91)	Submerged Logs, etc (124)		x	Carnivorous; adults emerge from May to August (124)		5.5 to 8.4	4 to 122	5 to 12	6 to 800	5 to 98
Corydalus cornutus (Linneaus)	Submerged Logs, etc. (121)		x	Carnivorous; egg laying and pupation occurs on shore; 2 to 3 year life cycle (121)	80°F (116)	5.5 to 8.8	4 to 206	5 to 14	4 to 233	5 to >72,000
Chauliodes pecticornis (Linneaus)	Submerged Logs, etc. (121)		x	Carnivorous; egg laying and pupation occurs on shore (121)		5.6 to 8.4	2 to 116	3 to 14	7 to 159	6 to 100
Elliptio strigosus (Lea)	Shifting Sands and Fine Mud (103)		x	Feeds on detritus and animal plankters fertilization takes place in water; mature larvae, in the millions, shed in water and reach development on host fish, before settling on bottom (103)						

1

TABLE 2.7-1

PERCENT COMPOSITION OF MAJOR COMMUNITY TYPES

TYPES	WITHIN PROPERTY BOUNDARIES (PERCENT)	WITHIN PROJECTED SITE IMPACT AREA (PERCENT)
CYPRESS BAYHEAD	6.1	6.8
BAYHEAD	18.7	15.0
MIXED MESOPHYTIC HARDWOODS	15.7	19.5
PINE PLANTATION	34.8 {19.6 MESOPHYTIC, 15.2 XEROPHYTIC}	23.4 {13.2 MESOPHYTIC, 10.2 XEROPHYTIC}
SAND HILL	11.4	8.8
RUDERAL	13.2	16.4
MIXED HARDWOOD SWAMPS	0.0	10.1
TOTALS	99.9	100.0

TABLE 2.7-2

IMPORTANCE VALUES OF THE TREE COMPONENT OF NATURAL COMMUNITIES AND ASSOCIATED DIVERSITY INDICES

COMMON NAME	CBH #	BH #	MHS #	MMH #	SH #	XSC #
POND CYPRESS	53.9*					
WHITE TITI	28.1*	12.7*				
TUPELO	18.0*	47.0*	21.4*	6.4		
SWEETBAY MAGNOLIA		21.2*		2.4		
POND PINE		4.0		1.0		
BUCKWHEAT TREE		4.4		0.9		
RED MAPLE		4.0	10.7*	3.1		
FETTERBUSH		2.9				
RED BAY		3.7		1.8		
OVERCUP OAK			8.9			
GREEN ASH			22.3*			
FLORIDA ELM			8.2	3.9		
BUTTON BUSH			1.9			
DIAMOND LEAF OAK			6.2			
SWEETGUM			4.7	4.9		
WATER HICKORY			9.0			
BALD CYPRESS			6.7			
BLACKJACK OAK				4.0		
CHERRY				1.2	2.8	
LARGE GALLBERRY				0.9		
LIVE OAK				23.6*	20.1*	11.9*
DOGWOOD				8.8		
SLASH PINE				5.1		
WINGED SUMAC				1.6		
TURKEY OAK				3.0	11.1*	38.5*
HUCKLEBERRY				6.1	3.4	
HOLLY				1.9		
SWAMP AZALEA				1.4		
SPRUCE PINE				3.0		
WILD OLIVE				1.8		
DEERBERRY				1.2		
MAGNOLIA				1.6		
LAUREL OAK				6.4		
POST OAK				1.6		
BEECH				2.7		
PERSIMMON					10.9*	
LONG LEAF PINE					39.1*	25.4*
SAND POST OAK					5.4	24.2*
DWARF LIVE OAK					7.0	
TOTAL NUMBER SPECIES	3	8	10	33	8	4
TOTAL NUMBER INDIVIDUALS	138	198	83	511	46	10
SPECIES DIVERSITY INDEX ($\bar{H}$)	0.96	1.53	2.04	2.71	1.77	1.17

\# CBH = Cypress Bayhead Community
BH = Bayhead Community
MHS = Mixed Hardwood Swamp Community
MMH = Mixed Mesophytic Hardwood Community
SH = Sandhill Community
XSC = Xerophytic Scrub Community

* = An importance value greater than 10, i.e., a dominant plant

TABLE 2.7-3

IMPORTANCE VALUES OF THE TREE COMPONENT
OF DISTURBED COMMUNITIES AND ASSOCIATED DIVERSITY INDICES

COMMON NAME	MPPU#	MPPB#	XPPU#	XPPB#
CHERRY			5.1	
LIVE OAK	39.5*	16.5*	28.0*	21.0*
DOGWOOD			0.8	1.5
SLASH PINE	17.4*	70.0*	39.7*	37.1*
WINGED SUMAC	3.0			
TURKEY OAK	8.0	13.5*	4.2	8.4
HUCKLEBERRY	7.6		8.8	5.2
DEERBERRY				2.0
POST OAK			1.1	1.6
PERSIMMON	5.2		1.6	4.0
SHORT NEEDLE PINE	19.3*		5.8	19.4*
LONG LEAF PINE			3.2	
SAND POST OAK			2.0	
TOTAL NUMBER OF SPECIES	7	3	11	9
TOTAL NUMBER INDIVIDUALS	95	28	273	170
SPECIES DIVERSITY INDEX, ($\overline{H}$)	1.52	0.71	1.51	1.56

\# MPPU = Mesophytic Pine Plantation Community (Unburned)
MPPB = Mesophytic Pine Plantation Community (Burned)
XPPU = Xerophytic Pine Plantation Community (Unburned)
XPPB = Xerophytic Pine Plantation Community (Burned)

* = An importance value greater than 10, i.e., a dominant plant

TABLE 2.7-4

IMPORTANCE VALUES OF THE SHRUB COMPONENT OF DISTURBED NATURAL COMMUNITIES AND ASSOCIATED DIVERSITY INDICES

COMMON NAME	CBH#	BH#	MMH#	SH#	XSC#
VINE WICKY	14.5*	2.9			
WHITE TITI	8.1	11.0*	2.0		
FETTERBRUSH	31.2*	36.4*	7.4		
MALEBERRY	3.3	0.4	1.3		
SWAMP LEUCOTHOE	34.9*	9.9*	8.3		
CYPRESS	4.6				
VIRGINIA WILLOW	3.4	10.4*	0.8		
SWEETBAY MAGNOLIA		6.9	3.3		
SWAMP AZALEA		5.8	2.5		
MYRTLE LEAVED HOLLY		0.4		9.6	
TUPELO		1.0	0.4		
INKBERRY		0.6	7.4	1.0	
BUCKWHEAT TREE		1.8	12.9		
RED MAPLE		3.8	2.3		
WAX MYRTLE		1.6	0.7		
MUSCADINE		1.8	3.1		
LARGE GALLBERRY		4.6	3.8		
POISON IVY		0.8	0.7		
TURKEY OAK			3.6	15.6*	32.3*
BLACKJACK OAK			0.3		
HIGHBUSH BLUEBERRY			6.3	3.4	
LIVE OAK			10.8*	29.3*	13.9*
HOLLY			2.5		
NARROW LEAF PAW-PAW			1.5	7.9	
SWEET GUM			1.3		
HUCKLEBERRY			3.4	4.3	26.4*
PERSIMMON			0.4	10.2*	20.5*
DEERBERRY			3.1	2.8	7.0
BEAUTY BERRY			0.7		
FLORIDA ELM			0.9		
FLORIDA CHINQUAPIN			0.4		
MAGNOLIA			3.1		
WILD PLUM			0.4		
RED BAY			1.5		
DOGWOOD			2.0		

TABLE 2.7-4 (Continued)

COMMON NAME	CBH#	BH#	MMH#	SH#	XSC#
CHERRY			0.4		
DWARF LIVE OAK				10.4*	
WINGED SUMAC				0.9	
POST OAK				0.9	
SAND POST OAK				3.2	
TOTAL NUMBER SPECIES	7	17	31	13	5
TOTAL NUMBER INDIVIDUALS	29	575	358	148	23
SPECIES DIVERSITY INDEX, ($\overline{H}$)	1.66	1.81	2.81	1.89	2.37

\# CBH = Cypress Bayhead Community
BH = Bayhead Community
MMH = Mixed Mesophytic Hardwood Community
SH = Sandhill Community
XSC = Xerophytic Scrub Community

* = An importance value greater than 10, i.e., a dominant plant

TABLE 2.7-5

IMPORTANCE VALUES OF THE SHRUB COMPONENT OF DISTURBED COMMUNITIES AND ASSOCIATED DIVERSITY INDICES

COMMON NAME	MPPU#	MPPB#	XPPU#	XPPB#
MYRTLE LEAVED HOLLY			1.3	
INKBERRY			3.0	12.0*
MUSCADINE			0.7	
TURKEY OAK	20.4*		3.1	12.4*
HIGHBUSH BLUEBERRY			16.1*	23.6*
LIVE OAK	16.4*	78.3*	21.0*	26.3*
NARROW LEAF PAW-PAW	2.1	5.9	0.7	5.5
HUCKLEBERRY			22.4*	3.7
PERSIMMON	13.8*	8.1	3.2	2.1
DEERBERRY			10.2*	1.7
BEAUTY BERRY			0.9	
WILD PLUM			7.9	
CHERRY			3.1	
SLASH PINE	12.8*	7.6	1.3	7.1
DWARF LIVE OAK	17.2*			3.1
SHORT NEEDLE PINE	13.4*			
CRAB APPLE	3.9			
WINGED SUMAC			3.1	
HICKORY			1 2	
POST OAK			0.8	
BEGGARS LICE				2.4
TOTAL NUMBER SPECIES	8	4	17	11
TOTAL NUMBER INDIVIDUALS	57	20	221	75
SPECIES DIVERSITY INDEX, ($\overline{H}$)	1.78	0.71	2.01	1.90

\# MPPU = Mesophytic Pine Plantation Community (Unburned)
MPPB = Mesophytic Pine Plantation Community (Burned)
XPPU = Xerophytic Pine Plantation Community (Unburned)
XPPB = Xerophytic Pine Plantation Community (Burned)

* = An importance value greater than 10, i.e., a dominant plant

TABLE 2.7-6

INVENTORY OF FLORA ENCOUNTERED

TREES

SCIENTIFIC NAME	COMMON NAME
Taxodium ascendens Brongn.	Pond cypress
Cyrilla racemiflora L.	White titi
Nyssa biflora Walt.	Swamp tupelo
Magnolia virginiana L.	Sweetbay magnolia
Pinus serotina Michx.	Pond pine
Cliftonia monophylla (Lam.) Britton	Buckwheat tree
Acer rubrum L.	Red maple
Lyonia lucida (Lam.) K. Koch	Fetterbush
Persea palustris (Raf.) Sarg.	Red bay
Quercus lyrata Walt.	Overcup oak
Fraxinus pennsylvanica Marsh.	Green ash
Ulmus americana v. floridana (Chapm.) Little	Florida elm
Cephalantus occidentalis L.	Button bush
Quercus laurifolia Michx.	Diamond leaf oak
Liquidambar stryaciflua L.	Sweet gum
Carya aquatica (Michx.) Nutt.	Water hickory
Taxodium distichum (L.) Rich.	Bald cypress
Quercus marilandica Meunch	Blackjack oak
Prunus sp.	Cherry
Ilex coriaceae (Pursh) Chapman	Large gallberry
Quercus virginiana Miller	Live oak
Corcus florida L.	Dogwood
Pinus elliottii Engelm.	Slash pine
Rhus copallina L.	Winged sumac
Quercus laevis Walt.	Turkey oak
Gaylussacia frondosa (L.) T. & G.	Huckleberry
Ilex opaca Aiton	Holly
Diospyros virginiana L.	Persimmon
Vaccinum stamineum L.	Deerberry
Callicarpa americana L.	Beauty berry
Ulmus americana v. floridana (Chapm.) Little	Florida elm
Castaenea floridana (Sarg.) Ashe.	Florida chinquapin
Magnolia grandiflora L.	Magnolia
Prunus sp.	Wild plum
Persea palustris (Raf.) Sarg.	Red bay
Cornus florida L.	Dogwood
Prunus sp.	Cherry
Pinus elliottii Engelm.	Slash pine
Quercus minima (Sarg.) Small	Dwarf live oak
Pinus echinata Miller	Short needle pine
Crataegus sp.	Crab apple
Rhus copallina L.	Winged sumac
Carya aquatica (Michx.) Nutt.	Water hickory
Quercus stellata Wang.	Post oak

TABLE 2.7-6 (Continued)

SCIENTIFIC NAME	COMMON NAME
Desmodium sp.	Beggars lice
Quercus margaretta Ashe.	Sand post oak
Sassafras albidum (Nutt.) Nees	Sassafras
SHRUBS	
Pieris phillyreifolia (Hook.) D.C.	Vine wicky
Cyrilla racemiflora L.	White titi
Lyonia lucida (Lam.) K. Koch	Fetterbush
Lyonia ligustrina (L.) D.C.	Maleberry
Leucothoe racemosa (L.) Gray	Swamp leucothoe
Taxodium ascendens Brongn.	Pond cypress
Itea virginica L.	Virginia willow
Magnolia virginiana L.	Sweetbay magnolia
Rhododendron viscosum var. serratulum (Small)	Ahles Swamp azalea
Ilex myrtifolia Walt.	Myrtle leaved holly
Nyssa biflora Walt.	Swamp tupelo
Ilex glabra (L.) Gray	Inkberry
Cliftonia monophylla (Lam.) Britton	Buckwheat tree
Acer rubrum L.	Red maple
Myrica cerifera L.	Wax myrtle
Vitis rotundifolia Michx.	Muscadine
Ilex coriaceae (Pursh) Chapman	Large gallberry
Rhus radicans L.	Poison ivy
Quercus laevis Walt.	Turkey oak
Quercus marilandica Meunch	Blackjack oak
Vaccinum elliottii Chapman	Elliott blueberry
Quercus virginiana Miller	Live oak
Ilex opaca Aiton	Holly
Asimina angustifolia Gray	Narrow leaf paw-paw
Liquidambar styraciflua L.	Sweet gum
Gaylussacia frondosa L.	Huckleberry
Rhododendron viscosum var. serratulum (Small)	Ahles Swamp azalea
Pinus glabra Walt.	Spruce pine
Osmanthus americana (L.) Benth. & Hook.	Wild olive
Vaccinum stamineum L.	Deerberry
Magnolia grandiflora L.	Magnolia
Quercus hemisphaerica Bartr.	Laurel oak
Quercus stellata Wang.	Post oak
Fagus grandifolia Ehrh.	Beech
Diospyros virginiana L.	Persimmon
Pinus echinata Miller	Short needle pine
Pinus palustris Miller	Long leaf pine
Quercus margaretta Ashe.	Sand post oak
Quercus minima (Sarg.) Small	Dwarf live oak
Nyssa ogeche Bartram	Ogeeche tupelo

TABLE 2.7-6 (Continued)

HERBS AND GRASSES

SCIENTIFIC NAME	COMMON NAME
Osmunda cinnamonea L.	Cinnamon fern
Serenoa repens (Bartr.) Small	Saw palmetto
Lyonia lucida (Lam.) K. Koch	Fetterbush
Vitis rotundifolia Michx.	Muscadine
Kalmia hirsuta Walt.	No common name
Gaylussacia frondosa (L.) T. & G.	Huckleberry
Smilax spp.	Greenbriar
Rhynchosia reniformis D.C.	No common name
Eriogonum tomentosum Michaux	Dog tongue
Aster sp.	Aster
Euphorbia curtisii Engelm.	No common name
Clitoria mariana L.	Butterfly pea
Berlandiera pumila (Michx.) Nutt.	Berlandiera
Stylosanthes biflora (L.) B.S.P.	Pencil flower
Hypericum sp.	St. John's wort
Ilex opaca Aiton	Holly
Solidago spp.	Goldenrod
Rhus radicans L.	Poison ivy
Andropogon sp.	Blue stem
Cnidoscolus stimulosus (Michx.) Engelm & Gray	No common name
Ambrosia artemisiifolia L.	Ragweed
Desmodium floridanum? Chapman	Beggar's lice
Gnaphalium obtusifolium L.	Everlasting
Hypericum hypericoides (L.) Crantz	St. Andrew's cross
Quercus laevis Walt.	Turkey oak
Desmodium sp.	Beggar's lice
Cronton punctatus Jacquin	No common name
Galium spp.	Bedstraw
Asimina angustifolia Gray	Narrow leag paw-paw
Diospyros virginiana L.	Persimmon
Helianthis sp.	Sunflower
Helianthus radula (Pursh) T. & G.	Sunflower
Pterocaulon pycnostachyum (Michx.) Ell.	Rabbit tobacco
Ilex glabra (L.) Gray	Inkberry
Veronia sp.	Iron weed
Myrica cerifera L.	Wax myrtle
Botryococcus ? sp.	Fern
Hibiscus aculeatus Walt.	Mallow
Rubus sp.	Blackberry
Galactica volublis (L.) Britton	No common name
Lonicera sp.	Honeysuckle
Rhus copallina L.	Winged sumac
Hypericum gentianoides (L.) Britton	Pine weed
Schrankia microphylla (Solander ex Smith) MacBride	Sensitive briar

TABLE 2.7-6 (Continued)

SCIENTIFIC NAME	COMMON NAME
Eupatorium capillifolium (Lam.) Small	Dog fennel
Cassia fasiculata Michx.	Partridge pea
Elephantopus elatus Bettoloni	Elephant foot
Hypericum? sp.	St. John's wort
Liatris gracilis Pursh	Blazing star
Strophostyles helvola? (L.) Ell.	No common name
Mentha sp.	Peppermint
Quercus virginiana Miller	Live oak
Yucca filamentosa L.	Bear grass
Rhexia cubensis Grisebach	Meadow beauty
Indigofera caroliniana Miller	No common name
Oxalis spp.	Sorrel
Kuhnia eupatorioides L.	False boneset
Chrysobalanus oblongifolius Michs.	Gopher apple
Carex glaucescens Ell.	Sedge
Rhexia mariana L.	Meadow beauty
Froelichia floridana (Nutt.) Moq.	Cotton weed
Eriocaulon decangulare L.	Pipewort
Verbena brasiliensis Vellozo	Verbena
Commelina communis L.	Dayflower
Tillandsia usenoides L.	Spanish moss
Myrica cerifera var. pumila Raf.	Dwarf wax myrtle
Arundinaria gigantea (Walt.) Muhl.	Cane
Aristida sp.	Wire grass
Sphagnum sp.	Sphagnum moss
Rhus toxicodendron L.	Poison oak

? = A question mark following the scientific name indicates either:
Genus ? sp. - Generic epithet uncertain, or
Genus species ? - Species epithet uncertain.

TABLE 2.7-7

INVENTORY OF FAUNA ENCOUNTERED

REPTILES AND AMPHIBIANS

SCIENTIFIC NAME	COMMON NAME
Agkistrodon piscivorus piscivorus	Eastern cottonmouth
Crotalus adamanteus	Eastern diamondback rattlesnake
Sistrurus miliarius barbouri	Florida ground rattlesnake
Coluber constrictor helvigularis	Brown-chinned racer
Opheodrys aestivus	Rough green snake
Lampropeltis getulus getulus	Eastern king snake
Coluber flagellum flagellum	Eastern coachwhip
Natrix sipedon	Banded water snake
Storeria occiptomaculata*	Red-bellied snake
Terrapene carolina bauri	Florida box turtle
Terrapene carolina carolina	Common box turtle
Terrapene carolina triunguis	Three-toed box turtle
Gopherus polyphemus	Gopher tortoise
Pseudemys scripta	Yellow-bellied turtle
Deirochelys veticularia	Chicken turtle
Sternothaerus carinatus minor	Loggerhead musk turtle
Alligator mississippienis	American alligator
Eumeces inexpectatus	Southeastern five-lined skink
Lygosoma laterale	Ground skink
Cnemidophorus sexlineatus	Six-lined racerunner
Scelophorus undulatus undulatus	Southern fence lizard
Anolis carolinensis	Carolina anole
Ophisaurus compressus*	Coastal glass snake
Ophisaurus ventralis	Common glass snake
Desmognathus fuscus*	Dusky salamander
Manculus quadridgitatus	Dwarf salamander
Rana pipiens sphenocephala	Southern leopard frog
Acris gryllus dorsalis	Florida cricket frog
Acris gryllus gryllus	Common cricket frog
Hyla gratiosa	Barking tree frog
Hyla cinerea cinerea	Green tree frog
Hyla versicolor versicolor	Common tree frog
Microhyla carolinensis carolinensis	Eastern narrow-mouth toad
Bufo quercicus	Oak toad
Bufo terrestrias	Southern toad

BIRDS

Colinus virginianus	Bobwhite quail
Pyrrhuloxia cardinalis	Cardinal
Parus carolinensis	Carolina chickadee

TABLE 2.7-7 (Continued)

SCIENTIFIC NAME	COMMON NAME
Myriarchus crinitus	Great crested flycatcher
Quiscalus quiscula	Common grackle
Caprimulgus carolinensis	Chuck-will's-widow
Thryothorus ludovicianus	Carolina wren
Lanius ludovicianus	Loggerhead shrike
Cyanocitta cristata	Blue jay
Toxostoma rufum	Brown thrasher
Corvus brachyrhynchos	Common crow
Mimus polyglottos	Mocking bird
Pipilo erythrophthalmus	Rufous-sided towhee
Euphagus carolinus	Rusty blackbird
Seiurus aurocapillus	Ovenbird
Emphidonax flaviventris	Yellow-bellied flycatcher
Hylocichla mustelina	Wood thrush
Coccyzus americanus	Yellow-bellied cuckoo
Dryocopus pileatus	Pileated woodpecker
Centurus carolinus	Red-bellied woodpecker
Colaptes auratus	Yellow-shafted flicker
Zenaidura macroura	Mourning dove
Columbigallina passerina	Ground dove
Bubo virginianus	Great horned owl
Buteo lineatus	Red-shouldered hawk
Coragyps atratus	Black vulture
Florida caerulea	Little blue heron
Ardea herodias	Great blue heron
Ardeola ibis	Cattle egret
Casmerodius albus	Common egret

MAMMALS

SCIENTIFIC NAME	COMMON NAME
Neotoma floridana	Florida woodrat
Sigmodon hispidus	Hispid cotton rat
Reithrodontomys humulis*	Eastern harvest mouse
Sylvilagus floridanus	Eastern cottontail
Procyon lotor	Raccoon
Didelphis marsupialis	Oppossum
Sciurus carolinensis	Gray squirrel
Sciurus niger	Eastern fox squirrel
Odocoileus virginianus	White-tailed deer

TABLE 2.7-7 (Continued)

SCIENTIFIC NAME	COMMON NAME
Urocyon cinereoargenteus	Gray fox
Castor canadensis	Beaver
Ondatra zibethicus*	Muskrat
Felis concolor coryi	Florida panther
Scalopus aquaticus	Eastern mole
Dasypus novemcinctus	Nine-banded armadillo
Neofiber alleni*	Florida water rat

* No positive identification (not actually seen).

TABLE 2.7-8

DISTRIBUTION AND OCCURRENCE OF REPTILES AND AMPHIBIANS OBSERVED AND/OR CAPTURED

COMMON NAME	COMMUNITY TYPE								
	NATURAL						DISTURBED		
	CBH#	BH#	MHS#	MMH#	SH#	XSC#	MPP#	XPP#	RC#
EASTERN COTTONMOUTH	C	C	0	0			R	R	
EASTERN DIAMONDBACK RATTLESNAKE[2]							R		
FLORIDA GROUND RATTLESNAKE[2]							R		
BROWN-CHINNED RACER			0				0	0	
ROUGH GREEN SNAKE		R							
EASTERN KING SNAKE				0			R		
EASTERN COACHWHIP						R			
BANDED WATER SNAKE	C	C							
RED-BELLIED SNAKE[4]			R						
FLORIDA BOX TURTLE									R
GULF COAST BOX TURTLE			R						
COMMON BOX TURTLE			0	0					
THREE-TOED BOX TURTLE			R						
GOPHER TORTOISE[1, 6]					0			0	
YELLOW-BELLIED TURTLE	R								
CHICKEN TURTLE									0
LOGGERHEAD MUSK TURTLE[3]			0						
AMERICAN ALLIGATOR[1]	R								
SOUTHEASTERN FIVE-LINED SKINK				C			C		
GROUND SKINK			C	C			C	C	

TABLE 2.7-8 (Continued)

COMMON NAME	COMMUNITY TYPE								
	NATURAL						DISTURBED		
	CBH#	BH#	MHS#	MMH#	SH#	XSC#	MPP#	XPP#	RC#
SIX-LINED RACERUNNER					C	C		C	
SOUTHERN FENCE LIZARD					C	C	C	C	
CAROLINA ANOLE			C	C	C	C	C		
COASTAL GLASS SNAKE[4]			R						
COMMON GLASS SNAKE			O						
DUSKY SALAMANDER[4]	R								
DWARF SALAMANDER			O						
SOUTHERN LEOPARD FROG	C	C	C	C			C	C	
FLORIDA CRICKET FROG	R	R		R					
COMMON CRICKET FROG	C	C	C	C					
BARKING TREE FROG				R					
GREEN TREE FROG			O						
COMMON TREE FROG			R						
EASTERN NARROW-MOUTH TOAD			R						
OAK TOAD						R			
SOUTHERN TOAD			C	C		O	C	O	
TOTAL TAXA 35 TOTAL TAXA/ COMMUNITY TYPE	8	6	17	12	4	6	11	8	2

\# CBH = Cypress Bayhead Community
BH = Bayhead Community
MHS = Mixed Hardwood Swamp Community
MMH = Mixed Mesophytic Hardwood Community
SH = Sandhill Community
XSC = Xerophytic Scrub Community

TABLE 2.7-8 (Continued)

MPP = Mesophytic Pine Plantation Community
XPP = Xerophytic Pine Plantation Community
RC = Ruderal Community

1 = Rare, Endangered, and/or Protected
2 = Reported by Local Residents
3 = Collected from Wrights Creek
4 = No Positive Identification (Not Acutally Seen)
6 = Tracks and/or Other Signs

TABLE 2.7-9

DISTRIBUTION AND OCCURRENCE OF BIRDS OBSERVED AND/OR CAPTURED

COMMON NAME	COMMUNITY TYPE								
	NATURAL						DISTURBED		
	CBH#	BH#	MHS#	MMH#	SH#	XSC#	MPP#	XPP#	RC*
BOBWHITE QUAIL[5]				C		0	C	0	
CARDINAL				C		C	C	C	
CAROLINA CHICKADEE				0			0	0	
GREAT CRESTED FLYCATCHER								0	
COMMON CRACKLE		0	0	0					
CHUCK-WILL'S-WIDOW							0	R	
CAROLINA WREN				0					
LOGGERHEAD SHRIKE						C		C	
BLUE JAY		0	C	C		C	C	C	
BROWN THRASHER				0			0		
COMMON CROW							C	0	
MOCKING BIRD						C	C		
RUFOUS-SIDED TOWHEE		0							
RUSTY BLACKBIRD	0	0							
OVENBIRD							R		
YELLOW-BELLIED FLYCATCHER								0	
WOOD THRUSH									
YELLOW-BILLED CUCKOO				0			0	0	
PILEATED WOODPECKER	0	0	0	0			0	0	
RED-BELLIED WOODPECKER			0	0		0	0		
YELLOW-SHAFTED FLICKER						0	0		
MOURNING DOVE[5]					0	0	0	0	
GROUND DOVE					R	0			

TABLE 2.7-9 (Continued)

COMMON NAME	COMMUNITY TYPE								
	NATURAL						DISTURBED		
	CBH#	BH#	MHS#	MMH#	SH#	XSC#	MPP#	XPP#	RC#
GREAT HORNED OWL	R	O	O	R					
RED-SHOULDERED HAWK				O	O	O	O	O	
BLACK VULTURE		O		R			R		
LITTLE BLUE HERON	R	R							
GREAT BLUE HERON	O	O							
CATTLE EGRET				O					
COMMON EGRET	R								
TOTAL TAXA 30 TOTAL TAXA/ COMMUNITY TYPE	6	9	5	14	3	10	15	14	1

# CBH = Cypress Bayhead Community
BH = Bayhead Community
MHS = Mixed Hardwood Swamp Community
MMH = Mixed Mesophytic Hardwood Community
SH = Sandhill Community
XSC = Xerophytic Scrub Community
MPP = Mesophytic Pine Plantation Community
XPP = Xerophytic Pine Plantation Community
RC = Ruderal Community

5 = Game Animal

TABLE 2.7-10

DISTRIBUTION AND OCCURENCE OF MAMMALS OBSERVED AND/OR CAPTURED

COMMON NAME	COMMUNITY TYPE								
	NATURAL						DISTURBED		
	CBH#	BH#	MHS#	MMH#	SH#	XSC#	MPP#	XPP#	RC#
FLORIDA WOODRAT				O					
HISPID COTTON RAT				C					C
EASTERN HARVEST MOUSE[4]				O					
EASTERN COTTONTAIL[5]				O		O	C	O	
RACOON	O	O	O	O			O		
OPPOSSUM	C	C		C			O		
GRAY SQUIRREL[5]				C			O	O	
WHITETAILED DEER[2, 5]							R		
EASTERN FOX SQUIRREL[5]							R		
GRAY FOX				O					
BEAVER[4]			O						
MUSKRAT [4, 6]			R						
FLORIDA PANTHER[1, 6]							R		
EASTERN MOLE						O	C	C	
NINE-SANDED ARMADILLO									O
FLORIDA WATER RAT[4, 6]			R						
TOTAL TAXA 14 TOTAL TAXA/ COMMUNITY TYPE	2	2	4	6		2	8	3	2

\# CBH = Cypress Bayhead Community
BH = Bayhead Community
MHS = Mixed Hardwood Swamp Community
MMH = Mixed Mesophytic Hardwood Community
SH = Sandhill Community
XSC = Xerophytic Scrub Community
MPP = Mesophytic Pine Plantation Community
XPP = Xerophytic Pine Plantation Community
RC = Ruderal Community

1 = Rare, Endangered, and/or Protected
2 = Reported by Local Residents
4 = No Positive Identification (Not Acutally Seen)
5 = Game Animal
6 = Tracks and/or Other Signs

CSP-ER-2

TABLE 2.7-11

SUMMARY OF CARYVILLE PLANT SITE BIRD AREA COUNTS (ROAD SURVEY)

Birds are listed in check-list order followed by listings of occurrence, relative density, and number of sightings:

Occurrence	Density
R-Resident	**R-Rare***
W-Winter Resident	**U-Uncommon**
S-Summer Resident	**C-Common**
M-Migrant	**A-Abundant**
A-Accidental	

Species: Occurrence-Density	Sightings
Common Loon: W-R	
Horned Grebe: W.M-R	
Pied-billed Grebe: R-U	
Anhinga: A-R	
Great Blue Heron: R-U	1
Eastern Green Heron: S-R	1
Little Blue Heron: S-U	
Cattle Egret: S-U	12
Common Egret: R-U	
Black-crowned Night Heron: S-R	
American Bittern: M-U	
Wood Stork: S-U	1
Mallard: W-U	
Black Duck: W-U	
Wood Duck: R-U	
Ring-necked Duck: W-U	
Common Goldeneye: W-R	
Ruddy Duck: W-R	
Hooded Merganser: W-R	
Common Merganser: W-R	
Red-breasted Merganser: W-R	
Turkey Vulture: R-C	
Black Vulture: R-C	
Sharp-shinned Hawk: R-R	
Cooper's Hawk: R-R	
Red-tailed Hawk: R-C	1
Red-shouldered Hawk: R-C	2
Marsh Hawk: W-U	
Osprey: M-U	
Sparrow Hawk: W-U	
Bobwhite: R-C	4
Turkey: R-U	
Virginia Rail: M-R	
Sora: M-R	
Killdeer: R-C	
Black-bellied Plover: M-R	
American Woodcock: R-U	
Common Snipe: W-C	
Lesser Yellowlegs: M-R	
Least Sandpiper: W-U	
Ring-billed Gull: W-R	
Rock Dove: R-U	
Mourning Dove: R-A	16
Broad-winged Hawk:	
Ground Dove: R-U	1
Barn Owl: R-U	
Screech Owl: R-U	
Great Horned Owl: R-C	
Barred Owl: R-C	1
Ruby-throated Hummingbird: S-C	
Belted Kingfisher: R-C	
Yellow-shafted Flicker: R-C	
Red-bellied Woodpecker: R-A	2
Red-headed Woodpecker: R-U	
Yellow-bellied Sapsucker: W-U	
Hairy Woodpecker: R-U	
Downy Woodpecker: R-C	1
Red-cockaded Woodpecker: R-R	
Eastern Kingbird: S-C	3
Eastern Phoebe: W-C	
Acadian Flycatcher: S-C	1
Least Flycatcher: M-U	
Eastern Wood Pewee: S-C	
Tree Swallow: M-U	
Bank Swallow: M-U	
Rough-winged Swallow: S-C	
Barn Swallow: M-U	
Purple Martin: R-C	
Blue Jay: R-A	6
Common Crow: R-C	15
Fish Crow: R-U	3
Carolina Chickadee: R-A	4
Tufted Titmouse: R-A	1
Red-breasted Nuthach: W-U	
Brown-headed Nuthatch: R-C	2
Brown Creeper: W-U	
House Wren: W-R	
Winter Wren: W-U	
Carolina Wren: R-C	2
Mockingbird: R-A	10
Catbird: R-R.C	
Brown Thrasher: R-A	
Robin: R-A	
Wood Thrush: S-C	
Eastern Bluebird: R-U	
Blue-grey Gnatcatcher: S-U	
Golden-crowned Kinglet: W-U	
Ruby-Crowned Kinglet: W-A	
Water Pipit: W-C	
Cedar Waxwing: W-C	
Loggerhead Shrike: R-C	5
Starling: R-C	
White-eyed Vireo: S-C	3
Yellow-throated Vireo: S-C	
Red-eyed Vireo: S-C	
Black-and-white Warbler-M-U	
Prothonotary Warbler: S-C	
Worm-eating Warbler: S-R	
Golden-winged Warbler: M-U	
Tennessee Warbler: M-C	
Orange Crowned Warbler: M(W)-U	
Parula Warbler: S(M)-U	
Yellow Warbler: S-U	
Myrtle Warbler: W-C	
Pileated Woodpacked	1
Yellow-billed Cookoo	3
Chimney Swift	3
Yellow-throated Warbler: S-U	
Pine Warbler: R-C	2
Prairie Warbler: S-C	
Palm Warbler: M-U	
Louisiana Waterthrush: S-U	
Kentucky Warbler: S-U	
Yellowthroat: R-C	1
Yellow-breasted Chat: S-C	
Hooded Warbler: S-C	1
American Redstart: S-C	
Eastern Meadowlark: R-C	
Redwinged Blackbird: R-C	
Orchard Oriole: S-C	
Baltimore Oriole: M(W)-U	
Rusty Blackbird: W-U	
Common Grackle: R-C	
Brown-headed Cowbird: R-C	
Scarley Tanager: M-U	
Summer Tanager: R-C	
Cardinal: R-A	12
Rose-breasted Grosbeak: M-U	
Glue Grosbeak: S-C	
Indigo Buntings: S-C	
Dickcissel: S-R	
Evening Grosbeak: W-U	
Purple Finch: W-C	
Pine Siskin: W-U	
American Goldfinch: R-U	
Rufous-sided Towhee: R-A	3
Savannah Sparrow: W-C	
Grasshopper Sparrow: R-U	
Vesper Sparrow: W-U	
Bachman's Sparrow: R-U	
Slate-colored Junco: W-C	
Chipping Sparrow: R-C	
Field Sparrow: R-C	
White-crowned Sparrow: W-R	
White-throated Sparrow: W-A	
Fox Sparrow: W-C	
Swamp Sparrow: W-C	
Song Sparrow: W-C	

Additional Remarks

32 Species
124 Individuals
22.5/Hr.

***Use of the term "Rare" serves only as an indication of frequency of observation. It does not describe the existence of the birds as recorded in the Federal or State classifications of rare, endangered, or protected species.**

TABLE 2.7-12

SUMMARY OF ROAD SURVEY (R.S.) AND COMPOSITE AREA COUNT (A.C.) DATA*
8/31/74, 9/1/74, 9/3-6/74

SPECIES	AOU	R.S. 1	A.C. 2	3	4	5	TOTAL INDIV	STOPS PER SPEC.
BROWN PELICAN	126							
ANHINGA	118	1	2					
GT. BLUE HERON	194	1	3					
GREEN HERON	201	0	2					
LITTLE BLUE HERON	200							
CATTLE EGRET	2001	32	99					
COMMON EGRET	196							
SNOWY EGRET	197							
LOUISIANA HERON	199							
BLACK-CR. NIGHT HERON	202							
YEL-CR. NIGHT HERON	203							
WHITE IBIS	184	5	0					
WOOD STORK	144	0	8					
TURKEY VULTURE	325	7	2					
BLACK VULTURE	326							
COOPER'S HAWK	333							
RED-TAILED HAWK	337	2	3					
RED-SHOULDERED HAWK	339	6	9					
BROAD-WINGED HAWK	343	1	1					
OSPREY	364							
SPARROW HAWK	360							
BOBWHITE	289	16	2					
TURKEY	310							
SANDHILL CRANE	206							
CLAPPER RAIL	211							
COMMON GALLINULE	219							
AMERICAN COOT	221							
KILLDEER	273							
WILLET	258							
LAUGHING GULL	058							
LEAST TERN	074							
BLACK SKIMMER	080							
ROCK DOVE	3131							
MOURNING DOVE	316	49	28					
GROUND DOVE	320	15	11					
YELLOW-BILLED CUCKOO	387	4	12					
SCREECH OWL	373							
GREAT HORNED OWL	375							
BARRED OWL	368	0	3					
CHUCK-WILL'S-WIDOW	416							
WHIP-POOR-WILL	417							
COMMON NIGHTHAWK	420							
CHIMNEY SWIFT	423	20	44					
RUBY-THR. HUMMINGBIRD	428							
BELTED KINGFISHER	390	0	1					
YELLOW-SHAFTED FLICKER	412	7	3					
PILEATED WOODPECKER	405	1	9					
RED-BELLIED WOODPECKER	409	23	21					
RED-HEADED WOODPECKER	406	2	5					
HAIRY WOODPECKER	393	1	0					
DOWNY WOODPECKER	394	3	8					
RED-COCKADED WDPKR.	395							
E. KINGBIRD	444	5	0					
GT. CRESTED FLYCATCHER	452	2	0					
E. PHOEBE	456							
ACADIAN FLYCATCHER	465	0	2					
E. WOOD PEWEE	461							
TREE SWALLOW	614							
ROUGHED-WINGED SWALLOW	617							
BARN SWALLOW	613	2	0					
PURPLE MARTIN	611	1	0					
BLUE JAY	477	112	45					

SPECIES	AOU	R.S. 1	A.C. 2	3	4	5	TOTAL INDIV	STOPS PER SPEC
COMMON CROW	488	67	32					
FISH CROW	490	6	8					
CAROLINA CHICKADEE	736	14	18					
TUFTED TITMOUSE	731	7	8					
WHITE-BREASTEDNUTHATCH	727							
BROWN-HEADED NUTHATCH	729	11	15					
HOUSE WREN	721							
BEWICK'S WREN	719							
CAROLINA WREN	718	43	17					
MOCKINGBIRD	703	52	41					
CATBIRD	704							
BROWN THRASHER	705	4	2					
ROBIN	761	1	1					
WOOD THRUSH	755							
E. BLUEBIRD	766							
BLUE-GRAY GNATCATCHER	751	0	1					
LOGGERHEAD SHRIKE	622	15	43					
STARLING	493	0	2					
WHITE-EYED VIREO	631	14	10					
YELLOW-THROATED VIREO	628	1	0					
RED-EYED VIREO	624	0	1					
BLACK-AND-WHT. WARBLER	636							
PROTHONOTARY WARBLER	637							
WORM-EATING WARBLER	639							
BLUE-WINGED WARBLER	641							
PARULA WARBLER	648	5	3					
YELLOW WARBLER	652							
BLK.-THR.-GRN. WARBLER	667							
CERULEAN WARBLER	658							
YELLOW-THR. WARBLER	663							
PINE WARBLER	671	5	7					
PRAIRIE WARBLER	673							
OVENBIRD	674							
LA. WATERTHRUSH	676	0	1					
KENTUCKY WARBLER	677							
YELLOWTHROAT	681	1	2					
YELLOW-BREASTED CHAT.	683							
HOODED WARBLER	684	1	2					
AMERICAN REDSTART	687							
HOUSE SPARROW	6882							
E. MEADOWLARK	501							
RED-WINGED BLACKBIRD	498	2	4					
ORCHARD ORIOLE	506							
BALTIMORE ORIOLE	507							
BOAT-TAIL GRACKLE	513							
COMMON GRACKLE	511	27	34					
BROWN-HEADED COWBIRD	495							
SCARLET TANAGER	608							
SUMMER TANAGER	610	1	2					
CARDINAL	593	44	41					
BLUE GROSBEAK	597							
INDIGO BUNTING	598							
PAINTED BUNTING	601							
DICKCISSEL	604							
AMERICAN GOLDFINCH	529							
RUFOUS-SIDED TOWHEE	587	29	15					
GRASSHOPPER SPARROW	546							
BACHMAN'S SPARROW	575							
CHIPPING SPARROW	560							
FIELD SPARROW	563							
SONG SPARROW	581							

FORM 3-3
(1969)

*Study was performed by Gulf Power Company.

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TABLE 2.7-13

SUMMARY OF BIRD AREA COUNTS

Birds are listed in check-list order followed by listings of occurrence, relative density, and number of sightings:

Occurrence	Density
R-Resident	R-Rare*
W-Winter Resident	U-Uncommon
S-Summer Resident	C-Common
M-Migrant	A-Abundant
A-Accidental	

Common Loon: W-R
Horned Grebe: W,M-R
Pied-billed Grebe: R-U
Anhinga: A-R -1
Great Blue Heron: R-U -3
Eastern Green Heron: S-C -2
Little Blue Heron: S-U
Cattle Egret: S-U -99
Common Egret: R-U
Black-crowned Night Heron: S-R
American Bittern: M-U
Wood Stork: S-U -8
Mallard: W-U
Black Duck: W-U
Wood Duck: R-U
Ring-necked Duck: W-U
Common Goldeneye: W-R
Ruddy Duck: W-R
Hooded Merganser: W-R
Common Merganser: W-R
Red-breasted Merganser: W-R
Turkey Vulture: R-C -2
Black Vulture: R-C
Sharp-shinned Hawk: R-R
Cooper's Hawk: R-R
Red-tailed Hawk: R-C -3
Red-shouldered Hawk: R-C -9
Marsh Hawk: W-U
Osprey: M-U
Sparrow Hawk: W-U
Bobwhite: R-C -2
Turkey: R-U
Virginia Rail: M-R
Sora: M-R
Killdeer: R-C
Black-bellied Plover: M-R
American Woodcock: R-U
Common Snipe: W-C
Lesser Yellowlegs: M-R
Least Sandpiper: W-U
Ring-billed Gull: W-R
Rock Dove: R-U
Mourning Dove: R-A -28
Broad-winged Hawk: -1

Ground Dove: R-U -11
Barn Owl: R-U
Screech Owl: R-U
Great Horned Owl: R-C
Barred Owl: R-C -3
Ruby-throated Hummingbird: S-C
Belted Kingfisher: R-C -1
Yellow-shafted Flicker: R-C -3
Red-bellied Woodpecker: R-A -21
Red-headed Woodpecker: R-U -5
Yellow-bellied Sapsucker: W-U
Hairy Woodpecker: R-U
Downy Woodpecker: R-C -8
Red-cockaded Woodpecker: R-R
Eastern Kingbird: S-C
Eastern Phoebe: W-C
Acadian Flycatcher: S-C -2
Least Flycatcher: M-U
Eastern Wood Pewee: S-C
Tree Swallow: M-U
Bank Swallow: M-U
Rough-winged Swallow: S-C
Barn Swallow: M-U
Purple Martin: R-C
Blue Jay: R-A -45
Common Crow: R-C -32
Fish Crow: R-U 8
Carolina Chickadee: R-A -18
Tufted Titmouse: R-A 8
Red-breasted Nuthach: W-U
Brown-headed Nuthatch: R-C -15
Brown Creeper: W-U
House Wren: W-R
Winter Wren: W-U
Carolina Wren: R-C -17
Mockingbird: R-A -41
Catbird: R-R,C
Brown Thrasher: R-A -2
Robin: R-A -1
Wood Thrush: S-C
Eastern Bluebird: R-U
Blue-grey Gnatcatcher: S-U -1
Golden-crowned Kinglet: W-U
Ruby-Crowned Kinglet: W-A
Water Pipit: W-C
Cedar Waxwing: W-C
Loggerhead Shrike: R-C -43
Starling: R-C -2
White-eyed Vireo: S-C -10
Yellow-throated Vireo: S-C
Red-eyed Vireo: S-C -1
Black-and-white Warbler-M-U
Prothonotary Warbler: S-C
Worm-eating Warbler: S-R
Golden-winged Warbler: M-U
Tennessee Warbler: M-C
Orange Crowned Warbler: M(W)-U
Parula Warbler: S(M)-U -3
Yellow Warbler: S-U
Myrtle Warbler: W-C
Pileated Woodpecker -9
Yellow-billed Cuckoo -12
Chimney Swift -44

Yellow-throated Warbler: S-U
Pine Warbler: R-C -7
Prairie Warbler: S-C
Palm Warbler: M-U
Louisiana Waterthrush: S-U -1
Kentucky Warbler: S-U
Yellowthroat: R-C -2
Yellow-breasted Chat: S-C
Hooded Warbler: S-C 2
American Redstart: S-C
Eastern Meadowlark: R-C
Redwinged Blackbird: R-C -4
Orchard Oriole: S-C
Baltimore Oriole: M(W)-U
Rusty Blackbird: W-U
Common Grackle: R-C -34
Brown-headed Cowbird: R-C
Scarlet Tanager: M-U
Summer Tanager: R-C -2
Cardinal: R-A -41
Rose-breasted Grosbeak: M-U
Glue Grosbeak: S-C
Indigo Buntings: S-C
Dickcissel: S-R
Evening Grosbeak: W-U 1
Purple Finch: W-C
Pine Siskin: W-U
American Goldfinch: R-U
Rufous-sided Towhee: R-A -15
Savannah Sparrow: W-C
Grasshopper Sparrow: R-U
Vesper Sparrow: W-U
Bachman's Sparrow: R-U
Slate-colored Junco: W-C
Chipping Sparrow: R-C
Field Sparrow: R-C
White-crowned Sparrow: W-R
White-throated Sparrow: W-A
Fox Sparrow: W-C
Swamp Sparrow: W-C
Song Sparrow: W-C

Additional Remarks

47 Species
632 Individuals
22.9/Hr.

*Use of the term "Rare" serves only as an indication of frequency of observation. It does not describe the existence of the birds as recorded in the Federal or State classifications of rare, endangered, or protected species.

TABLE 2.7-14

FISHES OF THE CHOCTAWHATCHEE BAY, RIVER, AND TRIBUTARIES (43)

Species	Status	
Okaloosa darter, *Etheostoma okaloosae*	endangered	
Channel catfish, *Ictalurus punctatus*	commercial	
Atlantic sturgeon, *Acipenser oxyrhynchus*	commercial	
White catfish, *Ictalurus catus*	commercial	
Black bullhead, *Ictalurus melas*	commercial	
Yellow bullhead, *Ictalurus natalis*	commercial	
Brown bullhead, *Ictalurus nebulosus*	commercial	
Longear sunfish, *Lepomis megalotis*	sport	
Redear sunfish, *Lepomis microlophus*	sport	
Spotted sunfish, *Lepomis punctatus*	sport	
Largemouth bass, *Micropterus salmoides*	sport	
Spotted bass, *Micropterus punctulatus*	sport	
White crappie, *Pomoxis annularis*	sport	
Black crappie, *Pomoxis nigromaculatus*	sport	
Warmouth, *Lepomis gulosus*	sport	
Bluegill, *Lepomis macrochirus*	sport	1
Redbreast sunfish, *Lepomis auritus*	sport	
Southern rockbass, *Ambloplites rupertris ariommus*	sport	
Flier, *Centrarchus macropterus*	sport	
Redfin pickerel, *Esox americanus*	sport	
Chain pickerel, *Esox niger*	sport	
Spotted sucker, *Minytrema melanops*	sport	
Blacktail redhorse, *Moxostoma poecilurum*	sport	
Speckled chub, *Hybopsis aestivalis*	forage	
Bigeye chub, *Hybopsis amblops*	forage	
Redeye chub, *Hybopsis harperi*	forage	
Silverjaw minnow, *Ericymba buccata*	forage	
Golden shiner, *Notemigonus crysoleucas*	forage	
Ironcolor shiner, *Notropis chalybaeus*	forage	
Dusky shiner, *Notropis cummingsae*	forage	
Pugnose minnow, *Notropis emiliae*	forage	
Sailfin shiner, *Notropis hypselopterus*	forage	
Longnose shiner, *Notropis longirostris*	forage	
Taillight shiner, *Notropis maculatus*	forage	
Coastal shiner, *Notropis petersoni*	forage	
Flagfin shiner, *Notropis signipinnis*	forage	
Weed shiner, *Notropis texanus*	forage	
Naked sand darter, *Ammocrypta beani*	forage	
Choctawhatchee darter, *Etheostoma davisoni*	forage	
Brown darter, *Etheostoma edwini*	forage	
Swamp darter, *Etheostoma fusiforme barratti*	forage	
Goldstrip darter, *Etheostoma parvipinne*	forage	
Gulf darter, *Etheostoma swaini*	forage	

TABLE 2.7-14 (Continued)

Species	Status
Underscribed darter, *Etheostoma* (Ulocentra) sp.	forage
Log perch, *Percina caprodes*	forage
Blackbanded darter, *Precina nigrofasciata*	forage
Everglades pygmy sunfish, *Elassoma evergladei*	forage
Okefenokee pygmy sunfish, *Elassoma okefenokee*	forage
Banded pygmy sunfish, *Elassoma zonatum*	forage
Bluespotted sunfish, *Enneacanthus gloriosus*	forage
Banded sunfish, *Enneacanthus obesus*	forage
Black madtom, *Noturus funebris*	forage
Tadpole madtom, *Noturus gyrinus*	forage
Gulf madtom, *Noturus leptacanthus*	forage
Golden topminnow, *Fundulus chrysotus*	forage
Banded topminnow, *Fundulus cingulatus*	forage
Starhead topminnow, *Fundulus notti*	forage
Blackspotted topminnow, *Fundulus olivaceus*	forage
Pygmy killfish, *Leptolucania ommata*	forage
Bluefin killfish, *Lucania goodei*	forage
Mosquitofish, *Gambusia affinis*	forage
Least killfish, *Heterandria formosa*	forage
Sailfish molly, *Poecilia latipinna*	forage
Pirate perch, *Aphredoderus sayanus*	forage 1
Brook silverside, *Labidesthes sicculus*	forage
Green sunfish, *Lepomis cyanellus*	forage
Dollar sunfish, *Lepomis marginatus*	forage
Alabama shad, *Alosa alabamae*	forage
Skipjack herring, *Alosa chrysochloris*	forage
Gizzard shad, *Dorosoma cepedianum*	forage
Threadfin shad, *Dorosoma petenense*	forage
Blacktail shiner, *Notropis venustus*	forage
Bluenose shiner, *Notropis welaka*	forage
Underscribed shiner, *Notropis atrapiculus*	forage
Creek chub, *Semotilis atromaculatus*	forage
River carpsucker, *Carpiodes carpio*	rough
Quillback, *Carpiodes cyprinus*	rough
Highfin carpsucker, *Carpiodes velifer*	rough
Lake chubsucker, *Erimyzon succetta*	rough
Sharpfin chubsucker, *Erimyzon tenuis*	rough
Spotted gar, *Lepisosteus oculatus*	rough
Longnose gar, *Lepisosteus osseus*	rough
Alligator gar, *Lepisosteus spatula*	rough
Bowfin, *Amia calva*	rough
Carp, *Cyprinus carpio*	rough
Southern brook lamprey, *Ichthyomyzon gagei*	none

TABLE 2.7-15
CHOCTAWHATCHEE RIVER AND ITS SMALL TRIBUTARIES (41)
SURVEYED 1957, 1958, 1959

SPECIES	Rotenone 18 Samples Percent Composition		Gill Nets 38 Sets Percent Composition		Trammel Nets 14 Sets Percent Composition		Electric Rigs 3 Samples Percent Composition		Total Results All Methods Percent Composition	
	No.	Wt.(lbs)	No.	Wt.(lbs)	No.	Wt.(lbs)	No.	Wt.(lbs)	No.	Wt.(lbs)
Largemouth bass	2.2	7.4	1.5	0.5	2.8	3.6	6.4	11.9	2.3	2.9
Spotted bass	0.2	0.1	-	-	-	-	0.4	0.3	0.2	0.1
Warmouth	5.5	7.3	1.0	0.1	2.8	0.2	1.6	0.6	5.0	1.7
Spotted sunfish	1.4	0.9	-	-	-	-	1.2	0.3	1.3	0.2
Bluegill	4.7	6.6	0.5	0.1	2.8	0.1	29.2	10.7	5.4	2.0
Redear sunfish	5.2	3.5	0.5	-	8.3	1.5	8.8	6.0	5.0	1.3
Redbreast	-	-	-	-	-	-	0.4	1.3	-	0.1
Longear sunfish	0.9	0.3	-	-	-	-	2.8	0.9	0.9	0.1
Dollar sunfish	0.9	0.1	-	-	-	-	-	-	0.8	-
Black crappie	2.4	3.9	0.5	0.1	5.5	0.8	1.2	1.3	2.2	1.0
Chain pickerel	0.6	3.8	-	-	2.8	0.8	2.4	3.3	0.6	1.1
Redfin pickerel	0.1	0.1	-	-	-	-	-	-	0.1	-
Channel cat	5.2	5.2	-	-	-	-	-	-	4.5	1.1
Yellow bullhead	0.5	2.4	-	-	-	-	-	-	0.4	0.5
White catfish	0.2	0.2	-	-	-	-	0.3	-	0.2	-
Tadpole madtom	1.5	0.1	-	-	-	-	-	-	1.3	-
Longnose gar	0.3	0.4	27.2	48.5	2.8	2.8	0.8	1.0	1.3	28.1
Spotted gar	0.2	0.5	31.3	8.4	8.3	5.4	3.2	9.7	1.4	6.1
Bowfin	0.5	14.6	2.1	1.9	19.4	18.2	0.8	2.8	0.7	6.6
Spotted sucker	0.4	6.8	7.7	3.2	19.4	9.7	0.8	2.7	0.8	4.7
Lake chubsucker	0.6	0.8	-	-	-	-	-	-	0.5	0.2
Blacktail redhorse	0.8	4.4	2.1	0.9	2.8	0.3	3.2	14.4	1.0	2.2
American eel	0.4	2.0	-	-	-	-	1.2	0.5	0.5	0.4
Striped mullet	0.3	4.5	0.5	0.2	-	-	12.0	29.3	0.9	2.6
Pirate perch	4.5	0.5	-	-	-	-	0.4	-	4.0	0.1
Pugnose minnow	0.5	-	-	-	-	-	-	-	0.4	-
Taillight shiner	2.1	0.1	-	-	-	-	0.8	-	1.9	
Blackspotted topminnow	-	-		-	-	-	0.8	-	0.1	
Weed shiner	0.4	-		-	-	-	1.6	-	0.4	
Golden shiner	3.4	1.0		-	-	-	3.6	0.2	3.1	0.2
Ironcolor shiner	0.2	-		-	-	-	-	-	0.1	
Flagfin shiner	0.7	-		-	-	-	-	-	0.6	
Blacktail shiner	-	-		-	-	-	6.4	0.4	0.7	
Starhead Topminnow	0.5	0.1		-	-	-	0.4	-	0.4	-
Brook silverside	0.8	-	-	-	-	-	1.6	-	0.8	-
Mosquitofish	0.3	-		-	-	-	-	-	1.3	
Logperch	0.7	0.1		-	-	-	0.4	-	0.6	-
Blackbanded darter	-	-		-	-	-	0.4	-	-	
Swamp darter	0.2	-		-	-	-	-	-	0.2	-
Hogchoker	1.1	0.1		-	-	-	-	-	0.9	-
Gizzard shad	2.0	7.1	6.2	0.9	-	-	0.4	1.0	2.0	2.
Brown bullhead	-	0.6	-	-	-	-	-		-	0.1
Lepomis sp	1.2	-	-	-	-	-	-		1.0	-
Southern flounder	0.1	2.6	6.7	2.3	16.7	5.0	-		0.5	2.5
Needlefish	0.1	0.3	0.5	0.5	-	-	1.2	0.2	0.2	0.4
Coastal shiner	0.3		-	-	-	-	0.8	-	0.3	-
Banded pygmy sunfish	0.2		-	-	-	-	0.4	-	0.2	
Spring redeye chub	-		-		-	-	-		0.6	
Alligator gar*	-		1.0	15.8	2.8	51.2	-		0.1	15.6
Highfin carpsucker	-		1.5	0.6	-	-	0.4	1.2	0.1	0.4
Gafftopsail cat	-		5.1	4.4	-	-	-	-	0.2	2.7
Sturgeon			0.5	2.3	-	-	-			1.3
Bullshark			3.1	9.0	-	-	-		0.1	5.1
Sheepshead			0.5	0.3	-	-	-		0.1	1.0
Quillback	0.4	3.3	-	-	2.8	0.3	-		0.3	0.7
Croaker	0.7	2.0	-	-	-	-	-		0.7	0.6
Stingray	-		-	-	-	-	-		-	0.3
Speckled trout		-	-	-	-	-	-		0.1	0.5
Sea catfish	-	-	-	-	-	-	-		0.1	0.5
Bay anchovy	13.8	0.3	-	-	-	-	0.4	-	12.1	0.1
Threadfin shad	0.9	1.1	-	-	-	-	-	-	0.8	0.2
Alabama shad	4.1	0.7	-	-	-	-	-	-	3.6	0.1
Naked goby	0.1		-	-	-	-	-	-	0.1	
Notropis sp	1.0	-	-	-	-	-	-	-	0.9	-
Mojarra	0.1	-	-	-	-	-	-	-	0.1	-
Spot	0.2	0.3	-	-	-	-	-	-	0.6	0.5
Anchovy sp	5.3	0.1	-	-	-	-	-	-	4.6	
Speckled worm eel	0.1	-	-	-	-	-	-	-	0.1	
Banded sunfish	0.1	-	-	-	-	-	-	-	0.1	-
Bluespotted sunfish	2.0	0.1	-	-	-	-	-	-	1.7	-
Everglade pygmy sunfish	0.4	-	-	-	-	-	-	-	0.4	-
Banded Topminnow	0.2	-	-	-	-	-	-	-	0.2	
Tidewater silverside	0.1	-	-	-	-	-	2.4	-	0.2	
Bluefin killifish	0.1	-	-	-	-	-	-	-	0.1	
Pipefish	0.2	-	-	-	-	-	-	-	0.2	-
Brevoortia sp	15.7	3.5	-	-	-	-	-	-	14.2	1.0
Pygmy killifish	0.1	-	-	-	-	-	-	-	0.1	-
Etheostoma sp		-	-	-	-	-	0.8	-	0.1	
Pinfish		-	-	-	-	-	-	-	0.1	0.1
	Total No 4901		Total No 195		Total No 36		Total No 250		Total No ** 5595	
	Total Wt.(lbs) 267.52		Total Wt.(lbs) 726.97		Total Wt.(lbs) 166.07		Total Wt.(lbs) 66.18		Total** Wt.(lbs) 1,278.77	

NOTES: *One Alligator gar caught in a gill net weighed 115 pounds and was six feet, three inches long (Caught in lake at bridge in Ebro, Florida, on September 10, 1958.) The other gar was too small to be weighed. One Alligator gar caught in a trammel net weighed 85 pounds and was five feet, nine inches long (Caught in Jolly Bay, Florida, on May 27, 1959.)

**In the interest of space in the above chart, haul seine results and wire minnow trap results are in a separate chart on a following page. However, the total results above include these samples.

TABLE 2.7-15 (Continued)

The species recorded below were collected with haul seines and wire minnow traps and are included in the computation of the"Total Results All Methods" column given on the preceding page.

	Haul Seine Three Sets		Wire Minnow Traps Three Sets	
SPECIES	Percent Composition		Percent Composition	
	No.	Wt. (pounds)	No.	Wt. (pounds)
Striped mullet	2.2	1.7	-	-
Golden shiner	-	-	0.8	-
Blacktail shiner	-	-	19.8	53.3
Mosquitofish	-	-	45.5	26.7
Redeye chub	-	-	30.6	20.0
Everglades pygmy sunfish	-	-	2.5	-
Brown darter	-	-	0.8	-
Gizzard shad	1.1	1.0	-	-
Sheepshead	6.5	36.0	-	-
Croaker	9.8	5.7	-	-
Stingray	2.2	7.7	-	-
Speckled trout	7.6	11.9	-	-
Spot	25.0	9.8	-	-
Brevoortia species	27.2	7.2	-	-
Pinfish	7.6	1.7	-	-
Sea catfish	8.7	11.7	-	-
Gafftopsail cat	1.1	5.3	-	-
Harvest fish	1.1	0.2	-	-
	TOTAL No. 92.0		TOTAL No. 121.0	
	TOTAL WT. (pounds) 51.73		TOTAL WT. (pounds) 0.30	

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TABLE 2.7-16

CHOCTAWHATCHEE RIVER AQUATIC ECOLOGY STUDY FISH SPECIES COLLECTED BY ELECTROSHOCKING AND SEINE HAULS FROM CONFLUENCE OF WRIGHTS CREEK TO U.S. HIGHWAY NO. 90 BRIDGE: 8/16/73 to 8/12/74* (75)

Species List

Centrarchidae (Sunfish Family)

Lepomis punctatus (Valenciennes) - spotted sunfish
Micropterus salmoides (Lacepede) - largemouth bass
Pomoxis nigromaculatus (LeSueur) - black crappie
Ambloplites rupestris (Rafinesque) - rock bass
Lepomis spp. - sunfish
Lepomis macrochirus (Rafinesque) - bluegill
Lepomis microlophus (Gunther) - redear sunfish
Lepomis megalotis (Rafinesque) - longear sunfish

Lepisosteidae (Gar Family)

Lepisosteus osseus (Linnaeus) - longnose gar
Lepisosteus oculatus (Winchell) - spotted gar 1

Catostomidae (Sucker Family)

Minytrema melanops (Rafinesque) - spotted sucker
Carpiodes velifer (Rafinesque) - highfin carpsucker
Carpiodes cyprinus (LeSueur) - quillback
Carpiodes carpio (Rafinesque) - river carpsucker
Moxostoma poecilurum (Jordan) - blacktail redhorse

Ictaluridae (Freshwater Catfish Family)

Ictalurus punctatus (Rafinesque) - channel catfish

Amiidae (Bowfin Family)

Amia calva (Linnaeus) - bowfin

Cyprinidae (Minnow Family)

Notropis venustus (Girard) - blacktail shiner
Ericymba buccata (Cope) - silver jaw minnow
Hybopsis amblops (Rafinesque) - bigeye chub
Hybopsis aestivalis (Girard) - speckled chub
Hybopois spp. - chub
Notropis texanus (Girard) - weed shiner

TABLE 2.7-16 (Continued)

Esocidae (Pike Family)

Esox niger (LeSueur) - chain pickerel

Percidae (Perch Family)

Ammocrypta beanii (Jordan) naked sand darter
Percina nigrofasciata (Agassiz) - blackbanded darter
Percina caprodes (Rafinesque) - logperch

Soleidae (Sole Family)

Trinectus maculatus (Block & Schneider) - hogchoker

Atherinidae (Silverside Family)

Labidesthes sicculus (Cope) - brook silverside 1

Clupeidae (Herring Family)

Alosa alabamae (Jordan & Everman) - alabama shad
Dorosoma cepedianum (LeSueur) - gizzard shad

*The exact dates in which sampling was performed by the U.S. Fish & Wildlife Service were 8/16/73, 8/29/73, 6/26/74, 7/16/74, and 8/12/74.

TABLE 2.7-17

CHOCTAWHATCHEE RIVER AQUATIC ECOLOGY STUDY
FISH POPULATION STUDIES BY ELECTROSHOCKING*, SPECIES DIVERSITY ($\bar{D}$), AND STANDING CROP, SUMMER PERIOD: 6/26/74, 7/16/74, 8/12/74 (75)

Parameters	Sampling Locations					
	Wrights Creek Area		U.S. Highway No. 90 Bridge Area			
	7/16/74	8/12/74	6/26/74		7/16/74	8/12/74
Number of Species	7	8	2	8	6	6
Average Number of Species	7.5		5.5			
Percent Coefficient Variance	9.43		45.76			
Number of Fish	11	12	7	16	26	13
Average Number of Fish	11.5		15.5			
Percent Coefficient Variance	6.15		51.21			
Species Diversity ($\bar{D}$)	2.66	2.86	0.86	2.83	2.04	2.45
Average Species Diversity ($\bar{D}$)	2.76		2.05			
Percent Coefficient Variance	5.12		41.73			
Weight (Grams) of Fish	10,175	4,495	3,310	4,885	13,200	2,145
Average Weight (Grams) of Fish	7,335		5,885			
Percent Coefficient Variance	54.76		85.03			

*The U.S. Fish and Wildlife Service used one-half hour per sampling area per period.

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TABLE 2.7-18

CHOCTAWHATCHEE RIVER AQUATIC ECOLOGY STUDY FISH POPULATION STUDIES BY ELECTROSHOCKING,*
PERCENT COMPOSITION BY NUMBER AND WEIGHT OF SPECIES AND MAJOR TAXONOMIC GROUPS,
SUMMER PERIOD: 6/26/74, 7/16/74, 8/12/74 (75)

Species Names	Wrights Creek Area		Highway No. 90 Bridge Area		Combined Study Area (Wrights Creek to Hwy. 90)	
	Percent by Number	Percent by Weight	Percent by Number	Percent by Weight	Percent by Number	Percent by Weight
Centrarchidae (Sunfish Family)	30.44	30.37	29.02	35.60	29.41	33.59
Micropterus salmoides	13.04	24.85	8.06	26.15	9.41	25.65
Ambloplites rupestris	8.70	5.08	-	-	2.35	1.96
Lepomis macrochirus	8.70	0.44	12.90	8.56	11.76	5.43
Lepomis punctatus	-	-	6.45	0.83	4.71	0.51
Lepomis microlophus	-	-	1.61	0.06	1.18	0.04
Lepisosteidae (Gar Family)	17.39	29.99	6.45	2.68	9.41	13.21
Lepisosteus osseus	13.04	24.24	4.84	1.19	7.06	10.08
Lepisosteus oculatus	4.35	5.75	1.61	1.49	2.35	3.13
Catostomidae (Sucker Family)	21.75	20.18	46.77	61.40	40.00	45.51
Minytrema melanops	8.70	15.00	1.61	0.17	3.53	5.89
Carpiodes velifer	-	-	16.13	22.92	11.76	14.08
Carpiodes cyprinus	4.35	3.45	20.97	33.47	16.47	21.90
Moxostoma poecilurum	8.70	1.73	8.06	4.84	8.24	3.64
Cyprinidae (Minnow Family)	17.39	0.17	16.13	0.28	16.47	0.23
Notropis venustus	17.39	0.17	16.13	0.28	16.47	0.23
Amiidae (Bowfin Family)	8.70	19.23	-	-	2.35	7.41
Amia calva	8.70	19.23	-	-	2.35	7.41
Soleidae (Sole Family)	4.35	0.07	-	-	1.18	0.03
Trinectus maculatus	4.35	0.07	-	-	1.18	0.03
Clupeidae (Herring Family)	-	-	1.61	0.04	1.18	0.03
Alosa alabamae	-	-	1.61	0.04	1.18	0.03

*Sampling performed by U.S. Fish and Wildlife Service

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TABLE 2.7-19

CHOCTAWHATCHEE RIVER AQUATIC ECOLOGY STUDY CONDITION INDEX, K(TL), OF FISH SPECIES COLLECTED BY ELECTROSHOCKING* AND SEINE HAULS* FROM CONFLUENCE OF WRIGHTS CREEK TO U.S. HIGHWAY NO. 90 BRIDGE, SUMMER PERIOD: 6/26/74, 7/16/74, 8/12/74 (75)

Species Names	Wrights Creek Area		Highway 90 Bridge Area		Combined Study Area (Wrights Creek to Hwy. 90)		K(TL) Values From Literature (reference 76)	
	No. Fish Observed	K(TL)** Mean	No. Fish Observed	K(TL)** Mean	No. Fish Observed	K(TL)** Mean	No. Fish Observed	K(TL)** Mean or Range Span
Micropterus salmoides	3	1.46	5	1.44	8	1.45	not available	
Ambloplites rupestris	2	2.37	-	-	2	2.37	not available	
Lepomis macrochirus	2	1.49	8	2.00	10	1.90	not available	
Lepomis punctatus	-	-	4	2.44	4	2.44	not available	
Lepomis microlophus	-	-	1	2.06	1	2.06	not available	
Lepisosteus osseus	3	0.21	3	0.15	6	0.18	118	0.13-0.41
Lepisosteus oculatus	1	0.64	1	0.36	2	0.50	163	0.12-0.31 and 0.28-0.49
Minytrema melanops	2	1.14	1	0.98	3	1.08	2,221	1.01 and 1.07
Carpiodes velifer	-	-	10	1.25	10	1.25	500	1.19 and 1.43
Carpiodes cyprinus	1	1.01	13	1.17	14	1.16	956	1.16-2.22
Moxostoma poecilurum	2	1.14	5	1.32	7	1.27	886	1.12
Notropis venustus	4	0.79	10	1.24	14	1.11	2,921	0.80-4.18
Amia calva	2	1.06	-	-	2	1.06	16	1.38 (K-SL)***
Trinectus maculatus	1	1.37	-	-	1	1.37	not available	
Alosa alabamae	-	-	1	1.17	1	1.17	not available	

*Sampling performed by U.S. Fish and Wildlife Service
**TL = Total length
***SL = Standard length

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TABLE 2.7-20

CHOCTAWHATCHEE RIVER AQUATIC ECOLOGY STUDY*
SUMMARY LIST OF MACROSCOPIC BENTHIC INVERTEBRATES FOUND INHIBITING THE CARYVILLE AREA
GENERAL INFORMATION REGARDING LIFE HISTORIES AND HABIT REQUIREMENTS

TAXONOMIC NAME (Collected by Gulf Except as noted)	PHYSICAL HABITAT			LIFE HISTORIES (Species Specific Only)	RANGES OF CERTAIN WATER QUALITY PARAMETERS AT WHICH SPECIES HAVE BEEN FOUND (Reference 103 Except as Noted)					
	Type Bottom	Lentic	Lotic		Temp.	pH	Alkalinity (mg/l)	Dissolved Oxygen (mg/l)	Total Hardness (mg/l)	Turbidity
__Didymops transversa__ (Say)	Sand and Mud (112)	x		Not Available		6.0 to 8.0	2 to 211	5 to 10	70 to 232	18 to 87
__Gynacantha sp.__ (Ramber) (91)		x		Not Available						
__Argia apicalis__ (Say)	Mud (113)	x	x	Predaceous; deposits eggs below water surface; adults emerge middle of June and flight period lasts until early September (113)		6.8 to 8.2	20 to 220	5 to 9	15 to 336	4 to >72,000
__Argia translata__ (Hagen) (91)	Mud, Sand, and Vegetation (113)	x	x	Same as __Argia apicalis__ (Say)		6.7 to 7.9	18 to 220	7 to 10	12 to 208	16 to >72,000
__Agrion maculatum__ (Beauvois)	Vegetation (113)		x	Predaceous; deposits eggs on vegetation; adults emerge mid-May and flight period lasts until mid-September (113)						
__Callibaetis floridanus__ (Banks) (91)	Vegetation (114)	x		Herbivors; deposits eggs on water surface; emergence of adults have been observed year-round (114)		5.6 to 8.3	5 to 220	4 to 14	13 to 900	8 to 66
__Caenis sp.__ (Stephens)	Mud and Silt (114)	x		Same as __Callibaetis floridanus__		5.4 to 8.5	3 to 220	2 to 14	6 to 705	3 to >72,000
__Tricorythodes albibneatus__ (Berner)	Sand and Vegetation (114)		x	Herbivors; emergence of adults have been observed year-round (114)		7.1 to 8.5	26 to 220	5 to 14	18 to 800	10 to >72,000
__Baetis sp.__ (Leach)	Vegetation (115)			Not Available		5.6 to 8.5	5 to 213	4 to 14	16 to 1,000	3 to >72,000
__Centroptilum viridocularis__ (Berner)	Sand and Vegetation (114)		x	Herbivors; deposits eggs on water surface; emergence of adults have been observed year-round (114)		6.0 to 8.8	2 to 74	9 to 10	7 to 117	18 to 39
__Heptagenia sp.__ (Walsh)				Not Available	83°F (116)	5.5 to 8.3	4 to 124	5 to 11	8 to 178	10 to >72,000
__Hexagenia munda marilandica__ (Traver) (91)	Silt (114)	x		Herbivors; deposits eggs on water surface; emergence of adults occurs in early March and lasts until late November. Larval development is approx. one year (114)						

*Study was performed by Gulf Power Company

TABLE 2.7-20 (Continued)

TAXONOMIC NAME (Collected by Gulf except as noted)	PHYSICAL HABITAT			LIFE HISTORIES (Species Specific Only)	RANGES OF CERTAIN WATER QUALITY PARAMETERS AT WHICH SPECIES HAVE BEEN FOUND (Reference 103 Except as Noted)					
	Type Bottom	Lentic	Lotic		Temp.	pH	Alkalinity (mg/l)	Dissolved Oxygen (mg/l)	Total Hardness (mg/l)	Turbidity
Stenonema exiguum (Traver) (91)	Submerged Logs, etc. (114)		x	Herbivors; deposits eggs on water surface; adults emerge year-round (114)		5.5 to 8.4	4 to 213	3 to 11	7 to 800	1 to 548
Stenonema proximum (Traver)	Submerged Logs, etc. (114)		x	Herbivors; deposits eggs on water surface; adults emerge year-round (114)		5.6 to 8.4	5 to 205	4 to 14	13 to 705	6 to >72,000
Stenonema smithae (Traver)	Submerged Logs, etc. (114)		x	Herbivors; deposits eggs on water surface; adults emerge year-round (114)		5.5 to 8.4	4 to 213	3 to 11	7 to 800	1 to 548
Isonychia sp. A	Submerged Logs, etc. (114)		x	Herbivors; deposits eggs on water surface; adults emerge year-round (114)		5.5 to 8.8	4 to 130	4 to 14	7 to 216	8 to >72,000
Ephemerella trilineata (Berner)	Sand and Silt (114)		x	Herbivors; deposits eggs on water surface; adults emerge from early February to late June. Nymphs develop in one year (114)	86°F (116)	6.6 to 6.7	1 to 20	7 to 8	21 to 22	10 to 15
Tortopus incertus (Traver)	Silt and Mud (115)	x		Not Available		6.8 to 7.0	15 to 28	7 to 9	8 to 15	25 to 548
Ancyronyx variegatus (Germar)	Sand and Submerged Logs, etc. (117)		x	Not Available		5.5 to 7.1	4 to 36	5 to 9	6 to 87	5 to 120
Stenelmis sp. (Dufour)	Sand and Submerged Logs, etc. (117)		x	Not Available						
Optioservus ovalis (LeConte)	Sand and Gravel (118)		x	Not Available		7.2 to 8.2	47 to 122	9 to 11	87 to 800	10 to 15
Gyrinus sp. (Muller)	Sand (117)	x		Not Available		5.5 to 8.5	2 to 124	3 to 14	8 to 5,000	3 to 548
Hydropsyche sp. (Rictet)	Submerged Logs, etc. (119)		x	Not Available	53.6 to 95°F (120)	6.5 to 9.0 (120)	10 to 550 (120)	1 to 15 (120)	5 to 5,000 (120)	10 to 1,000 (120)
Macronemum sp. (Burmeister) (91)	Submerged Logs, etc. (119)		x	Not Available	53.6 to 95°F (120)	3 to 9 (120)	10 to 150 (120)	5 to 11 (120)	5 to 500 (120)	10 to 1,000 (120)
Brachycentrus sp. (Curtis) (91)	Submerged Logs, etc. (119)		x	Not Available	62.6 to 82.4°F (120)	3 to 9 (120)	10 to 150 (120)	7 to 11 (120)	10 to 200 (120)	10 to 500 (120)
Leptocella sp. (Banks) (91)	Vegetation, etc. (103)		x	Not Available	53.6 to 95°F (120)	7.5 to 9.0 (120)	20 to 550 (120)	1 to 11 (120)	5 to 500 (120)	10 to 1,000 (120)

TABLE 2.7-20 (Continued)

TAXONOMIC NAME (Collected by Gulf Except as noted)	PHYSICAL HABITAT			LIFE HISTORIES (Speies Specific Only)	RANGES OF CERTAIN WATER QUALITY PARAMETERS AT WHICH SPECIES HAVE BEEN FOUND (Reference 103 Except as Noted)					
	Type Bottom	lentic	Lotic		Temp.	pH	Alkalinity (mg/l)	Dissolved Oxygen (mg/l)	Total Hardness (mg/l)	Turbidity
<u>Corbicula malinensis</u> (Philippi)	Virtually Any (103)	Not Available		Monoecious; reaches sexual maturity at from 10.3 millimeters (MM) to 17.5 MM in length; spawning season January to July in Philippines; immature ova 70 to 160 microns at widest diameter (125)						
<u>Goniobasis curvicostata</u> (Reeve)	Not Available		x (126)	Not Available						
<u>Goniobasis clenchi</u> (Goodrich)	Not Available	Not Available		Not Available						
<u>Campeloma lewisii</u> (91)	Not Available	Not Available		Not Available						
<u>Physa pumilia</u> (Conrad)	Mixed (126)	x	x	Not Available						
<u>Pomacea sp.</u> (Perry) (91)	Mixed (126)	x	x	Not Available						
<u>Hydra obligactis</u> (Pallas)	Submerged Objects (121)	x	x	Carnivorous; reproduce by budding (121)						
<u>Bezzia sp.</u> (Kieffer)	Mud and Debris (103)	x	x	Not Available		5.6 to 8.0	6 to 213	2 to 14	15 to 1,000	7 to 128
<u>Atherix variegata</u> (Walker)	Silt and Mud (121)		x	Carnivorous; eggs layed on shoreline vegetation (121)	89.6°F (116)	6.3 to 6.4	9 to 13	8 to 9	4 to 7	5 to 36
<u>Ablabesmyia janta</u> (Roback)				Not Available						
<u>Cladolanytarous sp.</u> (Kieff)				Not Available						
<u>Cryptotendipes sp.</u> (Lenz) (91)				Not Available						
<u>Corynoneura celeripes</u> (Winn) (91)				Not Available		6.4	9	9	6	5
<u>Cricotopus bicinctus</u> (Meig)	Sand and Gravel (120)	x		Not Available	32 to 93.2°F (120)	6.3 to 8.8	2 to 97	6 to 12	18 to 2,100	3 to 84
<u>Cricotopus sp.</u> (Van der Wulp)				Not Available	32 to 104.4°F (120)	7.4 to 8.4	87 to 97	10 to 11	197 to 216	19 to 29

TABLE 2.7-20 (Continued)

TAXONOMIC NAME (Collected by Gulf Except as noted)	PHYSICAL HABITAT			LIFE HISTORIES (Species Specific Only)	RANGES OF CERTAIN WATER QUALITY PARAMETERS AT WHICH SPECIES HAVE BEEN FOUND (Reference 103 Except as Noted)					
	Type Bottom	Lentic	Lotic		Temp.	pH	Alkalinity (mg/l)	Disolved Oxygen (mg/l)	Total Hardness (mg/l)	Turbidity
Cryptochironomus blarina (Townes)	Sand and Clay (120)		x	Not Available	39.9 to 80.1°F (120)	7.0 to 8.5 (120)				
Dicrotendipes sp. B				Not Available						
Dicrotendipes nervosus (Staeg.)	Marl, Plants (120)	x		Not Available	39.9 to 86°F (120)	6.3 to 8.3	17 to 56	3 to 11	18 to 386	18 to 165
Dicrotendipes neomodestus (Mall.)	Sand, Gravel (120)	x		Not Available	32 to 91°F (120)					
Glyptotendipes lobiferus (Say)	Marl, Plants (120)	x		Not Available	32 to 91°F (120)	6.6 to 8.5	20 to 180	6 to 14	21 to 900	4 to 125
Nanocladius alternantherae (Dendy and Sublette)				Not Available						
Omisus sp. (Townes)				Not Available						
Orthocladius sp. (Van der Wulp) (91)				Not Available						
Paralauterborniella sp. (Townes)				Not Available						
Pedionomus beckae (Sublette)				Not Available						
Polypedilum falax (Joh.)	Gravel (120)	x		Not Available	32 to 91°F (120)	4.6 to 8.0	9 to 180	7 to 9	6 to 570	5 to 25
Polypedilum scalaenum (Schrank)				Not Available		3.0 to 8.2	0 to 206	5 to 14	11 to 227	3 to >72,000
Polypedilum halterale (Coq.) (91)	Plants, Marl (120)	x	x	Not Available	39.9 to 86°F (120)	6.4 to 8.0	9 to 126	6 to 14	6 to 188	5 to >72,000
Polypedilum illinoense (Mall.) (91)	Sand and Gravel (120)	x		Not Available	32 to 91°F (120)	3.0 to 8.8	0 to 220	6 to 14	6 to 2,100	3 to >72,000

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TABLE 2.7-20 (Continued)

TAXONOMIC NAME (Collected by Gulf Except as noted)	PHYSICAL HABITAT			LIFE HISTORIES Species Specific Only)	RANGES OF CERTAIN WATER QUALITY PARAMETERS AT WHICH SPECIES HAVE BEEN FOUND (Reference 103 Except as Noted)					
	Type Bottom	Lentic	Lotic		Temp.	pH	Alkalinity (mg/l)	Dissolved Oxygen (mg/l)	Total Hardness (mg/l)	Tubidity
Polypedilum convictum (Walk.)				Not Available						
Procladius sp. (Skeuse)	Gravel, Marl (120)	x	x	Not Available	32 to 86°F (120)	4.4 to 8.3	0 to 102	4 to 10	13 to 250	2 to 110
Psectrocladius sp. (Kieff.)				Not Available		7.9 to 8.8	74 to 116	6 to 14	117 to 162	23 to 125
Rheotanytarsus exiguus (Joh.)				Not Available		5.5 to 8.8	2 to 128	3 to 14	4 to 193	5 to >72,000
Rheocricotopus robacki				Not Available						
Micropsectra sp. (Kieff.)	Sand, Gravel (120)		x	Not Available	32 to 86°F (120)	6.8 to 9.1 (120)				
Tanytarsus sp. (Van der Wulp)				Not Available						
Thienemaniella xena (Roback)				Not Available		7.3	39	8	66	20
Tribelos sp. (Townes)				Not Available						
Trichocladius sp. (Kieff)				Not Available		5.6	6	3	15	41

TABLE 2.7-21

CHOCTAWHATCHEE RIVER AQUATIC ECOLOGY STUDY*
MACROSCOPIC BENTHIC INVERTEBRATES COLLECTED BY MULTIPLE-PLATE SAMPLER
AUGUST 1 to 29, 1974

Species List**

Odonta (ORDER)
- Libellulidae (FAMILY) dragonflies
  - Didymops transversa (Say)
- Coenagriidae (FAMILY) damselflies
  - Argia apicalis (Say)
- Agriidae (FAMILY) damselflies
  - Agrion maculatum (Beauvois)

Ephemeroptera (ORDER) mayflies
- Caenidae (FAMILY)
  - Caenis sp. A (Stephens)
  - Tricorythodes albilineatus (Berner)
- Baetidae (FAMILY)
  - Baetis sp. A (Leach)
  - Centroptilum viridocularis (Berner)
- Heptageniidae (FAMILY)
  - Heptagenia sp. A (Walsh)
  - Stenonema smithae (Traver)
- Siphlonuridae (FAMILY)
  - Isonychia sp.A((Eaton)
- Ephemerellidae (FAMILY)
  - Ephemerella trilineata (Berner)
- Polymitarcidae (FAMILY)
  - Tortopus incertus (Traver)

Coleoptera (ORDER)
- Elmidae (FAMILY) elmid beetles
  - Ancyronyx variegatus (Germar)
  - Stenelmis sp. (Dufour)
  - Optioservus ovalis (LeConte)
- Gyrinidae (FAMILY) whirligig beetles
  - Gyrinus sp. (Muller)

Trichoptera (ORDER) caddisflies
- Leptoceridae (FAMILY)
  - Oecetis cinerascens (Hagen)
- Psychomyiidae (FAMILY)
  - Neureclipsis sp. (McLachlan)
  - Cyrnellus fraternus (Banks)
- Hydropsychidae (Family)
  - Cheumatopsyche sp. (Wallengren)

Oligochaeta (CLASS) aquatic earthworms
- Naididae (FAMILY)
  - Nais barbata (Müller)
  - Nais variabilis (Piquet)
  - Nais pseudobtusa (Piquet)

Plecoptera (ORDER) stoneflies
- Perlidae (FAMILY)
  - Acroneuria arenosa (Pictet)
  - Paragnetina sp. (Klapalek)

Species List*

Megaloptera (ORDER)
- Corydalidae (FAMILY)
  - Corydalus cornutus (Linnaeus) dobsonflies
  - Chauliodes pecticornis (Linnaeus) fishflies

Mesogastropoda (ORDER) operculate snails
- Pleuroceridae (FAMILY)
  - Goniobasis curvicostata (Reeve)

Basommatophora (ORDER) non-operculate snails
- Physidae (FAMILY)
  - Physa pumilia (Conrad)

Hydroida (ORDER) hydroids
- Hydra oligactis (Pallas)

Diptera (ORDER)
- Ceratopogonidae (FAMILY) biting midges
  - Bezzia sp. (Kieffer)
- Rhagionidae (FAMILY) snipe flies
  - Atherix variegata (Walker)
- Chironomidae (FAMILY) true flies
  - Ablabesmyia janta (Roback)
  - Omisus sp. (Townes)
  - Cladotanytarsus sp. (Kieff.)
  - Cricotopus bicinctus (Meig.)
  - Cryptochironomus blarina (Townes)
  - Dicrotendipes sp. B
  - Dicrotendipes nervosus (Staeg.)
  - Dicrotendipes neomodestus (Mall.)
  - Glyptotendipes lobiferus (Say)
  - Nanocladius alternantherae (Dendy & Sublette)
  - Cricotopus sp. (Van der Wulp)
  - Paralauterborniella sp. (Townes)
  - Pedionomus beckae (Sublette)
  - Polypedilum falax (Joh.)
  - Polypedilum scalaenum (Schrank)
  - Procladius sp. (Skeuse)
  - Psectrocladius sp. (Kieff.)
  - Rheotanytarsus exiguus
  - Micropsectra sp. (Kieff.)
  - Tanytarsus sp. (Van der Wulp)
  - Thienemaniella xena (Roback)
  - Tribelos sp. (Townes)
  - Trichocladius sp. (Kieff.)
  - Rheocricotopus robacki
  - Polypedilum convictum (Walk.)

*Study performed by Gulf Power Company
**Identifications tentative

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TABLE 2.7-22

CHOCTAWHATCHEE RIVER AQUATIC ECOLOGY STUDY*
MACROSCOPIC BENTHIC INVERTEBRATES COLLECTED BY MULTIPLE-PLATE SAMPLERS
AUGUST 1 to 29, 1974
QUALITATIVE AND QUANTITATIVE ANALYSES

TAXONOMIC CLASSIFICATIONS**	CHOCTAWHATCHEE RIVER - STATION 1 SAMPLING LOCATIONS (LOOKING DOWNSTREAM)			
	RIGHT SIDE		LEFT SIDE	
	A	B	A	B
Gyrinus sp.			1	
Atherix variegata			1	
Nais barbata			1	
Didymops transversa			1	1
Tanytarsus sp.	7	18	23	16
Rheotanytarsus exiguus	12	2	17	8
Ablabesmyia janta	2	8	3	9
Nanocladius alternantherae	6	6	26	3
Polypedilum falax	2	3	1	
Cryptochironomus blarina	1	1		
Rheocricotopus robacki			1	
Polypedilum scalaenum			1	3
Dicrotendipes neomodestus			1	
Orthocladius sp.			1	
Glyptotendipes lobiferus				1
Acroneuria arenosa		1	1	
Stenonema smithae	4	14	10	7
Caenis sp. A	8	3	4	8
Isonychia sp.	4		6	1
Centroptilum viridocularis	2			
Tricorythodes albilineata			1	
Cheumatopsyche sp.	9		5	1
Cyrnellus fraternus			2	
Ancyronyx variegata			1	1
Total number per 0.09 square meter	59	56	106	59
Average number per 0.09 square meter	57.5		82.5	
Percent Coefficient of Variance	3.69		40.28	
Species Diversity ($\bar{D}$)	3.29	2.60	3.23	3.01
Average Species Diversity ($\bar{D}$)	2.95		3.12	
Percent Coefficient of Variance	16.57		4.99	
Total wet weight (Grams) per 0.09 square meter	0.04746	0.05317	0.23638	0.06924
Average wet weight (Grams) per 0.09 square meter	0.0503		0.1528	
Percent Coefficient of Variance	8.02		77.34	

* Study performed by Gulf Power Company
** Identifications Tentative

TABLE 2.7-22 (Continued)

TAXONOMIC CLASSIFICATIONS**	WRIGHTS CREEK - STATION 1 SAMPLING LOCATIONS (LOOKING DOWNSTREAM) Center	
	A	B
Argia apicalis	2	2
Bezzia sp.	1	
Ablabesmyia janta	8	16
Nanocladius alternantherae	2	
Tanytarsus sp.	16	29
Cryptochironomus blarina	1	
Pedionomus beckae	2	
Dicrotendipes neomodestus	1	
Didymops transversa		1
Caenis sp. A		1
Oecetis cinerascens		1
Neureclipsis sp.		2
Nais barbata		1
Micropsectra sp.		1
Rheotanytarsus exiguus		1
Dicrotendipes sp. B		1
Rheocricotopus robacki		1
Paralauterborniella sp.		1
Polypedilum convictum		1
Psectrocladius sp.		1
Total number per 0.09 square meter	33	60
Average number per 0.09 square meter	46.5	
Percent Coefficient of Variance	41.06 percent	
Species Diversity ($\bar{D}$)	2.20	2.43
Average Species Diversity ($\bar{D}$)	2.32	
Percent Coefficient of Variance	7.03 percent	
Total wet weight (Grams) per 0.09 square meter	0.01231	0.03499
Average wet weight (Grams) per 0.09 square meter	0.0237	
Percent Coefficient of Variance	67.81 percent	

**Identifications Tentative

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TABLE 2.7-22 (Continued)

TAXONOMIC CLASSIFICATIONS**	CHOCTAWHATCHEE RIVER - STATION 2 SAMPLING LOCATIONS (LOOKING DOWNSTREAM) RIGHT SIDE A	RIGHT SIDE B	LEFT SIDE A	LEFT SIDE B
Acroneuria arenosa	1			
Corydalus cornutus	1			
Cheumatopsyche sp.	3			1
Cyrnellus fraternus	1			
Isonychia sp.	4	1	1	1
Stenonema smithae	9	5	5	2
Caenis sp. A	2		6	3
Tricorythodes albilineatus	2		2	1
Atherix variegata	1			
Ablabesmyia janta	5	12	4	15
Nanocladius alternantherae	26	7	9	7
Polypedilum falax	4	4	4	8
Tanytarsus sp.	13	11	6	12
Rheotanytarsus exiguus	2	4	3	2
Polypedilum scalaenum	1	1	2	
Cricotopus sp.	1		2	
Goniobasis curvicostata		4	2	
Argia apicalis		1	4	3
Tribelos sp.		2		
Dicrotendipes nervosus		3	1	
Pedionomus beckae		1		
Rheocricotopus robacki		1		
Gyrinus sp.			1	
Bezzia sp.			2	3
Didymops transversa				1
Omisus sp.				1
Dicrotendipes neomodestus				1
Nais pseudobtusa				1
Total number per 0.09 square meter	76	60	54	62
Average number per 0.09 square meter	68.0		58.0	
Percent Coefficient of Variance	16.64		9.75	
Species Diversity ($\bar{D}$)	3.13	3.52	3.72	3.32
Average Species Diversity ($\bar{D}$)	3.33		3.52	
Percent Coefficient of Variance	8.29		8.04	
Total wet weight (Grams) per 0.09 square meter	0.20420	2.20555	0.64491	0.03691
Average wet weight (Grams) per 0.09 square meter	1.2049		0.3409	
Percent Coefficient of Variance	117.45		126.11	

**Identifications Tentative

TABLE 2.7-22 (Continued)

TAXONOMIC CLASSIFICATIONS**	CHOCTAWHATCHEE RIVER - STATION 3 SAMPLING LOCATIONS (LOOKING DOWNSTREAM)			
	RIGHT SIDE		LEFT SIDE	
	A	B	A	B
Oecetis cinerascens	1			
Isonychia sp.	5		10	23
Tricorythodes albilineatus	2	1	1	1
Omisus sp.				1
Dicrotendipes nervosus	1			
Nanocladius alternantherae	9	42	40	10
Tanytarsus sp.	4	29	26	98
Rheotanytarsus exiguus	5	23	41	11
Nais barbata	1	2	2	1
Corydalus cornutus		1	2	1
Caenis sp. A		1		
Ephemerella trilineata		1		1
Stenonema smithae	7	12	25	13
Heptagenia sp. A		2		
Ablabesmyis janta		1	2	
Polypedilum convictum		2	5	1
Psectrocladius sp.		3	1	
Rheocricotopus robacki		4		
Acroneuria arenosa			1	
Chauliodes pecticornis			1	3
Neureclipsis sp.			3	
Cheumatopsyche sp.			4	6
Didymops transversa			1	
Stenelmis sp.			2	1
Hydra oligactis			1	
Cricotopus sp.			1	
Cladotanytarsus sp.			1	
Baetis sp.				2
Paragnetina sp.				1
Total number per 0.09 square meter	35	121	171	174
Average number per 0.09 square meter	78.0		172.5	
Percent Coefficient of Variance	77.96		1.23	
Species Diversity ($\bar{D}$)	2.80	2.51	3.11	2.31
Average Species Diversity ($\bar{D}$)	2.66		2.71	
Percent Coefficient of Variance	7.72		20.87	
Total wet weight (Grams) per 0.09 square meter	0.08139	0.03314	0.26461	0.21117
Average wet weight (Grams) per 0.09 square meter	0.0573		0.2379	
Percent Coefficient of Variance	59.58		15.88	

**Identifications Tentative

TABLE 2.7-22 (Continued)

TAXONOMIC CLASSIFICATIONS**	CHOCTAWHATCHEE RIVER - STATION 4 SAMPLING LOCATIONS (LOOKING DOWNSTREAM) RIGHT SIDE A	RIGHT SIDE B	LEFT SIDE A	LEFT SIDE B
Gyrinus sp.	1			
Argia apicalis	1	2		1
Caenis sp. A	1	3	2	
Tortopus incertus	2	1	1	
Ablabesmyia janta	4	3	2	3
Tribelos sp.	4	7		
Polypedilum falax	1	1	2	
Polypedilum convictum	3	2	2	2
Tanytarsus sp.	3	2	19	5
Rheotanytarsus exiguus	1		14	1
Cryptochironomus blarina	3	2		1
Cricotopus sp.	1			
Nais barbata	1	1		
Physa pumilia		2		
Paralauterborniella sp.		1		
Nais variabilis		1		
Isonychia sp.			11	
Stenonema smithae			18	1
Tricorythodes albilineatus			3	
Ephemerella trilineata			2	
Agrion maculatum			1	
Oecetis cinerascens			1	2
Cheumatopsyche sp.			1	2
Neureclipsis sp.			2	
Optioservus ovalis			1	
Nanocladius alternantherae			14	2
Procladius sp.			1	
Thienemaniella xena			1	
Cricotopus bicinctus			1	
Psectrocladius sp.			1	
Baetis sp.				1
Total number per 0.09 square meter	26	28	95	21
Average number per 0.09 square meter	27.0		58.0	
Percent Coefficient of Variance	5.24		90.22	
Species Diversity ($\bar{D}$)	3.46	3.41	3.23	3.23
Average Species Diversity ($\bar{D}$)	3.44		3.23	
Percent Coefficient of Variance	1.03		0.0	
Total wet weight (Grams) per 0.09 square meter	0.04947	0.04069	0.08060	0.02075
Average wet weight (Grams) per 0.09 square meter	0.0451		0.0507	
Percent Coefficient of Variance	13.77		83.51	

**Identifications Tentative

TABLE 2.7-23

CHOCTAWHATCHEE RIVER AQUATIC ECOLOGY STUDY*
MACROSCOPIC BENTHIC INVERTEBRATES COLLECTED BY MULTIPLE-PLATE SAMPLERS
AUGUST 1 to 29, 1974
PERCENT COMPOSITION BY NUMBER AND WEIGHT OF MAJOR TAXONOMIC GROUPS

SAMPLING LOCATIONS

MAJOR TAXONOMIC CLASSIFICATIONS	**CR No. 1		**CR No. 2		**CR No. 3		**CR No. 4		***WC No. 1	
	percent by number	percent by weight	percent by number	percent by weight	percent by number	percent by weight	percent by number	percent by weight	percent by number	percent by weight
Basommatophora	-	-	-	-	-	-	1.2	9.7	-	-
Coleoptera	0.7	8.0	0.4	0.3	0.6	0.2	1.2	16.0	-	-
Diptera	65.4	5.2	71.8	0.7	72.1	4.0	64.1	13.4	89.2	24.7
Ephemeroptera	26.4	43.4	18.7	3.3	21.0	71.6	24.1	36.6	1.1	1.0
Hydroida	-	-	-	-	0.2	0.1	-	-	-	-
Megaloptera	-	-	0.4	2.8	1.6	2.1	-	-	-	-
Mesogastropoda	-	-	2.4	89.8	-	-	-	-	-	-
Odonta	0.4	4.9	3.6	0.9	0.2	2.8	2.9	17.1	5.4	64.4
Oligochaeta	0.4	0.0	0.4	0.0	1.2	0.1	1.8	0.1	1.1	0.1
Plecoptera	0.7	36.5	0.4	2.0	0.4	16.9	-	-	-	-
Trichoptera	6.1	2.0	2.0	0.2	2.8	2.3	4.7	6.9	3.2	9.7

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* Study performed by Gulf Power Company
** CR = Choctawhatchee River
***WC = Wrights Creek

TABLE 2.7-24
CHOCTAWHATCHEE RIVER AQUATIC ECOLOGY STUDY*
TOW-DREDGE SAMPLING FOR SNAILS AND MUSSELS
TWO FIFTY-YARD TOWS MADE PER STATION ALONG SANDBARS IN 18 TO 24 INCHES IN WATER
AUGUST 29, 1974

TAXONOMIC CLASSIFICATION**		SAMPLING LOCATIONS							
		CR No. 1		CR No. 2		CR No. 3		CR No. 4	
		Number	Weight (Grams)	Number	Weight (Grams)	Number	Weight (Grams)	Number	Weight (Grams)
Elliptio strigosus (Lea)	A					1	5.038		
	B								
Goniobasis curvicostata (Reeve)	A			4	2.820	15	5.124	1	0.471
	B					1	0.424		
Goniobasis clenchi (Goodrich)	A					2	2.672	1	1.537
	B					1	1.272		
Corbicula malinensis (Philippi)	A	1	0.558			90	279.492	4	11.645
	B	2	2.356	2	4.748	21	54.823	5	16.988
Average No./50 yards/ Tow-Dredge		1.5		3.0		65.5		5.5	
Percent Coefficent of Variance		47.14 percent		47.14 percent		91.76 percent		12.86 percent	
Average No. Species/ 50 yards/Tow-Dredge		1.0		1.0		3.5		2.0	
Percent Coefficient of Variance		0.0 percent		0.0 percent		20.20 percent		70.71 percent	
Average Wet Weight/50 yards/Tow-Dredge		1.457		3.784		174.423		15.321	
Percent Coefficient of Variance		87.26 percent		36.03 percent		95.60 percent		15.39 percent	

* Study performed by Gulf Power Company
** Identifications Tentative

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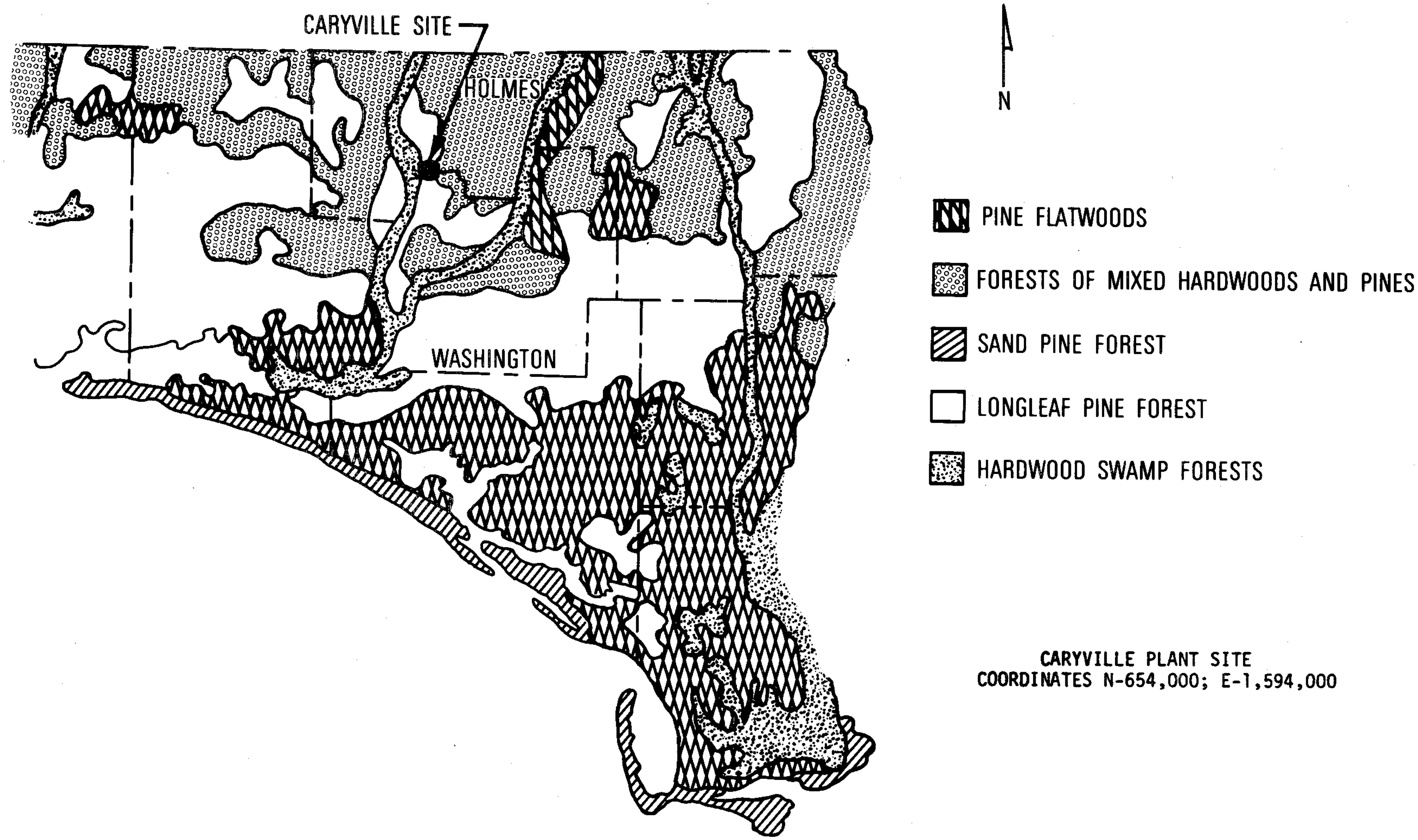
TABLE 2.7-25
CHOCTAWHATCHEE RIVER AQUATIC ECOLOGY STUDY
PERIPHYTON COLLECTED FROM GLASS SLIDES SUSPENDED IN WATER
CELL NUMBER AND VOLUME PER MILLILITER (1 GLASS SLIDE TO 100 MILLILITER DISTILLED WATER)
(STUDY PERFORMED BY GULF POWER COMPANY)

AUGUST 1 to 29, 1974

TAXONOMIC CLASSIFICATIONS	STATION LOCATIONS - LOOKING DOWNSTREAM								
	CR NO. 1		CR NO. 2		CR NO. 3		CR NO. 4		WC NO. 1
	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	CENTER
GREEN ALGAE:									
Closterium dianae Ehrbg. var. *minus* (Will) Schroder									
DIATOMS:									
Bacillaria paradoxa Gemlin									2,040
Caloneis bacillum (Grun.) Cl.									
Cocconeis placentula Ehrbg.			2,040	5,100					
Cymbella amphicephala Naeg.									
Cymbella tumida (Breb.) Heurck									
Fragilaria capucina Desmazieres	2,040		3,060						
Gomphonema olivaceum (Lyngbye) Ktz.				1,020					
Gyrosigma spencerii (W. Smith) Cl. var. *nodifera* Grun.		2,040		1,020	1,020	2,040	2,040	1,020	
Melosira varians C.A.Ag.									
Navicula confervacea Ktz.	3,060		2,040	1,020	1,020				1,020
Navicula cryptocephala Ktz.	4,080	5,100	1,020	1,020			2,040	2,040	2,040
Navicula rhyncocephala Ktz.		1,020	1,020						
Neidium affine (Ehr.) Pfitz.		1,020			1,020				
Nitzschia acicularia (Ktz.) Wm Smith									
Nitzschia filiformis (Wm Smith) Hustedt									
Nitzschia ignorata Krauke									
Nitzschia palea (Ktz.) Wm Smith		1,020					1,020	1,020	
Nitzschia tryblionella Hantz var. *victoriae* Grun.									
Pinnularia mormonorum (Grun.) Patr.	1,020								
Stauroneis obtusa Lagerst.									
Surirella elegans Ehr.									
Surirella linearis Wm Smith		1,020	1,020						
Surirella saxonica Auersw.									
Synedra ulna (Nitzsch.) Ehr.		1,020				1,020			
Synedra ulna (Nitzsch.) Ehr. var. *aequalis* (Ktz.) Hust.								2,040	
BLUE-GREEN ALGAE:									
Lyngbya diguetii Gomont									
Oscillatoria chalybea Mertins									
Plectonema gracillimum (Zopf) Hansg.									
Schizothrix calcicola (Ag.) Heurck	2,040	1,020	2,040	5,100	1,020				1,020
Total Number of Algal Cells per Milliliter	12,750	13,260	12,240	14,280	4,080	3,060	5,100	6,120	6,120
Average Number of Algal Cells per Milliliter	13,005		13,260		3,570		5,610		6,120
Percent Coefficient of Variance	2.8PERCENT		10.9PERCENT		20.2PERCENT		12.9PERCENT		---
Percent Composition of Green Algal Cells	---		---		---		---		---
Percent Composition of Diatom Algal Cells	88.2PERCENT		73.1PERCENT		85.7PERCENT		100 PERCENT		83.3Percent
Percent Composition of Blue Green Algal Cells	11.8PERCENT		26.9PERCENT		14.3PERCENT		---		16.7Percent
GREEN ALGAE:									
Closterium dianae Ehrbg. var. *minus* (Will) Schroder									
DIATOMS:									
Bacillaria paradoxa Gemlin									612
Caloneis bacillum (Grun.) Cl.									
Cocconeis placentula Ehrbg.			694	5,738					
Cymbella amphicephala Naeg.									
Cymbella tumida (Breb.) Heurck									
Fragilaria capucina Desmazieres	352		689						
Gomphonema olivaceum (Lyngbye) Ktz.				536					
Gyrosigma spencerii (W.Smith) Cl. var. *nodifera* Grun.		8,568		2,486	2,486	8,568	8,568	4,284	
Melosira varians C.A.Ag.									
Navicula confervacea Ktz.	536		1,224	179	612				612
Navicula cryptocephala Ktz.	1,877	2,206	469	485			882	882	882
Navicula rhyncocephala Ktz.		765	893		765				
Neidium affine (Ehr.) Pfitz.		536			536				
Nitzschia acicularia (Ktz.) Wm Smith									
Nitzschia filiformis (Wm Smith) Hustedt									
Nitzschia ignorata Krauke									
Nitzschia palea (Ktz.) Wm Smith		281					326	326	
Nitzschia tryblionella Hantz var. *victoriae* Grun.									
Pinnularia mormonorum (Grun.) Patr.	1,530								
Stauroneis obtusa Lagerst.									
Surirella elegans Ehr.									
Surirella linearis Wm Smith		678	1,224						
Surirella saxonica Auersw.									
Synedra ulna (Nitzsch.) Ehr.		1,658				510			
Synedra ulna (Nitzsch.) Ehr. var. *aequalis* (Ktz.) Hust.								383	
BLUE-GREEN ALGAE:									
Lyngbya diguetii Gomont									
Oscillatoria chalybea Mertins									
Plectonema gracillimum (Zopf) Hansg.									
Schizothrix calcicola (Ag.) Heurck	408	115	89	421	41				51
Total Areal Units (1=400 square microns) of Algal Cells per Milliliter	4,193	14,807	5,282	9,845	4,440	9,078	9,776	5,875	2,157
Average Areal Units (1=400 square microns) of Algal Cells per Milliliter	9,500		7,564		6,759		7,826		2,157
Percent Coefficient of Variance	79.0Percent		42.7Percent		48.5Percent		35.2Percent		----
Percent Composition of Green Algal Cells	---		---		---		---		----
Percent Composition of Diatom Algal Cells	97.2Percent		96.6Percent		99.7Percent		100.0Percent		97.6Percent
Percent Composition of Blue Green Algal Cells	2.8 Percent		3.4Percent		0.3Percent		---		2.4Percent

CSP-ER-2
1

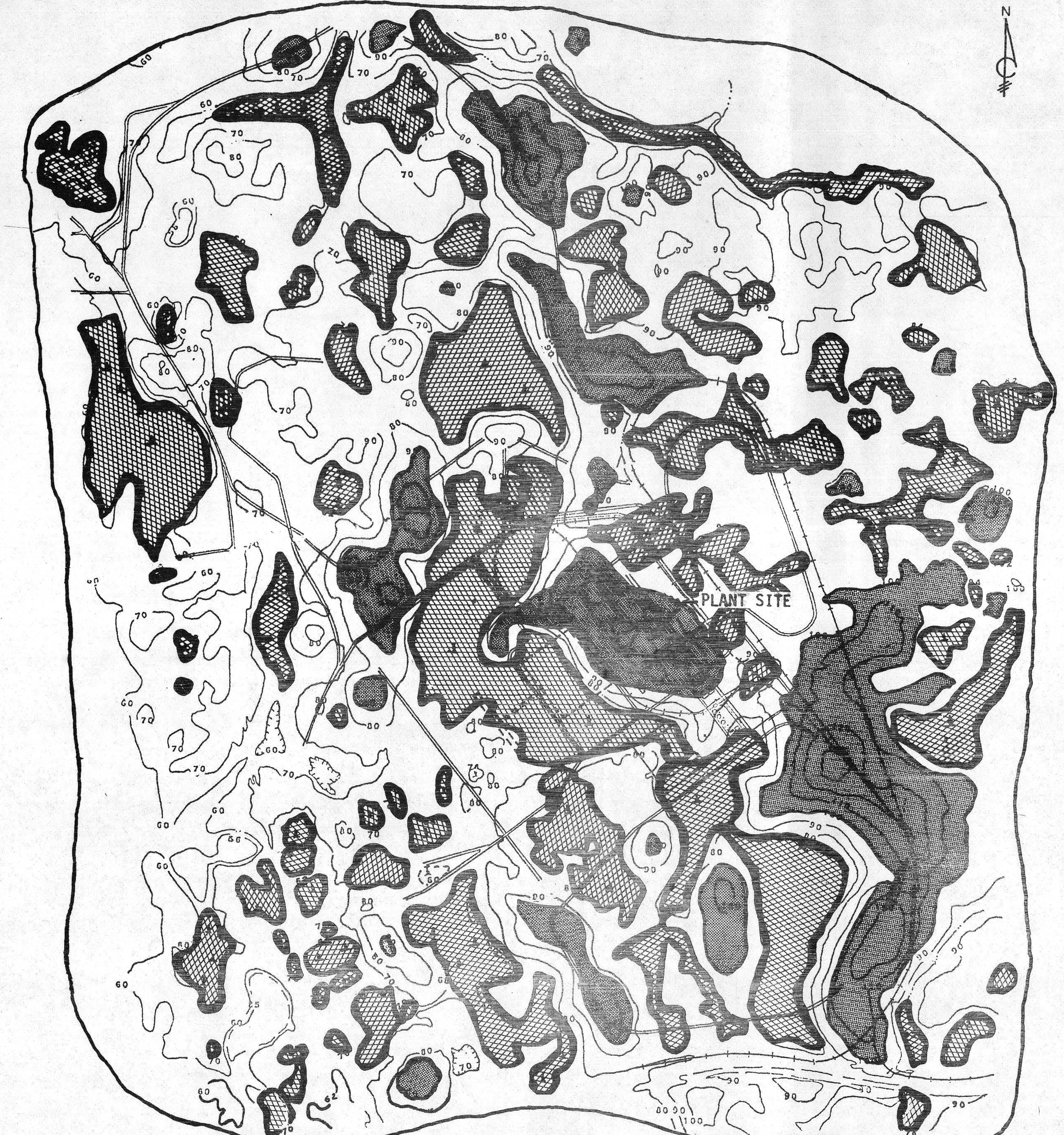
Amendment 1 6/75



GULF POWER CO.
CARYVILLE STEAM PLANT

MAP OF NATURAL VEGETATION
(MODIFIED FROM REFERENCE 5)

FIGURE 2.7-1



CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

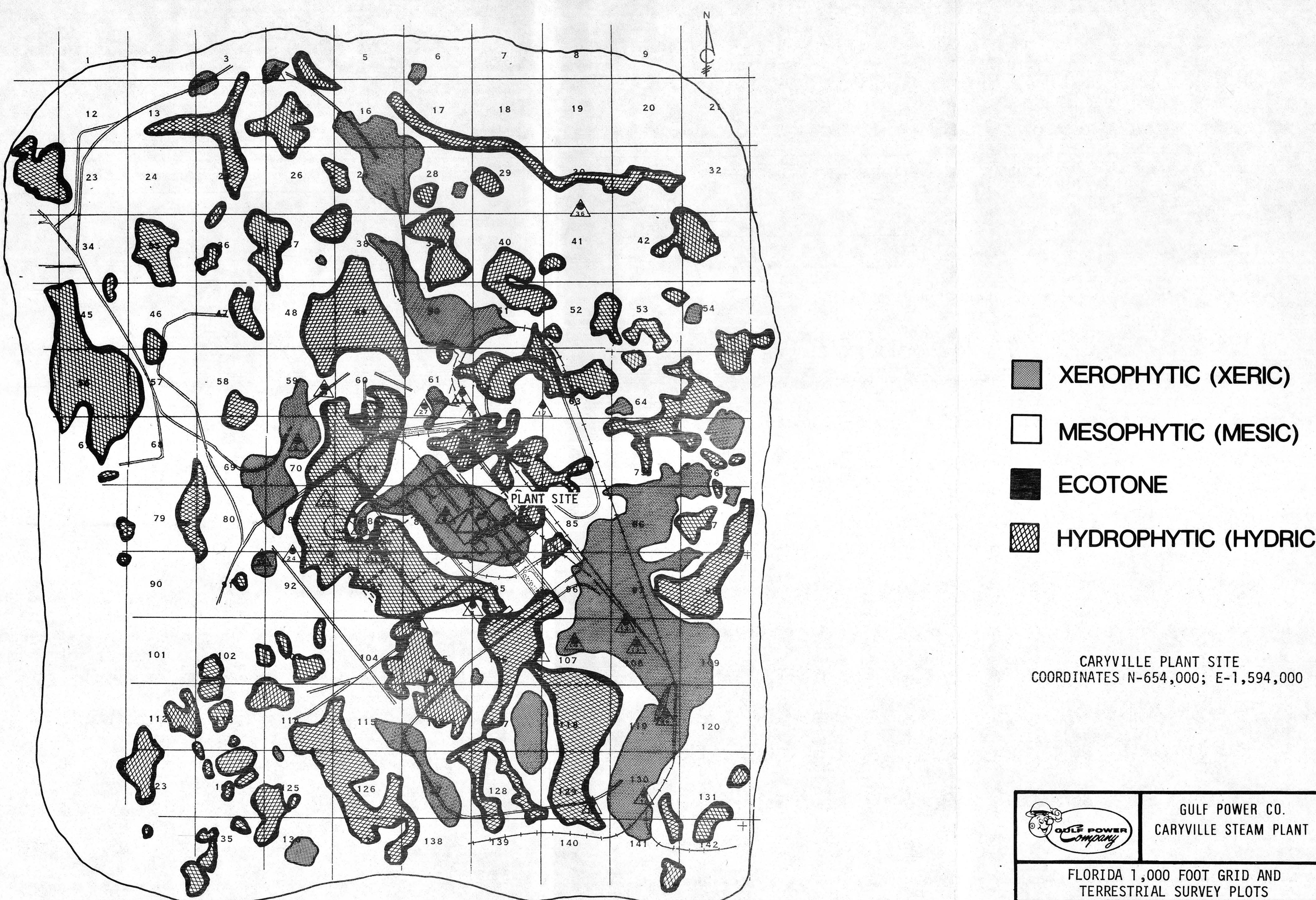
TOPOGRAPHIC FEATURES

FIGURE 2.7-2

GULF POWER CO.
CARYVILLE STEAM PLANT

PLANT LAYOUT

FIGURE 2.7-3



CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

FLORIDA 1,000 FOOT GRID AND
TERRESTRIAL SURVEY PLOTS

FIGURE 2.7-4

XEROPHYTIC (XERIC)

MESOPHYTIC (MESIC)

ECOTONE

HYDROPHYTIC (HYDRIC)

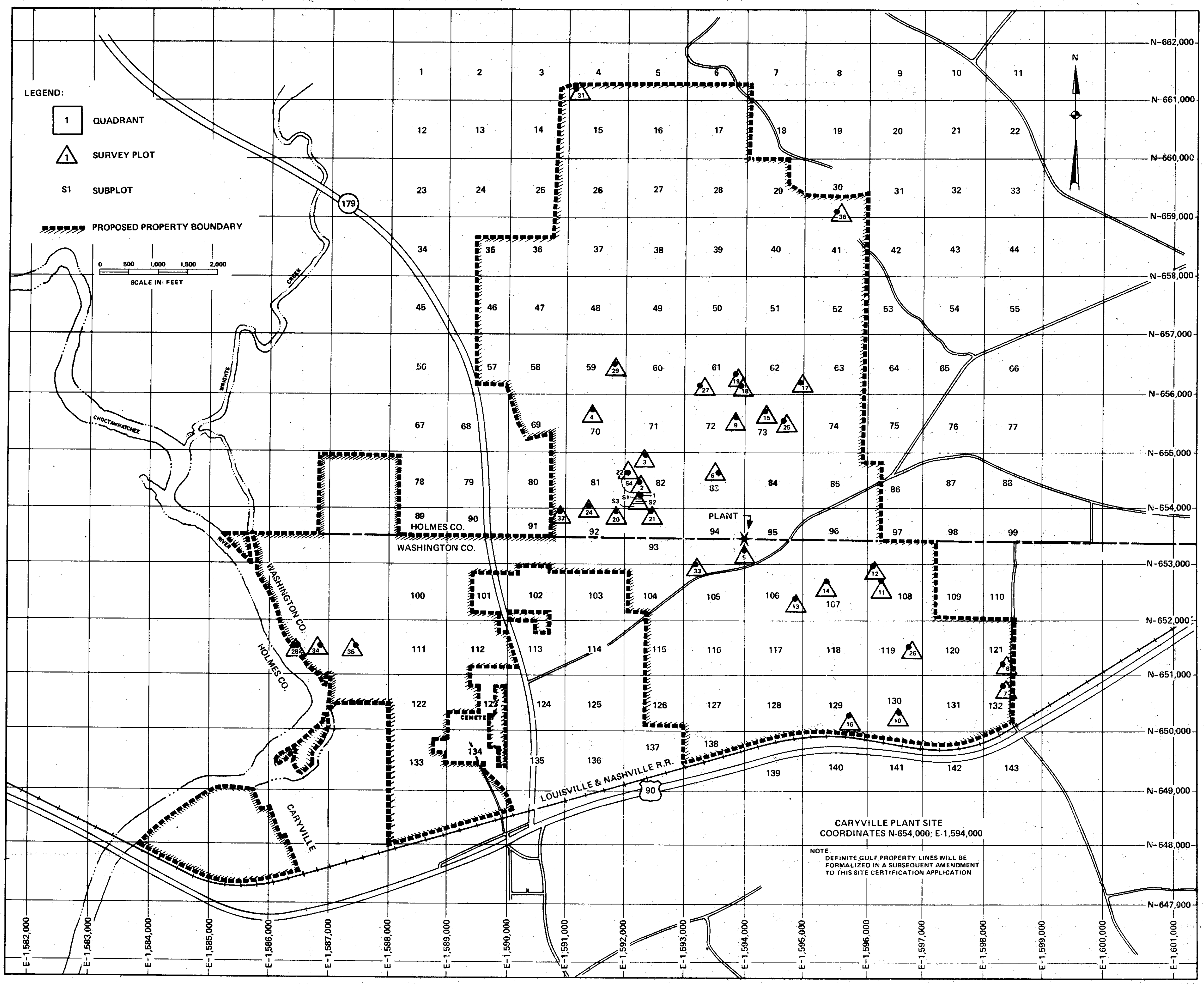
□ - GOPHER TORTOISE MOUNDS

■ - FLORIDA PANTHER TRACK

✦ - AMERICAN ALLIGATORS

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT
LOCATIONS OF RARE, PROTECTED, AND ENDANGERED SPECIES	
FIGURE 2.7-5	

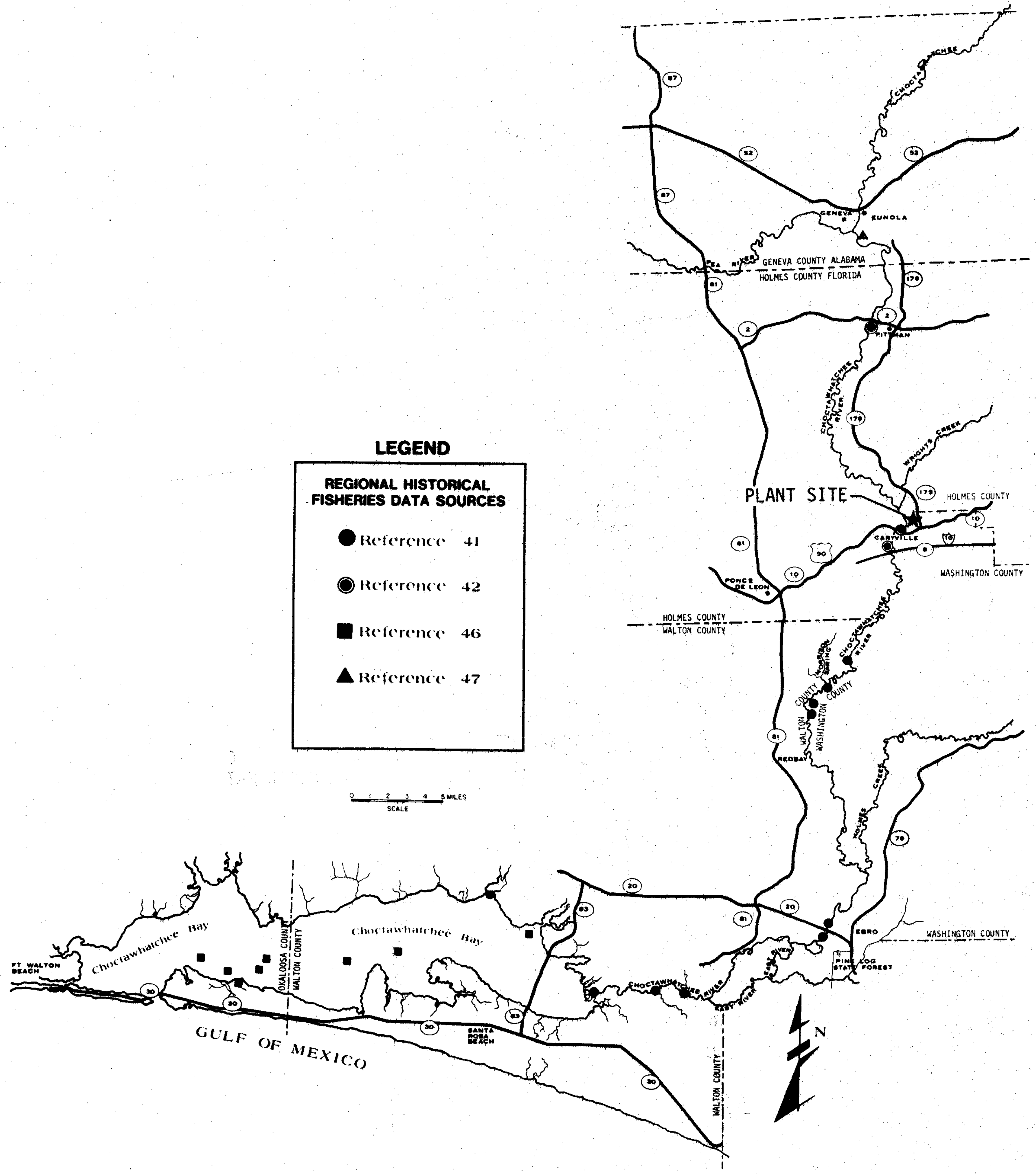


Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

PROPOSED PROPERTY BOUNDARIES AND PROJECTED IMPACT AREA WITH LOCATION OF TERRESTRIAL SURVEY PLOTS

FIGURE 2.7-6



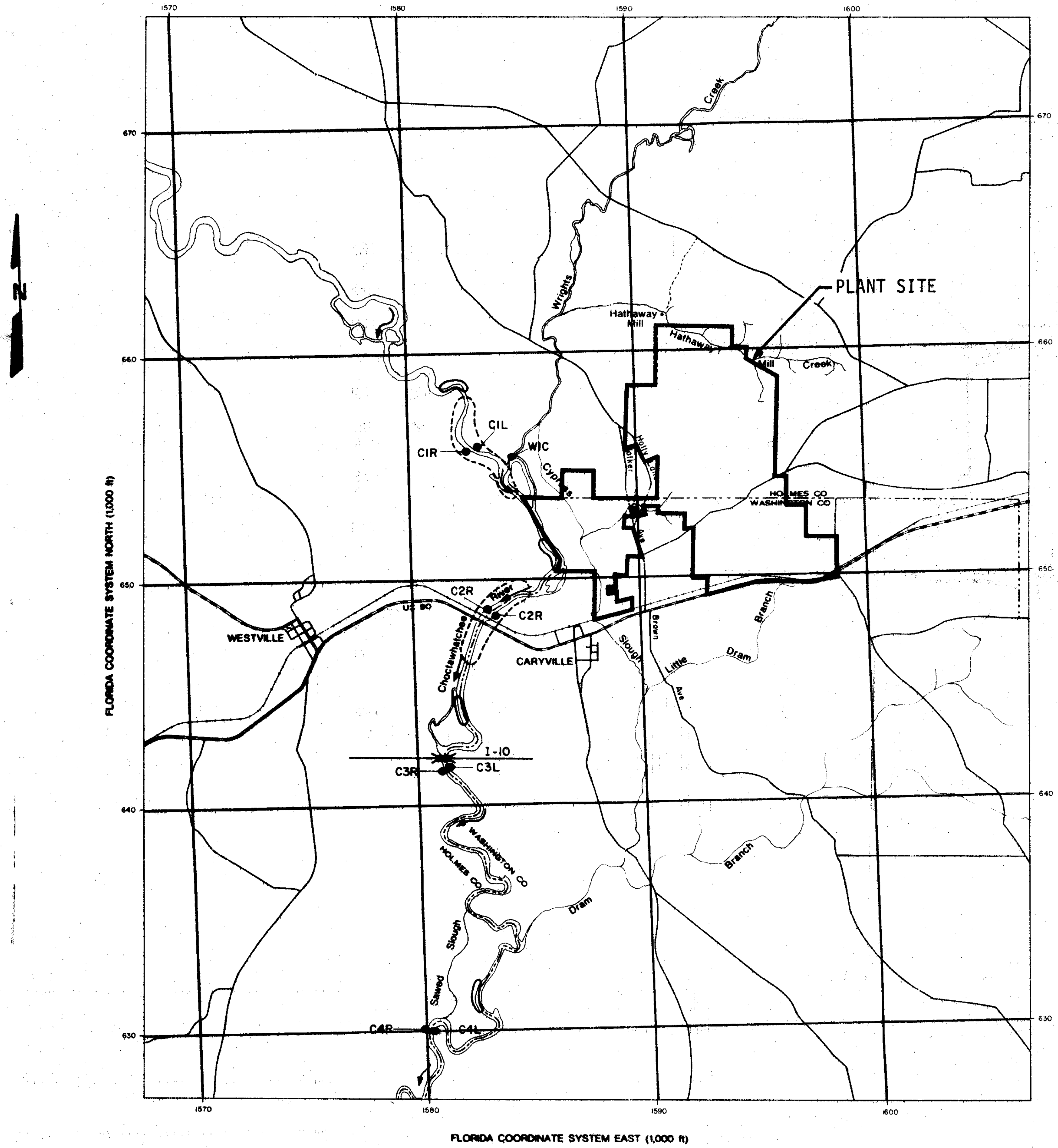
CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

Amendment 1 6/75

GULF POWER CO.
CARYVILLE STEAM PLANT

REGIONAL HISTORICAL FISH POPULATION SAMPLING STATIONS, CHOCTAWHATCHEE RIVER

FIGURE 2.7-64



LEGEND:

LOCATION OF NINE SAMPLING STATIONS

(C) CHOCTAWHATCHEE RIVER

(W) WRIGHTS CREEK

(L) LEFT SIDE, LOOKING DOWNSTREAM

(R) RIGHT SIDE, LOOKING DOWNSTREAM

● MULTIPLE PLATE SAMPLERS (BENTHOS) AND GLASS SLIDES (PERIPHYTON)

FISH POPULATION SAMPLING AREAS USED BY U.S. FISH AND WILDLIFE SERVICE

DREDGE TOW SAMPLING (MOLLUSKS)

NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

½ 0 1 MILE
SCALE

Amendment 1 6/75

GULF POWER CO.
CARYVILLE STEAM PLANT

CHOCTAWHATCHEE RIVER
AQUATIC ECOLOGY STUDY

FIGURE 2.7-65

CANOPY COVER OF CYPRESS BAYHEAD COMMUNITY
FIGURE 2.7-7

GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION OF CYPRESS BAYHEAD COMMUNITY
FIGURE 2.7-8

VEGETATION OF CYPRESS BAYHEAD COMMUNITY
FIGURE 2.7-9

GULF POWER CO.
CARYVILLE STEAM PLANT

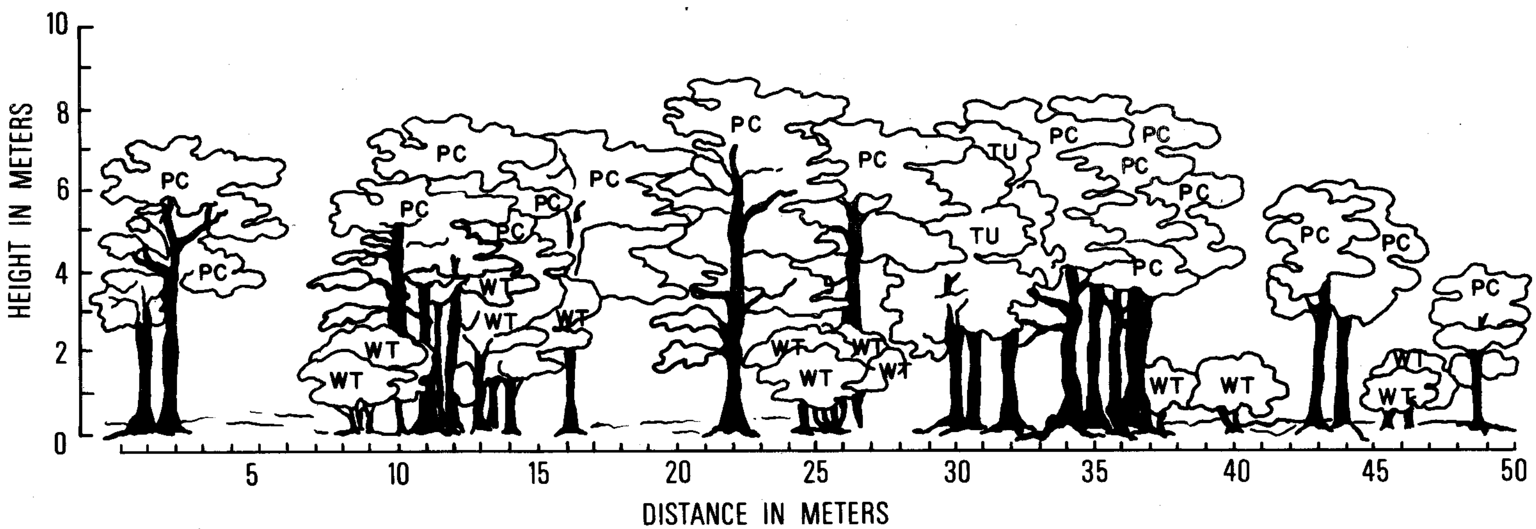
VEGETATION OF "DRIER" CYPRESS BAYHEAD COMMUNITY
FIGURE 2.7-10

VEGETATION OF "DRIER" CYPRESS BAYHEAD COMMUNITY
FIGURE 2.7-11

GULF POWER Company

GULF POWER CO.
CARYVILLE STEAM PLANT

PC - POND CYPRESS
WT - WHITE TITI
TU - TUPELO



GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	IDEALIZED COMMUNITY PROFILE OF CYPRESS BAYHEAD COMMUNITY
		FIGURE 2.7-12

VEGETATION RIVER LEVEE OF MIXED HARDWOOD SWAMP COMMUNITY
FIGURE 2.7-23

VEGETATION NEAR RIVER OF MIXED HARDWOOD SWAMP COMMUNITY
FIGURE 2.7-24

GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION NEAR RIM SWAMP STREAM OF MIXED HARDWOOD SWAMP COMMUNITY
FIGURE 2.7-25

GULF POWER CO.
CARYVILLE STEAM PLANT

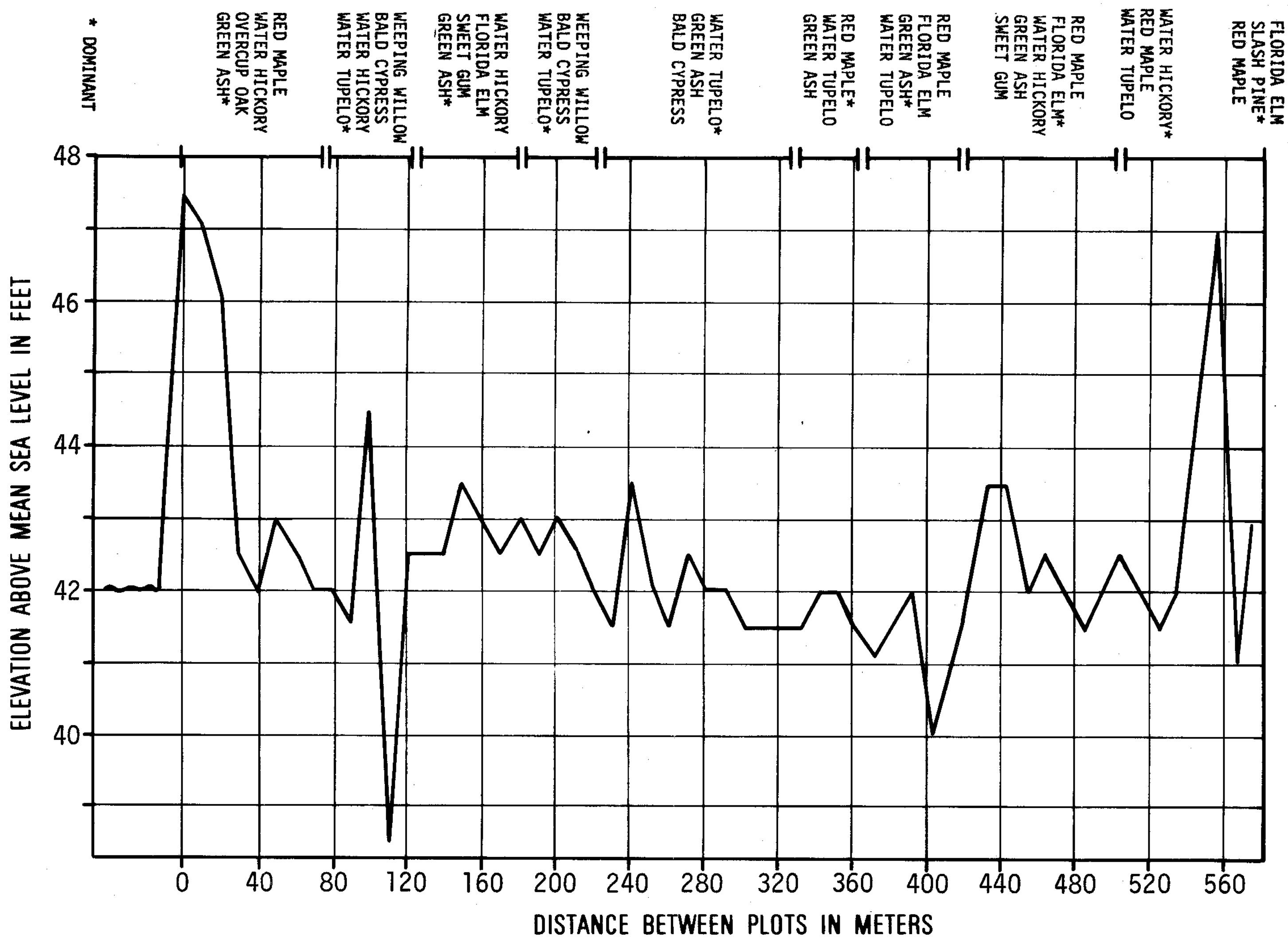
VEGETATION NEAR RIM SWAMP STREAM OF MIXED HARDWOOD SWAMP COMMUNITY
FIGURE 2.7-26

GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION OF MIXED HARDWOOD SWAMP COMMUNITY
FIGURE 2.7-27

VEGETATION OF HIGHER (DRIER) AREAS OF MIXED HARDWOOD SWAMP COMMUNITY
FIGURE 2.7-28

GULF POWER CO.
CARYVILLE STEAM PLANT



GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION TRANSECT THROUGH MIXED MESOPHYTIC HARDWOOD SWAMP

FIGURE 2.7-29

CANOPY COVER OF MIXED MESOPHYTIC HARDWOOD COMMUNITY
FIGURE 2.7-30

VEGETATION OF MIXED MESOPHYTIC HARDWOOD COMMUNITY
FIGURE 2.7-31

GULF POWER Company

GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION OF MIXED MESOPHYTIC HARDWOOD COMMUNITY
FIGURE 2.7-32

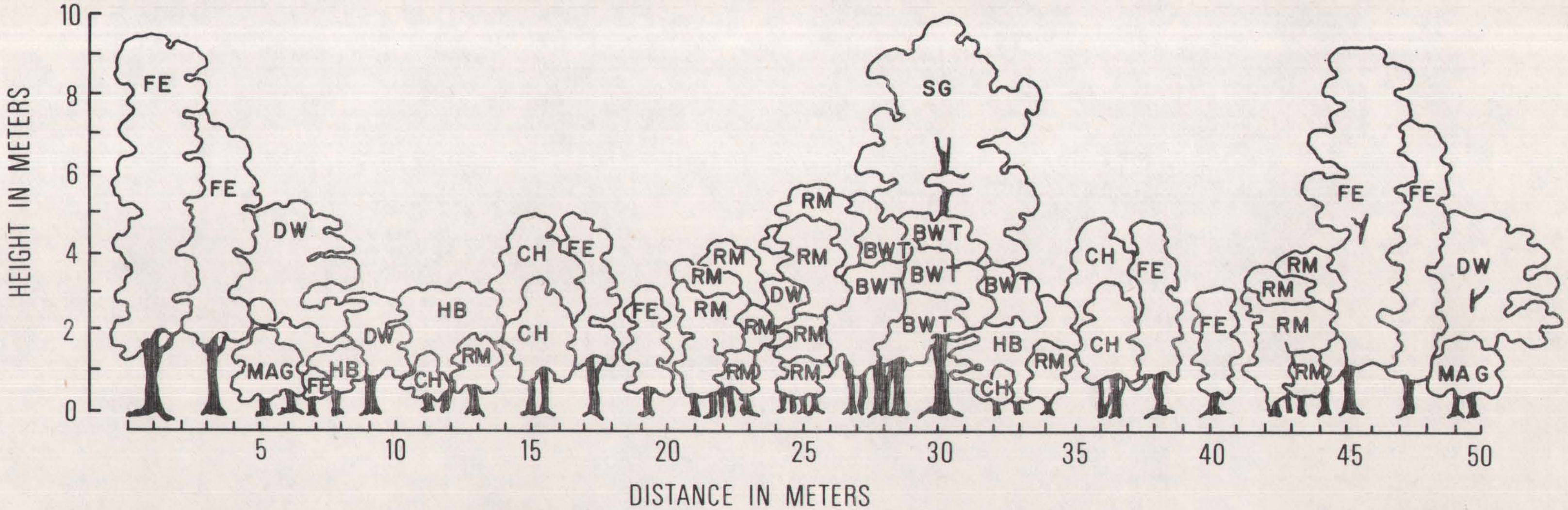
VEGETATION OF MIXED MESOPHYTIC HARDWOOD COMMUNITY
FIGURE 2.7-33

GULF POWER CO.
CARYVILLE STEAM PLANT

GROUND COVER VEGETATION OF APPARENT CLIMAX OF MIXED MESOPHYTIC HARDWOOD COMMUNITY
FIGURE 2.7-34

GULF POWER CO.
CARYVILLE STEAM PLANT

FE - FLORIDA ELM
DW - DOGWOOD
SG - SWEET GUM
CH - CHERRY
RM - RED MAPLE
MAG - MAGNOLIA
HB - HUCKLEBERRY
BWT - BUCKWHEAT TREE



GULF POWER CO
CARYVILLE STEAM PLANT

IDEALIZED COMMUNITY PROFILE OF
MIXED MESOPHYTIC HARDWOOD

FIGURE 2.7-35

CANOPY COVER OF MESOPHYTIC PINE PLANTATION: UNBURNED
FIGURE 2.7-36

GULF POWER CO.
CARYVILLE STEAM PLANT

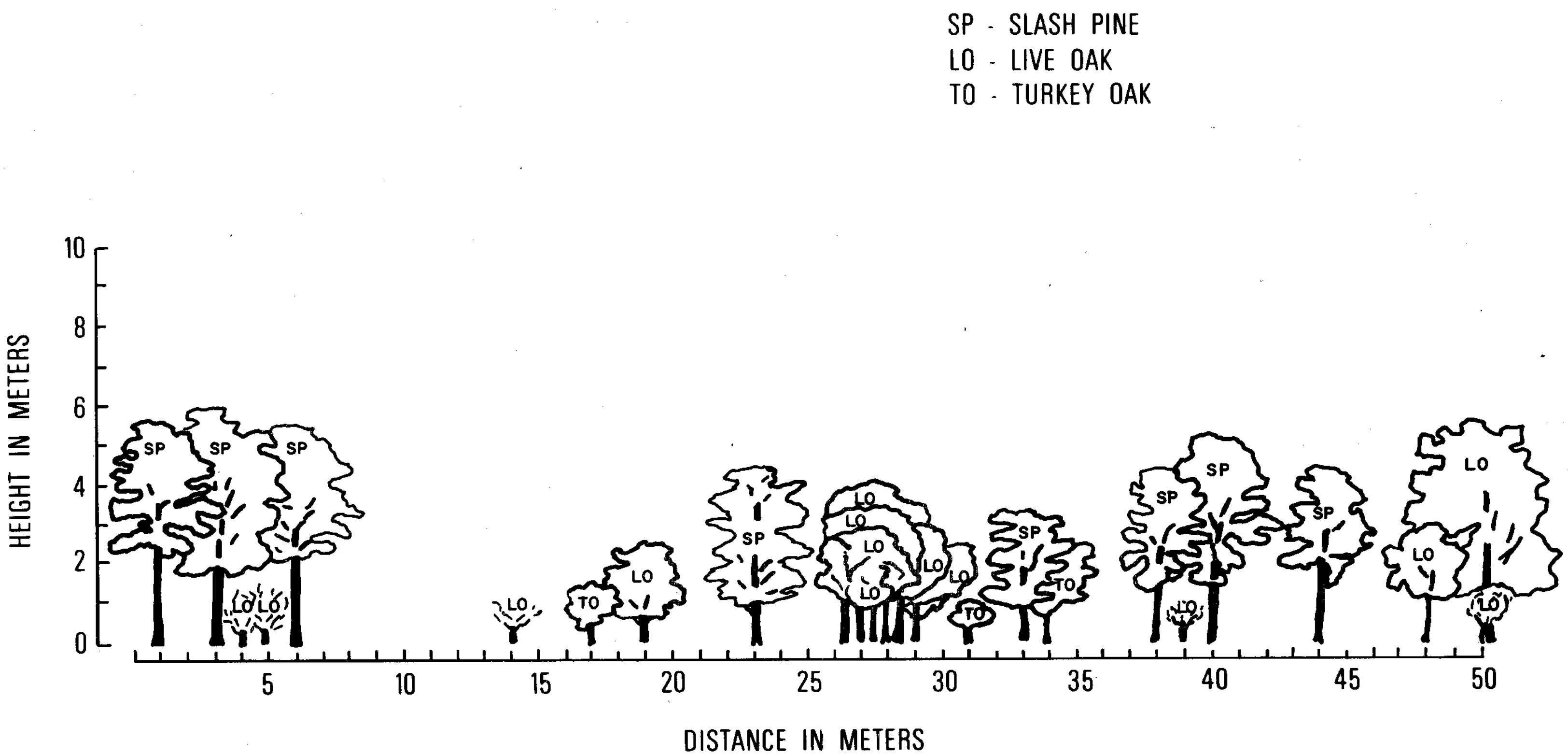
VEGETATION OF MESOPHYTIC PINE PLANTATION: UNBURNED
FIGURE 2.7-37

VEGETATION OF MESOPHYTIC PINE PLANTATION: UNBURNED
FIGURE 2.7-38

GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION OF MESOPHYTIC PINE PLANTATION: BURNED
FIGURE 2.7-39

GULF POWER CO.
CARYVILLE STEAM PLANT



GULF POWER CO.
CARYVILLE STEAM PLANT

IDEALIZED COMMUNITY PROFILE OF MESOPHYTIC PINE PLANTATION: UNBURNED

FIGURE 2.7-40

CANOPY COVER OF XEROPHYTIC SANDHILL COMMUNITY
FIGURE 2.7-41

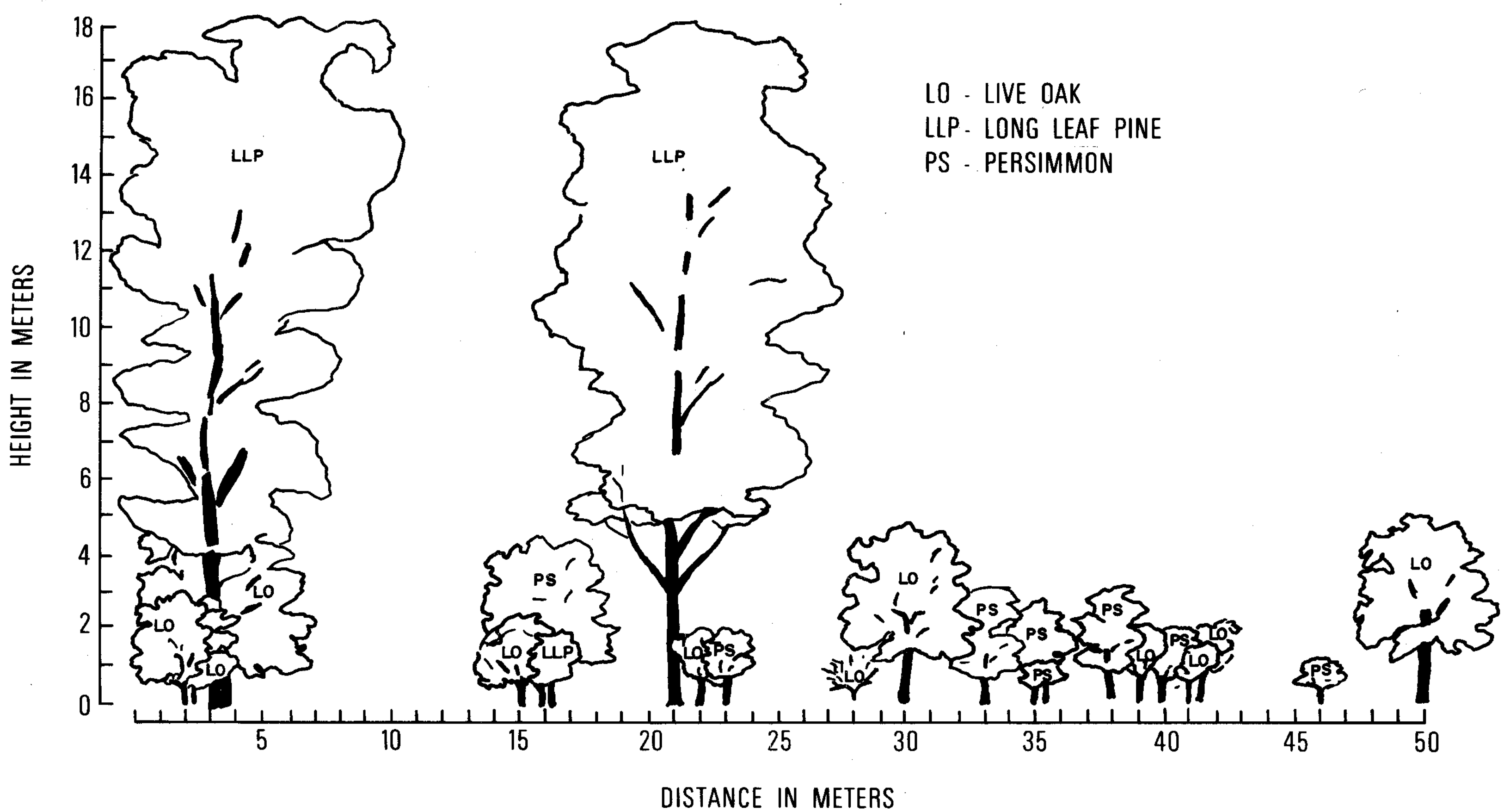
VEGETATION OF XEROPHYTIC SANDHILL COMMUNITY
FIGURE 2.7-42

GULF POWER Company

GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION OF XEROPHYTIC SANDHILL COMMUNITY
FIGURE 2.7-43

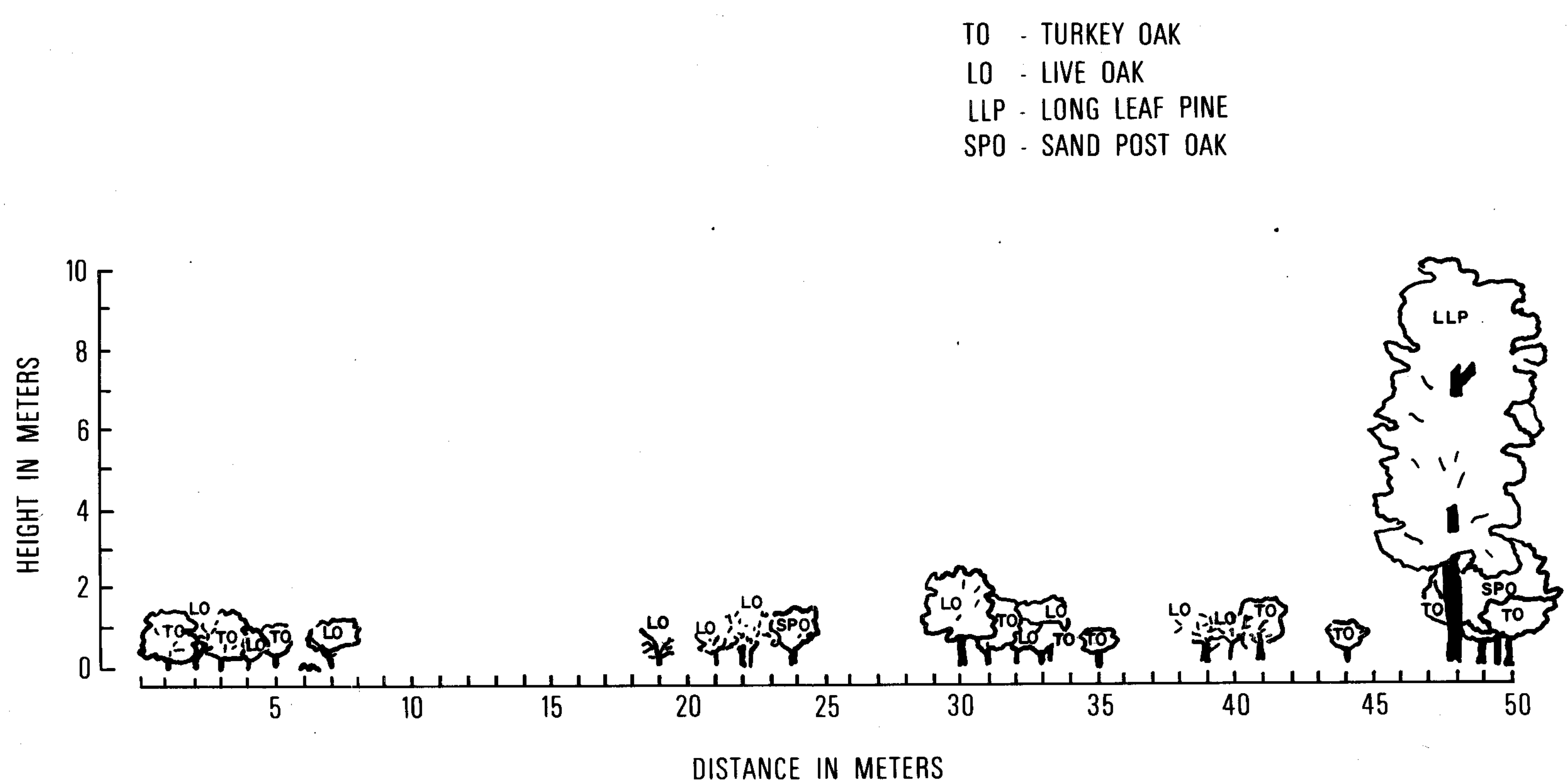
GULF POWER CO.
CARYVILLE STEAM PLANT



GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	IDEALIZED COMMUNITY PROFILE OF SANDHILL COMMUNITY FIGURE 2.7-44

VEGETATION OF XEROPHYTIC SCRUB COMMUNITY
FIGURE 2.7-45

GULF POWER CO.
CARYVILLE STEAM PLANT



GULF POWER CO.
CARYVILLE STEAM PLANT

IDEALIZED COMMUNITY PROFILE OF XEROPHYTIC SCRUB COMMUNITY

FIGURE 2.7-46

CANOPY COVER OF XEROPHYTIC PINE PLANTATION
FIGURE 2.7-47

VEGETATION OF XEROPHYTIC PINE PLANTATION: UNBURNED
FIGURE 2.7-48

GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION OF XEROPHYTIC PINE PLANTATION: UNBURNED
FIGURE 2.7-49

GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION OF XEROPHYTIC PINE PLANTATION: UNBURNED
FIGURE 2.7-50

VEGETATION OF XEROPHYTIC PINE PLANTATION: UNBURNED
FIGURE 2.7-51

GULF POWER Company

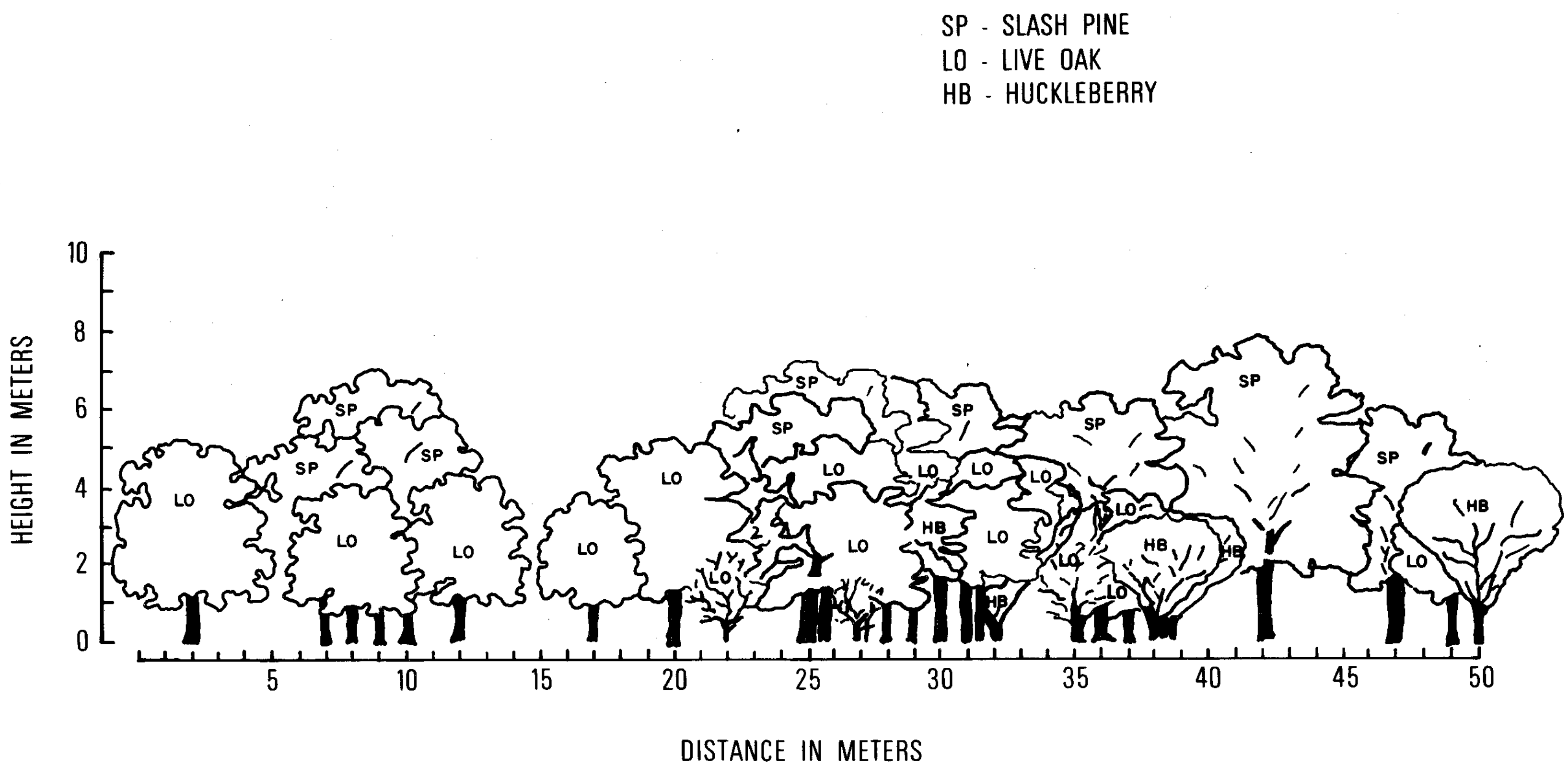
GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION OF XEROPHYTIC PINE PLANTATION: BURNED
FIGURE 2.7-52

GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION OF XEROPHYTIC PINE PLANTATION: BURNED
FIGURE 2.7-53

GULF POWER CO.
CARYVILLE STEAM PLANT



	GULF POWER CO. CARYVILLE STEAM PLANT	IDEALIZED COMMUNITY PROFILE OF XEROPHYTIC PINE PLANTATION: UNBURNED
		FIGURE 2.7-54

VEGETATION OF RUDERAL COMMUNITY
FIGURE 2.7-55

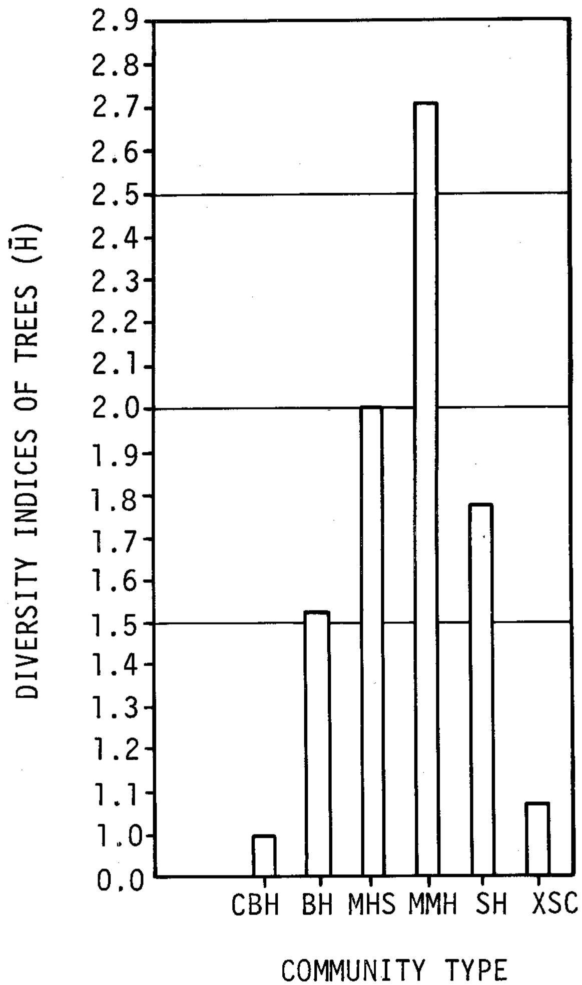
VEGETATION OF RUDERAL COMMUNITY
FIGURE 2.7-56

GULF POWER CO.
CARYVILLE STEAM PLANT

VEGETATION OF RUDERAL COMMUNITY
FIGURE 2.7-57

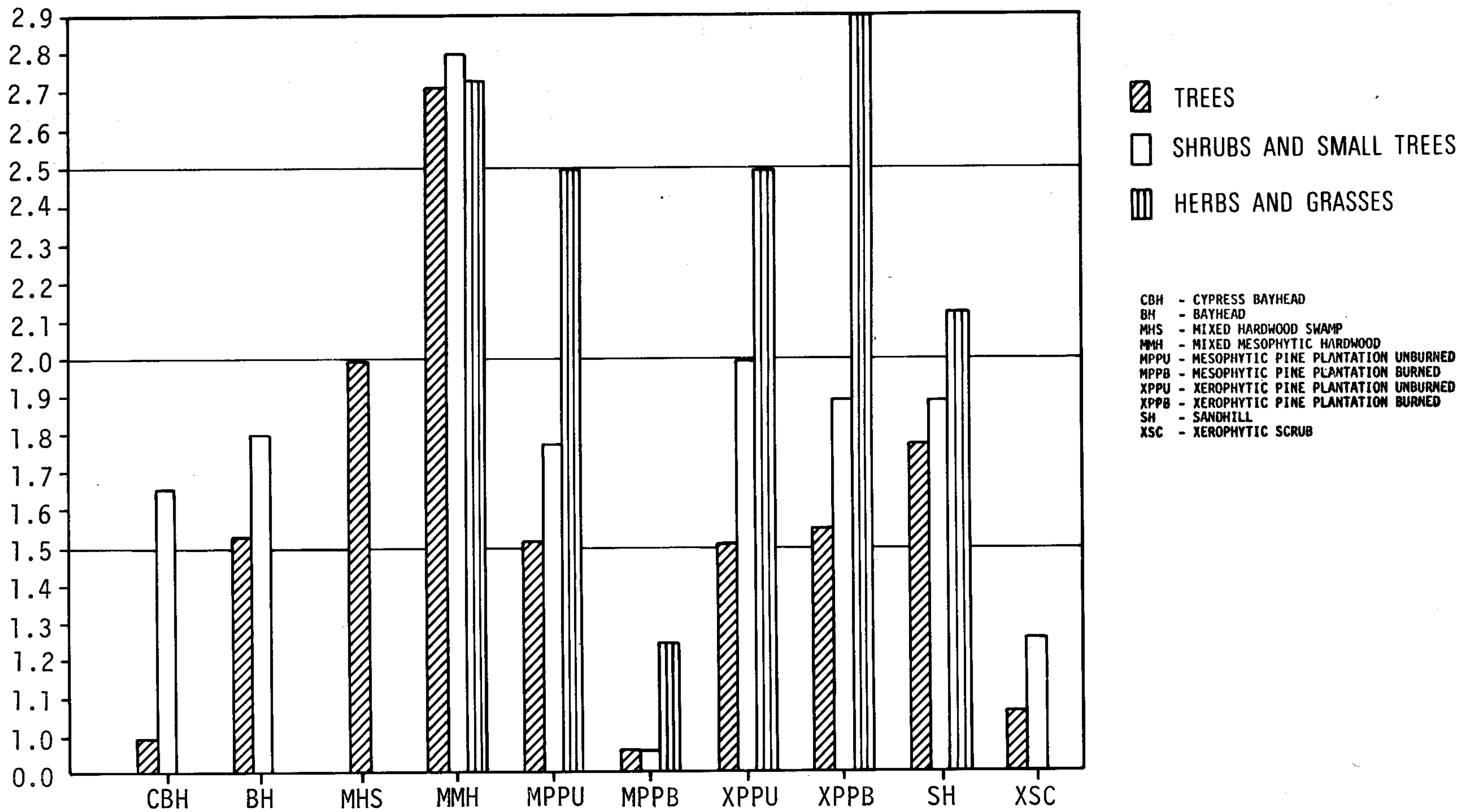
VEGETATION OF RUDERAL COMMUNITY
FIGURE 2.7-58

GULF POWER CO.
CARYVILLE STEAM PLANT



CBH - CYPRESS BAYHEAD
BH - BAYHEAD
MHS - MIXED HARDWOOD SWAMP
MMH - MIXED MESOPHYTIC HARDWOOD
SH - SANDHILL
XSC - XEROPHYTIC SCRUB

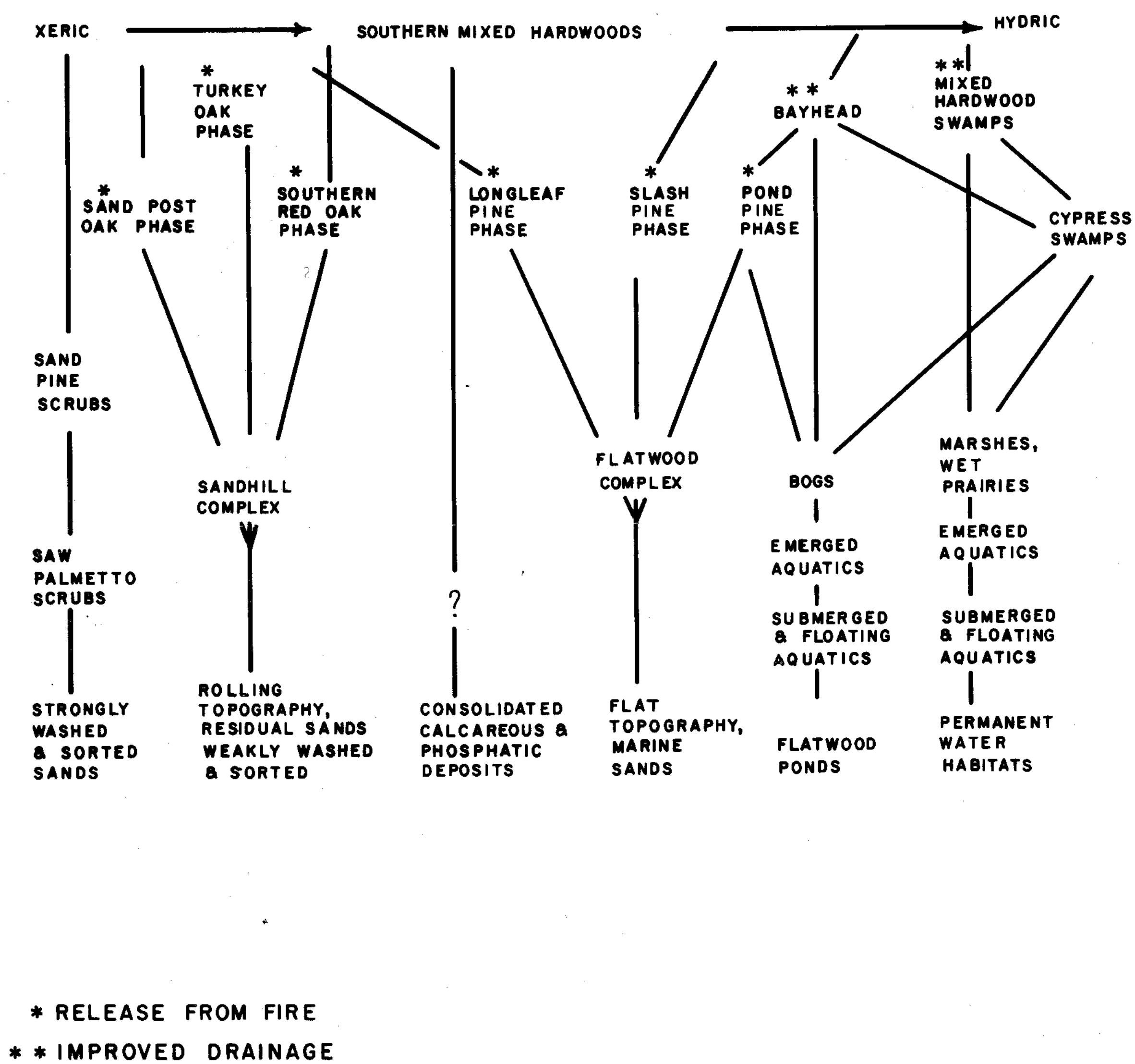
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	DIVERSITY OF TREE COMPONENT NATURAL COMMUNITIES FIGURE 2.7-59



GULF POWER CO.
CARYVILLE STEAM PLANT

DIVERSITY OF VEGETATIONAL COMPONENTS OF COMMUNITIES

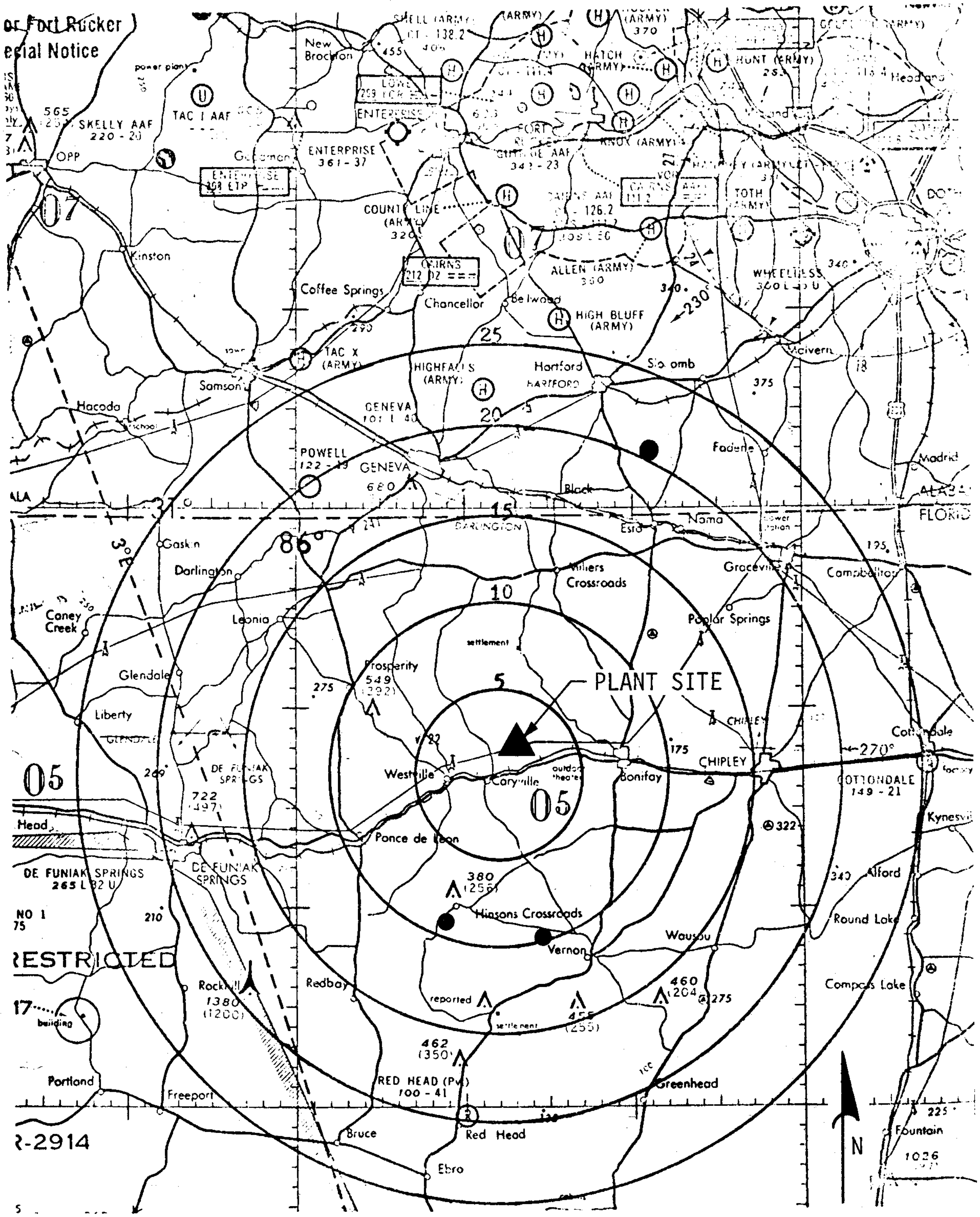
FIGURE 2.7-60



GULF POWER CO.
CARYVILLE STEAM PLANT

GENERALIZED VEGETATION SUCCESSION PATHWAYS (AFTER REFERENCE 10)

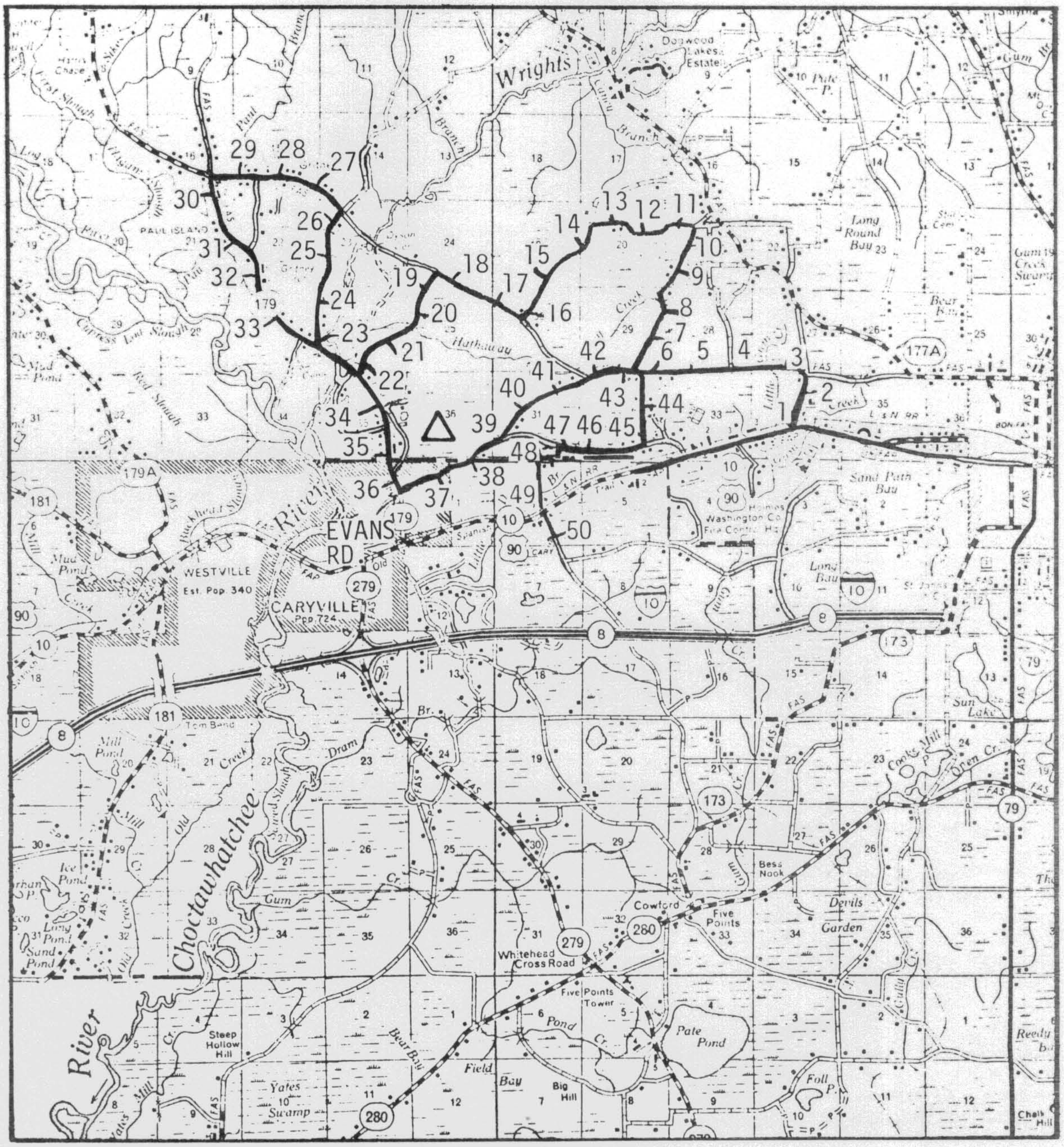
FIGURE 2.7-61



● - WADING BIRD COLONIES

Amendment 1 6/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	CARYVILLE PLANT SITE WITH THE AREA STUDIED FOR WADING-BIRD COLONIES
		FIGURE 2.7-62



N

△= PLANT SITE

Amendment 2 8/75

Amendment 1 6/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ROUTE FOR BIRD ROAD SURVEY WITH STOPS INDICATED
		FIGURE 2.7-63 (SHEET 1 OF 3)

1. Highway 90 and 1st dirt road west of Gum Creek.

2. Transmission line support pole on right. Pine plantation on right; shrubby field on left.

3. Turn left at cross-road. Transmission pole on right. Cut-over pines, both sides.

4. Cross Little Creek, after house on right, just before cross-road, Mixed pines, both sides.

5. On downgrade from a hill. High, dry, mixed pines.

6. Past white house on left; yellow mobil home on right. Island of trees in grass field on right.

7. Turn right, continue about 0.3 mile. Cut-over pines, both sides.

8. Mixed pine, both sides swampy.

9. Past beehives on left; transmission pole on right. Open fields, both sides.

10. Transmission pole, left; swamp on left; cypress-pine.

11. Turn left at crossroads; continue 0.2 mile. Between white house on right and big barn on left.

12. Left, four-pole gap gateway across from field house and barn.

13. Pig yard on right.

14. Turn left on crossroad for 0.3 mile. Pasture, both sides.

15. Small pine at right edge of road. Cut-over pine, both sides.

16. Just before red-brick house (owner, P.W. Thompson) with many Purple Martin bird houses. Pasture right; pine - pasture left.

17. Turn right for 0.3 miles. Pasture left; mixed pine right.

18. Right, orange marker stake No.54. Pine both sides.

19. Turn left at crossroads for 0.1 mile. Oak - pine both sides.

20. Top of hill. Mixed oak - pine. Just before Hathaway Mill Creek.

21. Mixed hardwoods both sides.

22. Highway 179 ahead; just past yellow moble home.

23. Highway 179 and road on right, across form Sellers Cemetery.

24. Dirt road on left. Mixed oak, both sides.

25. Mixed oak both sides. Marker.

26. Past red-brick house, right. Stop sign ahead.

27. Turn left at crossroads to transmission pole with transformer (pole No.EEMM3, 44). Cultivated fields, both sides.

Amendment 1 6/75

Gulf Power Company	GULF POWER CO. CARYVILLE STEAM PLANT	ROUTE FOR BIRD ROAD SURVEY WITH STOPS INDICATED
		FIGURE 2.7-63 (SHEET 2 OF 3)

28. Power pole No.EEMM, 51, on right, Swamp, both sides.

29. Hog wallow on right.

30. Turn left on Highway 179 for 0.1 mile. Past guard rails.

31. Wires cross road. Right-of-way marker. Past green cottage on right. Mixed woods.

32. Dirt road on left. Stop under four wires crossing road. Pole No.71 on right.

33. Past Gritney Baptist Mission to transmission line pole on right (No. 76,A). Mobile home on left in woods.

34. Break to past Wright's Creek. Proceed 0.5 mile past Hathaway Mill Road. Past top of hill. Yellow marker.

35. Power pole with transformer on left; rust-colored house on left. Pasture both sides.

36. Pond on left; environmental data tower on right. In city limits.

37. Turn left on Evans Road. Stop just before double, white-board gates on right.

38. Power post No. 299. Pine flat woods.

39. Past chain-link fence with white house on right. Pasture, right; mixed oak, left.

40. Swamp on left; pine right. Marker on right.

41. Abandoned house on right. Pasture, both sides.

42. Just past intersecting road on left. Cut-over pine, both sides.

43. Swampy both sides. Marker on right. Near pole No. AA85.

44. Turn right. Between white and red-brick houses. Swamp, left; pasture, right.

45. Intersection. Pasture both sides.

46. Turn right and stop before bridge. Swamp forest both sides. Marker, right.

47. Wood gates both sides. Open pine left; pasture right.

48. Turn left, continue 0.4 mile. Before left turn in road. Yellow marker.

49. "Don't Dump" sign on right. Corn, left; mixed oaks, right.

50. Cross Highway 90. Yellow marker on right. Cut-over pine both sides.

Amendment 1 6/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ROUTE FOR BIRD ROAD SURVEY WITH STOPS INDICATED FIGURE 2.7-63 (SHEET 3 OF 3)

2.8

2.8 Ambient Air

Equipment for monitoring ambient concentrations of sulfur dioxide, nitrogen dioxide, and particulate matter is being installed and will be operational in the near future. Gulf will collect data on the three parameters mentioned above for one year. The data will be reduced into a format acceptable to the Florida Department of Pollution Control, and will be included in a subsequent Amendment to this Site Certification Application. 1

The monitoring program for obtaining baseline ambient air quality data is described in subsection 6.5.1, "Onsite Meteorological and Air Quality Measurement Program."

2.9 Other Environmental Features

2.9.1 Sound Level Studies

2.9.1.1 Introduction - This section discusses Gulf's past and presently ongoing ambient sound level studies at the proposed plant site. The purpose of these studies is to determine and document the sound levels which presently exist at several grid coordinates about the site under various temporal, meteorological, and seasonal conditions. Additionally, based on sound level studies conducted at other plant sites, Gulf predicts the expected sound levels during the construction and operation stages of its proposed Caryville plant. (Refer to subsection 5.6.5, "Sound Levels During Plant Operation," for more discussion.)

2.9.1.2 Ambient Sound Levels - During the summer of 1974, Gulf began sound level measurements using the equipment schematically illustrated in figure 2.9-1. These measurements were made at a number of locations around the proposed site to determine ambient sound levels prior to construction and are still being conducted in order to establish seasonal variations in the sound levels.

2.9.1.2.1 Sound Level Monitoring Equipment Formats - The information obtained from the sound level monitoring equipment is presented in a number of different formats as discussed below.

A. An all-weather outdoor microphone system provides the input to the environmental noise classifier. The classifier develops a complete amplitude distribution of sound levels in eleven bands, Such a distribution allows the plotting of histograms for various intervals of time such as per hour, per shift, or per day. A good estimation of both the equivalent sound level, designated L_{eg}, 3
and the sound level exceeded N percent of the time, designated L_N, can also be determined.

B. Short samples of the sound level as a function of time are plotted on the level recorder to illustrate significant aspects of the noise.

C. Magnetic tape recordings are processed using narrow band analyzers to obtain the actual sound spectrum as a function of frequency. Such processing determines if a predominant frequency exists which could cause community noise problems.

D. Octave band data and A-weighted sound level data are tabulated at each site.

2.9.1.2.2 Grid Coordinates - The following descriptions are summaries of results obtained at locations "A," "B," and "C" shown on figure 2.9-2.

A. <u>Florida Grid N-658,500; E-1,596,000</u> - This location is near the Northeast corner property line. Figure 2.9-3 shows representative plots of sound levels versus time for both daytime and nighttime 3 as observed during the summer of 1974. From this figure, the following sound level can be observed:

	Summer Sound Levels	
	dBA	dB Linear
Daytime	26 to 42	37 to 50
Nighttime	46 to 52	47 to 65

Weather conditions during these tests were (a) clear to partly cloudy, (b) winds ranging from calm to five miles per hour, and (c) daytime Fahrenheit temperatures in the low 90's and nighttime temperatures dropping to the high 70's.

Nighttime sound levels were higher due to an increase in noise associated with crickets, frogs, and other summer night life sounds. A plot of the nighttime sound as a function of frequency, as shown in figure 2.9-4, indicates that the spectrum is concentrated in the 2,000 to 4,000 hertz (Hz) range. Such a spectrum for summer nighttime outdoor sound levels is typical.

Although the subject measurement grid coordinate is approximately 1.5 miles from U.S. Highway No. 90, truck traffic noises were clearly audible and produced intermittent peaks in the sound level. These peaks are quite noticeable in the dB linear plots on figure 2.9-3 for both daytime and nighttime hours. With the low background noise during the day, peaks also occur in the dBA response. However, with the much higher ambient noise level at night, the A-weighted response on figure 2.9-3 remains relatively constant and is essentially controlled by night life sounds. Some truck traffic did increase the sound level by four to five dBA.

Results quite similar to those illustrated in figures 2.9-3 and -4 were obtained when the sound level studies were repeated 3 during the summer of 1975.

Illustrated in figure 2.9-5 are representative plots of sound levels versus time for both daytime and nighttime during winter months. From this figure, the following sound level ranges can be observed:

	Winter Sound Levels	
	dBA	dB Linear
Daytime	26 to 42	43 to 51
Nighttime	15 to 28	30 to 45

Weather conditions during these tests were (a) clear, (b) winds calm to five miles per hour, and (c) daytime Fahrenheit temperatures in the 40's and nighttime temperatures ranging from 25 to 37 degrees.

A comparison of summer and winter sound levels plotted on figures 2.9-3 and -5, respectively, indicates that daytime sound levels are similar for both periods, but nighttime sound levels during the winter are much lower. Virtually no animal or insect sounds were noted during the winter nights but birds were commonly present during winter days. Truck traffic noises from U.S. Highway No. 90 were clearly audible and produced intermittent peaks in the sound level during the winter tests.

B. Florida Grid N-656,000; E-1,591,400 - This location is on the Northwest side of the property and beneath the existing east-west transmission line. The sound levels measured at this point were similar in all respects to those obtained at position A above (Florida grid N-658,500; E-1,596,000).

C. Florida Grid N-649,500; E-1,594,500 - This location is a proposed property line adjacent to the Louisville and Nashville railroad, approximately 250 feet from U.S. Highway No. 90. At this location, the sound level varies over quite a wide range. Figure 2.9-6 is representative of the daytime sound levels observed. With no traffic, the sound level dropped below 40 dBA. With light traffic composed of automobiles only, the sound levels were in the 45 to 55 dBA range. Heavy truck traffic increased the sound level to 70 to 75 dBA.

Gulf used an environmental noise classifier to determine hourly amplitude distributions of the sound level during several different time periods. These distribution data are listed on tables 2.9-1 through -5. From table 2.9-1 note the significant shift in the predominant sound level distribution from 47 to 50 dBA range to the 52 to 55 dBA range. This shift occurred shortly after sunset on September 23, 1974, and continued throughout the remainder of the test period. The shift is attributed to a marked increase in cricket and other night life sounds. The temperature was 72^{o}F at sunset and dropped to only the mid-60's during the night. As shown in table 2.9-3, no such shift occurred during the night of October 2/3, 1974, when the temperature dropped to approximately 40^{o}F. The crickets, etc., were much quieter for this October test. 3

A comparison of the sound level amplitude distributions for the morning hours shown on table 2.9-2 and the afternoon hours shown on table 2.9-1 indicates that the distributions are quite similar. Note also that during daytime hours the sound level was below 45 dBA for approximately 20 minutes each hour, whereas the sound level did not drop below 45 dBA during the nighttime hours for the September test. However, for the October test, the evening sound levels were below 45 dBA for approximately 30 minutes each hour.

A 24-hour sound level distribution study was conducted on June 16-17, 1975, to determine the effect of opening Interstate Highway No. 10 eastward of Bonifay, Florida. The results are shown in table 2.9-4. Although the number of trucks was not determined for each hour, it appears that the number of trucks passing the proposed plant site along U.S. Highway No. 90 has been reduced significantly. This reduction in the number of trucks has caused a corresponding decrease in the duration of sound levels in the 50 to 60 dBA range as may be noted by comparing the data in tables 2.9-1 and -2 with those in table 2.9-4. The upward shift in the sound level distribution at sunset also occurred during this survey. 3

Table 2.9-5 lists three typical 12-hour dBA amplitude distributions of sound levels taken during nighttime hours using the environmental noise classifier. The distributions were obtained during fall and winter nights when the temperature was 40°F or lower. A comparison of these three distributions reveals that they are similar. Thus, the winter nighttime sound level distributions appear to be repeatable.

2.9.1.2.3 Summary of the Environmental Sound Level Measurements - The sound levels in the ranges greater than 55 dBA were due primarily to trucks. These trucks were counted and the resulting count is shown on tables 2.9-1, -2, and -3. For the 23-hour period covered in the tests, 907 trucks were counted. Based on 6,240 vehicles (1), as the 1973 average daily traffic on U.S. Highway No. 90, this number of trucks represents 15 percent of the total. However, during the nighttime hours, particularly from midnight to 5:00 a.m., trucks were the predominant vehicles. As noted above, the number of trucks has declined with the extension of Interstate Highway No. 10. 3

At locations "A" and "B," shown in figure 2.9-2, the sound levels are, in general, considerably lower than those at location "C." This is particularly true during the winter nighttime. As a result, it can be concluded that the sound level distribution at location "C" is dominated by truck traffic.

During the summer months insect and other night life sounds increase the ambient sound levels to values considerably higher than those measured during the winter.

2.9.2 References

(1) 1973 Average Daily Traffic for Holmes and Washington Counties, Florida Department of Transportation, Division of Planning and Programming, Bureau of Planning, 1974.

TABLE 2.9-1

SOUND LEVEL STUDY (HOURLY INCREMENTS FROM 3 P.M. THROUGH 10 P.M.)
AT CARYVILLE PLANT SITE TYPICAL dBA AMPLITUDE DISTRIBUTION OF SOUND LEVEL
AT FLORIDA GRID N-649,500; E-1,594,500

Level \ Time	3-4 p.m.	4-5 p.m.	5-6 p.m.	6-7 p.m.	7-8 p.m.	8-9 p.m.	9-10 p.m.
45 to 47	7.6	7.2	9.2	6.4	4.3	0.1	0.7
47 to 50	14.8	15.5	15.3	13.5	8.0	6.2	9.2
50 to 52	3.4	3.9	3.1	3.3	1.6	3.6	4.1
52 to 55	7.2	6.6	5.3	9.6	31.8	34.0	31.3
55 to 57	2.9	3.3	2.5	3.0	5.5	5.9	4.6
57 to 60	2.6	2.7	2.2	2.9	3.4	4.2	4.0
60 to 62	0.9	0.9	0.6	1.0	1.3	1.6	1.6
62 to 65	1.2	1.4	0.7	1.6	1.3	2.8	2.9
65 to 67	0.5	0.3	0.2	0.9	0.6	0.9	1.0
67 to 70	0.3	0.3	0.1	0.5	0.4	0.5	0.5
70 to 72	0.0	0.0	0.1	0.0	0.0	0.2	0.1
72 to 75	0.1	0.1	0.0	0.0	1.8	0.0	0.0
Number of Trucks	47	52	46	42	45	39	40
Wind Speed (MPH) (Average)	6	6	3.5	3	2	2.5	2
Temperature (°C)	26	26	25	22.5	20.5	19.5	18.5
Relative Humidity (Percent)	41	41	44	52	59	64	68

Date of Survey: September 23, 1974

TABLE 2.9-2

SOUND LEVEL STUDY (HOURLY INCREMENTS FROM 9 A.M. THROUGH 1 P.M.)
AT CARYVILLE PLANT SITE TYPICAL dBA AMPLITUDE DISTRIBUTION OF SOUND LEVEL
AT FLORIDA GRID N-649,500; E-1,594,500

Level \ Time	9-10 a.m.	10-11 a.m.	11-12 p.m.	12-1 p.m.
45 to 47	7.6	7.9	7.2	9.0
47 to 50	16.9	16.9	15.2	13.5
50 to 52	2.7	5.0	4.5	4.4
52 to 55	12.0	8.9	7.3	2.5
55 to 57	2.9	3.1	4.2	2.4
57 to 60	2.9	2.8	3.5	2.2
60 to 62	0.7	0.5	0.9	0.4
62 to 65	1.7	0.6	1.0	0.9
65 to 67	0.6	0.2	0.4	0.3
67 to 70	0.7	0.1	0.3	0.2
70 to 72	0.0	0.1	0.0	0.0
72 to 75	0.1	0.0	0.4	0.1
Number of Trucks	46	45	40	48
Wind Speed (MPH) (Average)	6	9	8	8
Temperature (°C)	18.0	19.5	20.5	21.5
Relative Humidity (Percent)	59	60	62	61

Date of Survey: September 24, 1974

TABLE 2.9-3

SOUND LEVEL STUDY (HOURLY INCREMENTS FROM 9 P.M. THROUGH 9 A.M.) AT CARYVILLE PLANT SITE TYPICAL dBA AMPLITUDE DISTRIBUTION OF SOUND LEVEL AT FLORIDA GRID N-649,500; E-1,594,500

Level \ Time	9-10p.m.	10-11p.m.	11-12p.m.	12-1a.m.	1-2a.m.	2-3a.m.	3-4a.m.	4-5a.m.	5-6a.m.	6-7a.m.	7-8a.m.	8-9a.m.
45-47	7.5	4.6	4.1	3.5	2.6	3.0	4.4	3.4	4.3	3.4	5.4	8.8
47-50	21.7	6.7	6.8	5.9	5.1	9.0	3.1	7.5	10.1	11.0	15.8	13.8
50-52	1.6	1.1	1.2	1.1	1.2	1.2	1.3	1.6	1.8	2.3	3.0	1.6
52-55	9.1	6.3	6.3	5.3	6.3	6.3	6.9	9.1	9.4	19.8	17.7	11.2
55-57	2.1	1.8	1.5	2.0	1.9	1.4	1.7	3.0	2.5	4.4	3.3	2.9
57-60	2.7	2.7	2.0	3.0	3.1	2.4	2.1	3.7	3.1	5.2	3.6	3.0
60-62	1.1	1.0	1.0	1.5	0.9	1.0	0.9	1.2	1.2	1.7	1.2	0.9
62-65	1.2	1.4	1.8	2.2	1.5	2.2	1.4	2.3	1.7	3.0	1.6	1.4
65-67	0.3	0.2	0.4	0.8	0.6	0.7	0.6	0.7	0.4	0.8	0.5	0.4
67-70	0.3	0.1	0.2	0.5	0.6	0.5	0.6	0.7	0.4	0.9	0.2	0.3
70-72	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.2	0.1	0.3	0.1	0.1
72-75	0.0	0.1	0.0	0.1	0.1	0.1	0.2	3.1	0.7	2.2	0.1	0.1
Number of Trucks	38	26	26	36	33	28	31	32	43	20	56	48

Date of Survey: October 2-3, 1974

CSP-ER-2

TABLE 2.9-4

SOUND LEVEL STUDY (HOURLY INCREMENTS FROM 3 P.M. THROUGH 3 P.M.)
AT CARYVILLE PLANT SITE TYPICAL dBA AMPLITURE DISTRIBUTION OF SOUND LEVEL
AT FLORIDA GRID N-649,500; E-1,594,500

Level \ Time	3-4 p.m.	4-5 p.m.	5-6 p.m.	6-7 p.m.	7-8 p.m.	8-9 p.m.	9-10 p.m.	10 p.m.-7 a.m.
45 to 47	9.5	9.0	8.5	8.7	7.7	0.1	0.0	110.9
47 to 50	13.9	14.2	14.8	12.7	10.0	0.3	0.2	160.0
50 to 52	5.5	5.0	5.1	4.0	4.8	0.5	0.3	51.0
52 to 55	1.5	1.9	1.8	2.1	2.8	30.2	37.0	84.8
55 to 57	2.3	2.8	2.0	2.5	2.7	27.3	20.5	9.2
57 to 60	1.7	2.0	1.8	1.8	1.3	0.7	1.1	8.5
60 to 62	0.4	0.4	0.5	0.4	0.4	0.2	0.2	2.8
62 to 65	0.3	0.5	0.8	0.3	0.5	0.4	0.3	3.4
65 to 67	0.0	0.3	0.2	0.3	0.2	0.2	0.2	1.0
67 to 70	0.1	0.1	0.1	0.2	0.3	0.1	0.1	0.9
70 to 72	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.2
72 to 75	0.0	0.0	2.5	0.1	0.0	0.0	0.1	2.9
Number of Trucks	16							

Level \ Time	7-8 a.m.	8-9 a.m.	9-10 a.m.	10-11 a.m.	11-12 N	12-1 p.m.	1-2 p.m.	2-3 p.m.
45 to 47	11.0	8.8	7.6	8.4	7.0	7.4	7.4	7.7
47 to 50	16.8	12.4	9.5	8.1	8.1	7.7	9.6	10.9
50 to 52	3.7	3.3	2.7	3.8	3.3	4.6	3.2	3.9
52 to 55	4.5	2.1	1.1	0.3	0.4	0.0	0.4	1.5
55 to 57	1.5	1.9	1.7	1.4	1.4	0.2	0.3	1.3
57 to 60	1.3	1.3	1.1	1.4	1.1	0.7	0.5	0.9
60 to 62	0.3	0.4	0.3	0.2	0.5	0.5	0.1	0.2
62 to 65	0.5	0.3	0.4	0.4	0.5	0.1	0.1	0.2
65 to 67	0.1	0.1	0.2	0.3	0.3	0.2	0.2	0.1
67 to 70	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.0
70 to 72	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0
72 to 75	0.0	0.0	0.3	0.0	0.0	0.4	0.0	0.0
Number of Trucks	22	23	20	24	26	11	11	25

Date of Survey: June 16-17, 1975

3

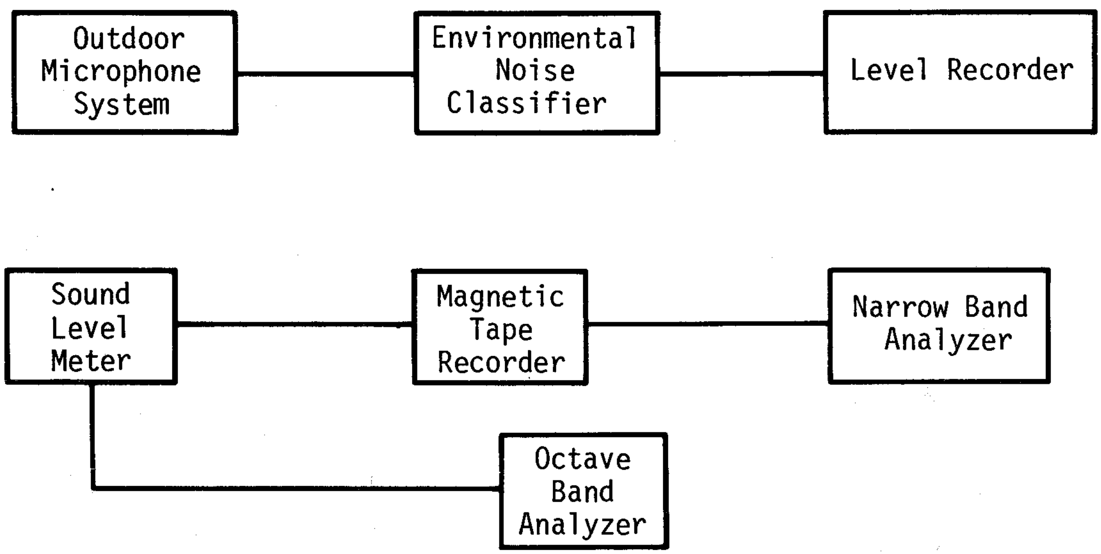
TABLE 2.9-5

SOUND LEVEL STUDY AT CARYVILLE PLANT SITE
TYPICAL 12-HOUR dBA AMPLITUDE DISTRIBUTION OF
SOUND LEVEL AT FLORIDA GRID N-649,500; E-1,594,500 DURING NIGHTTIME HOURS

dBA	October 2-3, 1974		December 9-10, 1974		February 10-11, 1975	
Range	Minutes	Percent	Minutes	Percent	Minutes	Percent
< 45	≈296	41.1	≈245	34.1	≈265	36.8
45 to 47	55.0	7.6	43.8	6.1	59.3	8.2
47 to 50	116.5	16.2	90.7	12.6	113.6	15.8
50 to 52	19.0	2.6	23.1	3.2	25.2	3.5
52 to 55	113.7	15.8	125.3	17.4	129.3	18.0
55 to 57	28.5	4.0	43.2	6.0	34.6	4.8
57 to 60	36.5	5.1	53.5	7.4	36.2	5.0
60 to 62	13.6	1.9	23.3	3.2	13.7	1.9
62 to 65	21.7	3.0	32.4	4.5	21.5	3.0
65 to 67	6.4	0.9	13.7	1.9	8.5	1.1
67 to 70	5.3	0.7	15.1	2.1	6.4	0.9
70 to 72	1.3	0.2	4.6	0.6	1.5	0.2
62 to 75	6.8	0.9	6.5	0.9	5.7	0.8

< = less than

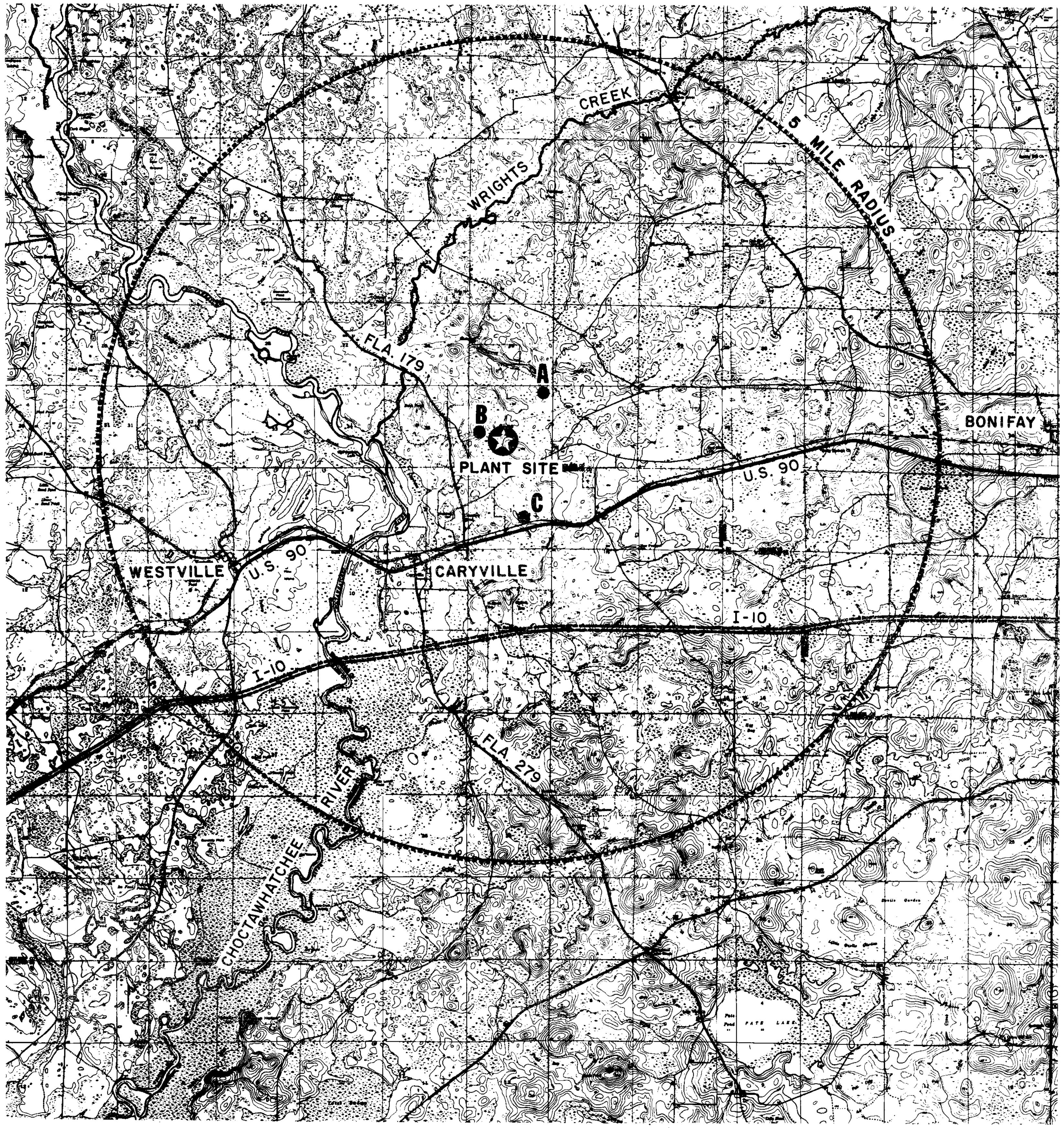
≈ = approximately



GULF POWER CO.
CARYVILLE STEAM PLANT

SOUND LEVEL MONITORING EQUIPMENT SCHEMATIC

FIGURE 2.9-1



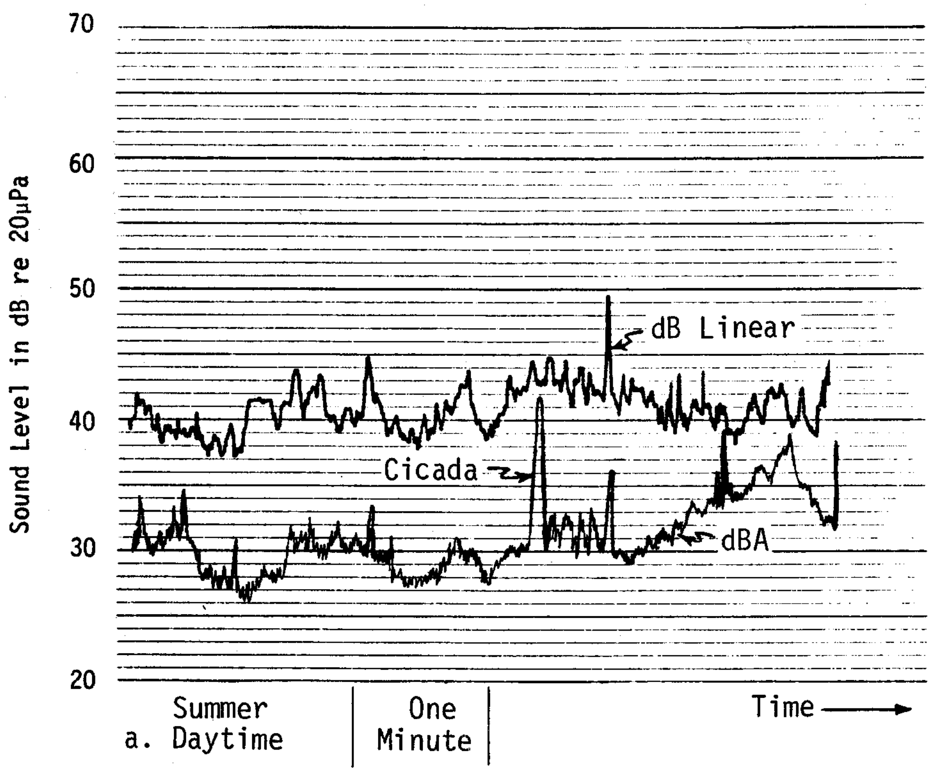
NORTH
SCALE 1" = 8000'

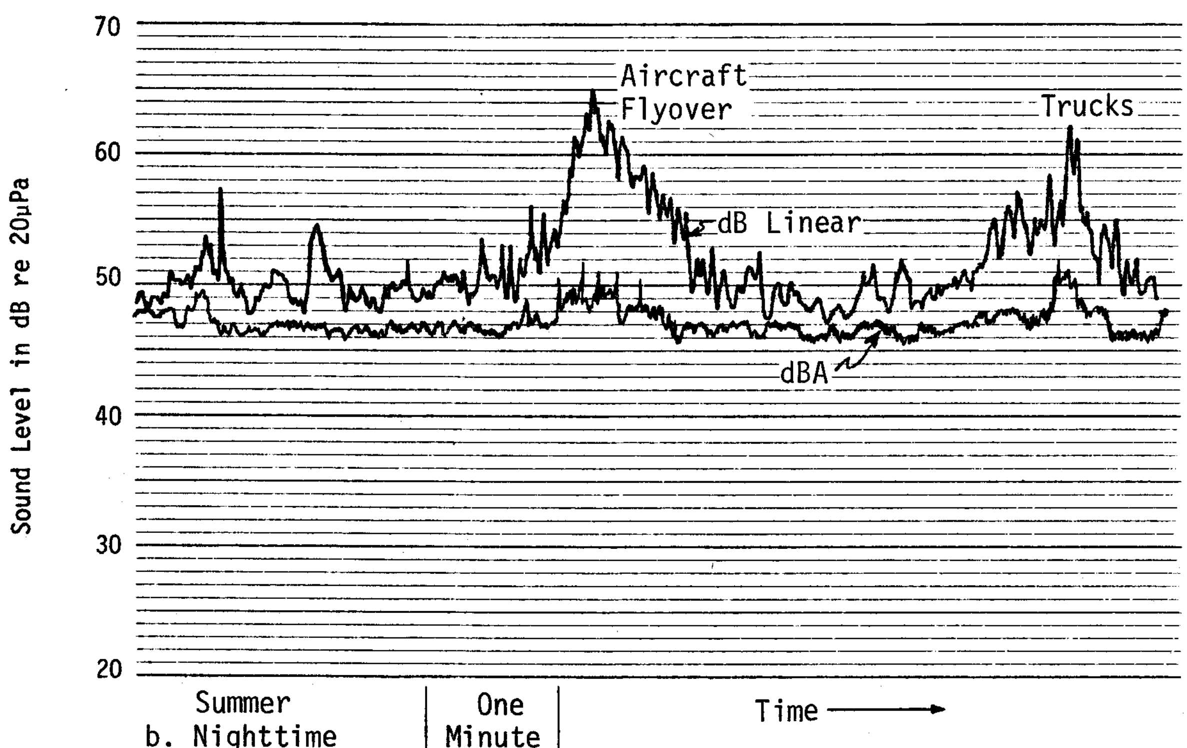
CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

SOUND LEVEL MEASUREMENT LOCATIONS
"A", "B", and "C"

FIGURE 2.9-2

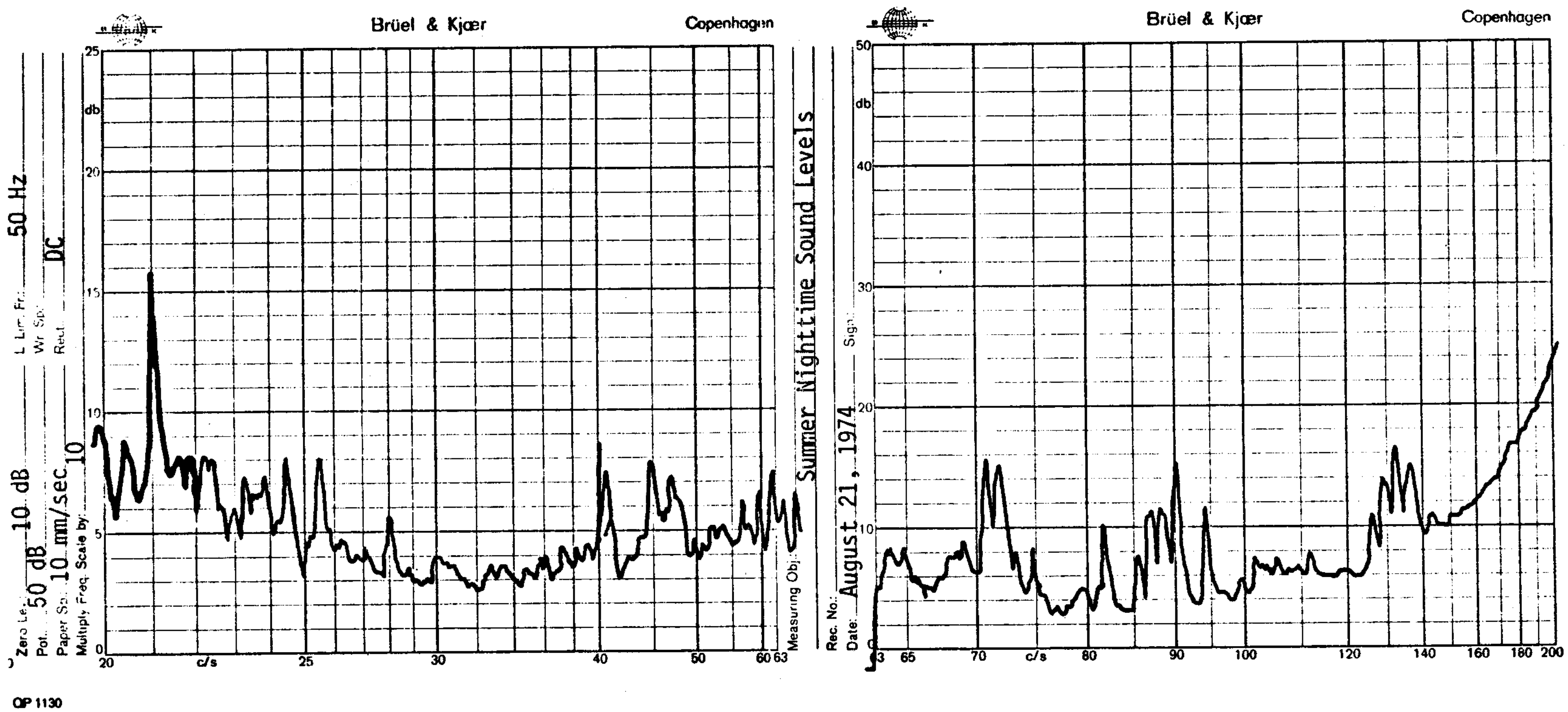




GULF POWER CO.
CARYVILLE STEAM PLANT

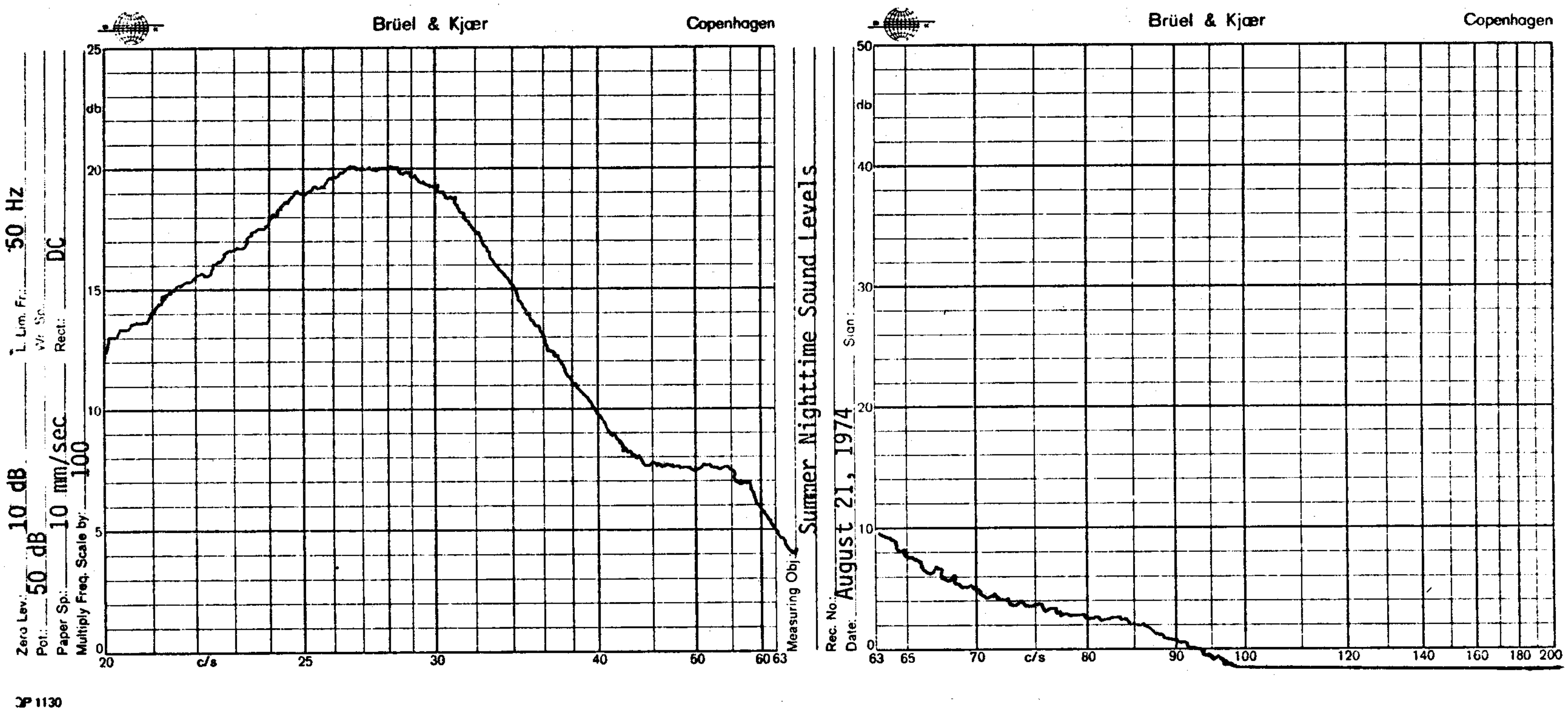
LINEAR AND A-WEIGHTED dB LEVELS AS A FUNCTION OF TIME AT GRID N-658,000; E-1,596,000, SUMMER DAY AND NIGHT

FIGURE 2.9-3



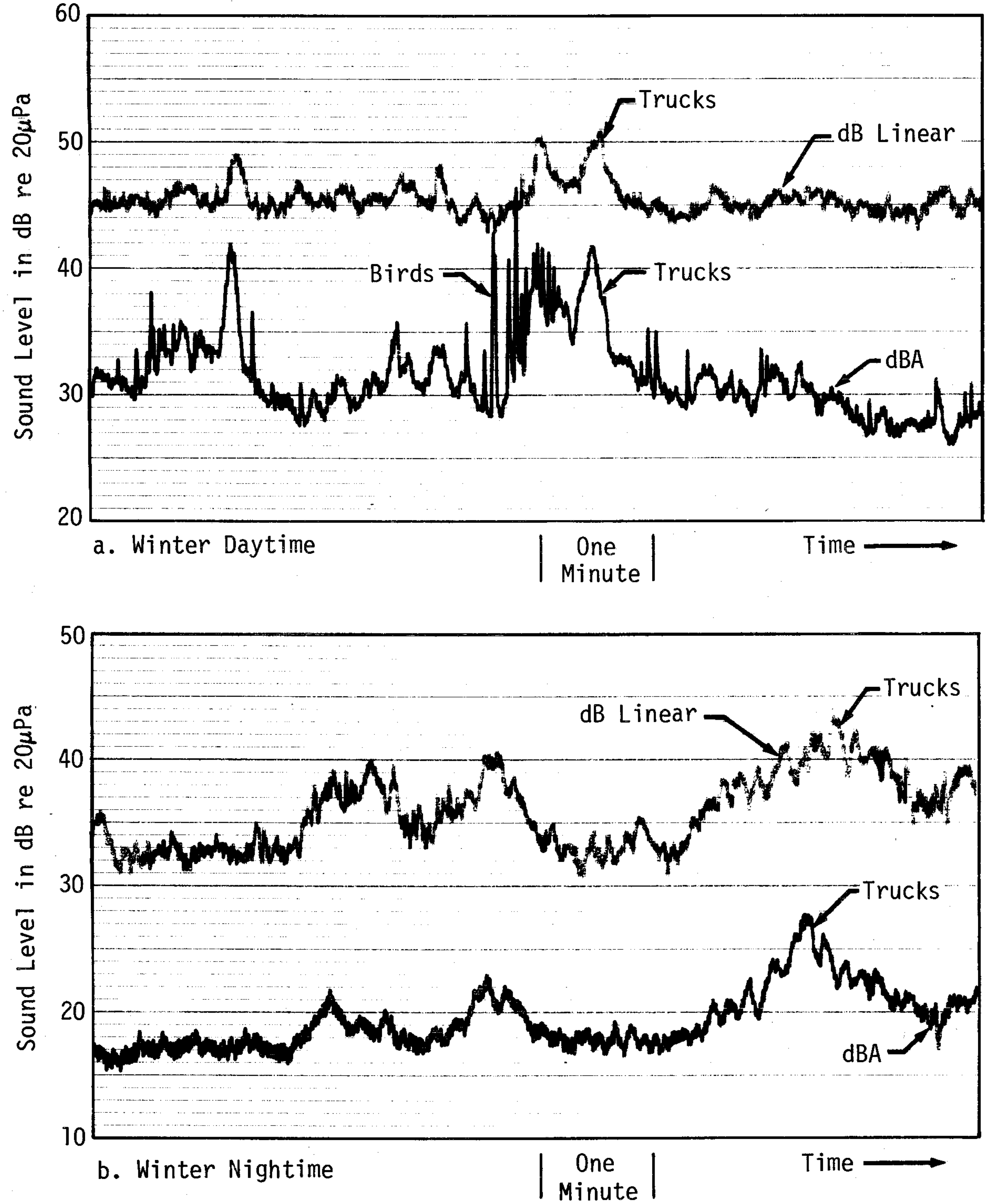
a. Frequency Range = 200 Hz to 2,000 Hz

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ONE-THIRD OCTAVE BAND ANALYSIS OF SUMMER NIGHT dB LEVELS MEASURED AT GRID N-658,000; E-1,596,000
		FIGURE 2.9-4 (SHEET 1 of 2)



b. Frequency Range = 2,000 Hz to 20,000 Hz

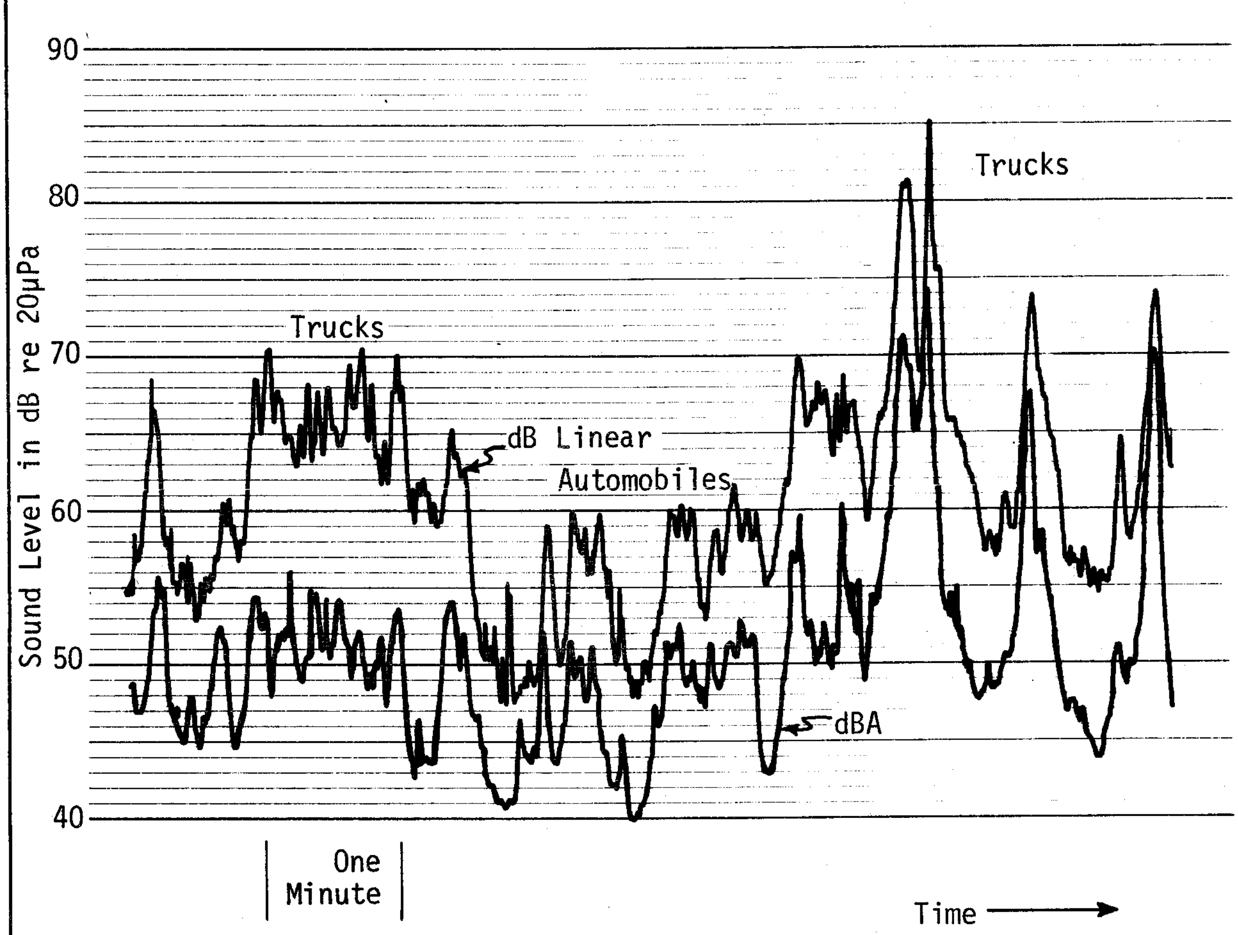
GULF POWER CO. CARYVILLE STEAM PLANT	ONE-THIRD OCTAVE BAND ANALYSIS OF SUMMER NIGHT dB LEVELS MEASURED AT GRID N-658,000; E-1,596,000 FIGURE 2.9-4 (SHEET 2 of 2)



GULF POWER CO.
CARYVILLE STEAM PLANT

LINEAR AND A-WEIGHTED dB LEVELS AS A FUNCTION OF TIME AT GRID N-658,000; E-1,596,000, WINTER DAY AND NIGHT

FIGURE 2.9-5



GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	LINEAR AND A-WEIGHTED dB LEVELS AS A FUNCTION OF TIME AT GRID N-649,500; E-1,594,000, DAYTIME
		FIGURE 2.9-6

Caryville Steam Plant

Site Certification Application

VOLUME 2

GULF POWER Company

APRIL, 1975

COPY NO. 50

AMENDMENT STATUS PAGE

Periodically throughout the life of this document, new pages will be added, some existing pages will be deleted, and some existing pages will be amended and replaced. Such changes are called amendments and are accomplished to reflect updated information and agreements between Gulf Power Company and various regulatory agencies.

Insert latest amended pages and dispose of superseded pages in accordance with the amended page status indicated below.

NOTES: A. A zero in the amendment number column indicates an original page. An arabic number in this column indicates the latest amendment number to a page.

B. On an amended text or table page, that portion of the text or table affected by the latest amendment is indicated by a vertical line and an amendment number in the outer margin of the page, and the latest amendment number and date is shown at the bottom of that page.

C. Amendments to figures (illustrations) are indicated by the latest amendment number and its date above the title block.

D. Occasionally a page of text, a table, or a figure may be replaced which has been amended only, for example, to correct a misspelled word or to improve its visual appearance. Such a page will not have the vertical line, amendment number, etc.

E. To improve readability of the following tabular information, a double-space break separates every fifth entry.

Page Number	Amendment Number	
1 of 10 through 10 of 10 (Amendment Page Insertion Guide)	3	
Title Page (Volume 1)	0	
A through J (Volume 1 Amendment 3 Status Page)	3	3
i through vi	3	
(1) through (2) (Preface)	2	
Introduction (1)	0	
(2)	1	
(3) through (4)	0	
Title Page (Chapter 1.0)	0	

Amendment 3 9/75
Amendment 2 8/75
Amendment 1 6/75

Page Number	Amendment Number	
1-i through 1-ii	0	
1.1-1	0	
1.1-2	1	
Fla. Certification	0	
Figure 1.1-1	0	
Title Page (Chapter 2.0)	0	
2-i		
2-ii	2	
2-iii	3	
2-iv	2	
2-v	1	
2-vi	3	
2-vii	2	
2-viii	1	
2-ix	2	
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2-xiii	1	
2-xiv	0	3
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Figure 2.1-1 through Figure 2.1-2	0	
2.2-1 through 2.2-5/2.2-6	0	
Table 2.2-1 through Table 2.2-2	0	
Figure 2.2-1 through Figure 2.2-5	0	
2.3-1/2.3-2		
Figure 2.3-1	0	
Figure 2.3-2	2	
2.4-1	0	
2.4-2 through 2.4-6	2	
2.4-7 through 2.4-9	0	
2.4-10 through 2.4-11	2	
2.4-12 through 2.4-13/2.4-14	0	
Figure 2.4-1	0	
Figure 2.4-2	2	
Figure 2.4-3	0	
Figure 2.4-4	2	
Figure 2.4-5	0	
Figure 2.4-6 through Figure 2.4-6c	2	
Figure 2.4-7	2	
Figure 2.4-8 through Figure 2.4-9	0	
Figure 2.4-10	1	
Figure 2.4-11	0	
Figure 2.4-12	1	

Page Number	Amendment Number
Figure 2.4-13 through Figure 2.4-15	0
Figure 2.4-16	2
Figure 2.4-17 through 2.4-18	0
Figure 2.4-19	2
2.5-1 through 2.5-3	2
2.5-4	0
2.5-5 through 2.5-12	2
2.5-9/2.5-10	0
Table 2.5-1	2
Table 2.5-2 through Table 2.5-6	0
Table 2.5-6a through Table 2.5-6b	2
Table 2.5-7	0
Figure 2.5-1 through Figure 2.5-3	0
Figure 2.5-4	2
Figure 2.5-5 through Figure 2.5-17	0
Figure 2.5-17a	2
Figure 2.5-18	0
Figure 2.5-18a	2
Figure 2.5-19	0
Figure 2.5-19a	2
Figure 2.5-20 through Figure 2.5-39	0
2.6-1	1
2.6-2	2
2.6-3 through 2.6-5/2.6-6	1
Table 2.6-1 through Table 2.6-10	1
Figure 2.6-1 through Figure 2.6-6	1
2.7-1 through 2.7-44	0
2.7-45 through 2.7-46	2
2.7-47 through 2.7-61	1
2.7-62 through 2.7-63	2
2.7-64 through 2.7-68	1
2.7-69	3
2.7-70 through 2.7-71	0
2.7-72 through 2.7-78	1
Table 2.7-1 through Table 2.7-10	0
Table 2.7-11 through Table 2.7-25	1
Figure 2.7-1 through Figure 2.7-5	0

3

Page Number	Amendment Number
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Figure 2.7-7 through Figure 2.7-62	1
Figure 2.7-63 (Sheet 1 of 3)	2
Figure 2.7-63 (Sheet 2 and 3 of 3)	1
Figure 2.7-6 through Figure 2.7-65	1
2.8-1/2.8-2	1
2.9-1 through 2.9-4	3
2.9-5/2.9-6	0
Table 2.9-1 through Table 2.9-3	0
Table 2.9-4	3
Table 2.9-5	0
Figure 2.9-1 through Figure 2.9-6	0
Title Page (Volume 2)	0
A through G/H (Volume 2 Amendment Status Page)	2
i through vi	3
Title Page (Chapter 3.0)	0
3-i	2
3-ii through 3-iv	3
3-v	2
3-vi	3
3-vii/3-viii	2
3.1-1	0
3.1-2	2
Figure 3.1-1 through Figure 3.1-2	2
Figure 3.1-3	0
3.2-1 through 3.2-4	2
3.2-5/3.2-6	0
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Periodically throughout the life of this document, new pages will be added, some existing pages will be deleted, and some existing pages will be amended and replaced. Such changes are called amendments and are accomplished to reflect updated information and agreements between Gulf Power Company and various regulatory agencies. 2

Insert latest amended pages and dispose of superseded pages in accordance with the amended page status indicated below.

NOTES: A. A zero in the amendment number column indicates an original page. An arabic number in this column indicates the latest amendment number to a page.

B. On an amended text or table page, that portion of the text or table affected by the latest amendment is indicated by a vertical line and an amendment number in the outer margin of the page, and the latest amendment number and date is shown at the bottom of that page.

C. Amendments to figures (illustrations) are indicated by the latest amendment number and its date above the title block.

D. Occasionally a page of text, a table, or a figure may be replaced which has been amended only, for example, to correct a misspelled word or to improve its visual appearance. Such a page will not have the vertical line, amendment number, etc. 2

E. To improve readability of the following tabular information, a double-space break separates every fifty entry.

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3.1

3.1 External Appearance

Gulf's design philosophy is to integrate the various site components into a functional, attractive complex. This approach is reflected in the artistic rendering enclosed herein as figure 3.1-1. The primary goals of these esthetic criteria are to ensure that the plant facilities and grounds are both visually pleasing and compatible with the surrounding environment.

3.1.1 General

The following design philosophy objectives were used to accomplish the desired goals:

A. organize the various site components (structures, parking, railroad spurs, etc.) in a neat, functional manner with a maximum of visual harmony,

B. integrate and enhance the plant's visual scenario via appropriate textural and color treatments, and

C. use landscaping and earth-moving techniques, where possible, to complement plant appearance.

The plant buildings and facilities will be located approximately 8,000 feet from the east bank of the Choctawhatchee River on a finished plant grade of approximately 97 feet and six inches above mean sea level.

3.1.2 Specific

Building layout and plant site perimeter with the locations and elevations of release points for liquids and gases are shown in figure 3.1-2. Figure 3.1-3 profiles the relationship of the stack height to the overall plant.

3.1.2.1 Main Power House - The main power house will be a semi-outdoor structure of colored metal and/or transite siding selected to blend with the surrounding countrysite.

3.1.2.2 Service Building and Auxiliary Buildings - The service building, together with miscellaneous auxiliary buildings, such as water treatment, waste treatment, hydrogen house, tractor garage, and personnel building, complement the overall plant and provide functional work areas for the employees.

3.1.2.3 Cooling Towers - Units 1 and 2 will use natural draft cooling towers within a closed loop for cooling the plant's condenser water.

3.1.2.4 Stacks - Tall stacks of sufficient height for proper gas dispersion will be used to exhaust the plant's combustion gases. Gulf expects that each stack will be approximately 700 feet above surface elevation. At this height, they will be the highest structures at the site. (Refer to subsection 3.7.3, "Gas Data," for a description of air emissions from the stacks.)

3.1.2.5 Ash Disposal Area - All ash disposal areas will be ringed with indigenous flora of suitable density, spacing, arrangement, color, and variety for screening and enhancing areas visible to the general public.

3.1.2.6 Coal Storage - Coal will be stored in an open stockpile of relatively low profile compared to the main power house. A railroad on a high fill will encompass the major portion of the coal storage pile, thereby providing a screen to the general public. The fill will be suitably planted or stabilized to prevent erosion.

3.1.2.7 Oil Storage - Gulf will store oil in closed fuel oil tanks surrounded by sealed dikes. The tanks will be painted various colors to harmonize with adjacent buildings and grounds. (Refer to subsection 3.2.2.6, "Drainage and Spillage," for a description of provisions to control drainage and spillage.) 2

3.2

3.2 Fuel

3.2.1 Coal

The plant is designed to burn a wide range of coal as the primary fuel, and will be capable of operating at maximum steaming capacity with coal having an approximate analysis as follows: 2

		Range
A.	moisture (percent)	3 to 15
B.	volatile (percent)	15 to 40
C.	fixed carbon (percent)	40 to 72
D.	ash (percent)	4 to 20
E.	sulfur (percent)	0.5 to 4.0
F.	heat content (BTU per pound)	10,000 to 13,200
G.	softening temperature (°F)	2,000 to 2,600
H.	grindability (hardgroove)	40 to 85

3.2.1.1 Consumption

3.2.1.1.1 Rate per Hour - Using conservative design criteria by assuming coal to have a heat content of 10,000 British thermal unit (BTU) per pound, the steam generators for Units No. 1 and 2 will each burn 482,600 pounds of coal per hour at a steam flow rate of 3,600,000 pounds per hour.

Each Unit 120.6 Tons/Hr

3.2.1.1.2 Rate per Year - Annual fuel consumption is based on the unit load factor which is expected to vary over the life of each unit. The average load factor over the life of a unit is expected to be approximately 50 percent. Calculated below are the annual coal consumption rates for the plant at selected load factors (LF):

	Unit No. 1 500 MW*	Unit Nos. 1 & 2 1,000 MW*	Total Site 3,000 MW*
80 percent LF (Tons)	1,690,000	3,380,000	10,140,000
70 percent LF (Tons)	1,480,000	2,960,000	8,880,000
60 percent LF (Tons)	1,270,000	2,540,000	7,620,000
50 percent LF (Tons)	1,057,000	2,114,000	6,342,000
40 percent LF (Tons)	845,000	1,690,000	5,070,000

2

*MW = Megawatts

3.2.1.2 Delivery

3.2.1.2 Delivery - Coal will be delivered to the plant by unit train rail shipments. (A unit train is a series of train cars with a common content, e.g., coal. Usually, the cars are specially designed and used for one particular application.) Each unit train normally 2

consists of 100 cars with a capacity of 100 tons each or a total of 10,000 tons per train. Based on expected seven-day operating requirements at 50 percent load factor, a total of 40,600 tons per week per 1,000 MW will be required. This is equivalent to four unit train deliveries per week for each 1,000 MW or two deliveries per day for the total 3,000 MW site. 2

13 train loads to store 90-Day for 1 unit

3.2.1.3 Storage - Gulf will store coal equivalent to 90-days of generation in an open stockpile and maintain approximately 13 hours of coal in silos within the plant. 2

3.2.1.4 Availability - There is an adequate supply of economically recoverable low and high sulfur coal in the United States to last for several hundred years at current rates of consumption. Of the U. S. coal reserves, about 70 percent, based on tonnage, are located west of the Mississippi River; however, this portion comprises only 45 percent of the coal based on calorific value. These Western reserves represent the bulk of the low sulfur coal in the U. S. (1).

3.2.1.5 Contracts - Gulf is currently actively negotiating for a quantity of the higher quality, high BTU, low sulfur, Western coal as well as for a quantity of high BTU, low sulfur, Eastern coal for the Caryville plant. Present plans are to have a duly executed contract(s) on low-sulfur coal for this unit by mid-1976. Though substantial quantities of high-sulfur coal are available east of the Mississippi River (1), purchases for high-sulfur coal to be used in this unit are not proposed at the present time.

3.2.1.6 Drainage and Spillage

A. Drainage - Because it is a solid fuel form, coal does not present a particular handling problem; however, the coal unloading facilities and the coal storage pile will be within a controlled drainage area, and Gulf will control coal dust by spraying with water at transfer points.

Rainwater runoff associated with up to a 10-year/24-hour rainfall event, originating from the coal storage pile and coal conveyor drainage area, will be routed to detention pond "A". The pond will temporarily contain the runoff and allow for settling of suspended solids. After settling, the water from the pond will be pumped to either (a) the bottom ash disposal area as make-up to the bottom ash sluice system, (b) the fly ash disposal area as make-up to the fly ash sluice system, or (c) the plant pretreatment filters to supplement plant make-up water. The water will be routed to a bottom ash and fly ash disposal area on an "as required" basis. Continuous low volume coal pile seepage collected between rainfall events will be pumped to the bottom ash disposal area. 2

All rainfall runoff associated with more than a 10-year/24-hour rainfall event will overflow from detention pond "A" to detention pond

"B". All overflow will be recorded by an event recorder operating on a calibrated weir and monitored for suspended solids and pH. 2

B. Spillage Coal spillage will be handled by routine housekeeping to maintain pleasant appearance and good working conditions.

3.2.2 No. 2 Oil

In addition to coal, Gulf will use No. 2 oil for initial lightoff and for low-load flame stabilization. The oil will have the following approximate analysis:

A. carbon (percent)	86.9
B. hydrogen (percent)	12.5
C. sulfur (percent)	<1.0
D. nitrogen (percent)	0.1
E. heat content (BTU per pound)	19,400

3.2.2.1 Consumption

3.2.2.1.1 Rate per Startup - Gulf estimates that, on the average, each 500 MW unit will consume 21,400 gallons of No. 2 oil for each startup. Six startups per year per unit are expected to be required.

3.2.2.1.2 Rate per Year - The annual consumption rate of No. 2 oil has the following four variables:

A. number of startups per year,

B. type of startup (hot or cold) (A hot startup is one where residual heat is present from a previous operation. This requires less oil than a cold startup where residual heat is not present.)

C. problems encountered during startup which would extend time for firing oil, and

D. number of hours the unit is operated at loads where oil is required to stabilize combustion.

From the estimates given in subsection 3.2.2.1.1 above, Gulf calculates an annual fuel oil consumption rate, in gallons, as follows:

Unit No. 1 500 MW	Unit 1 & 2 1,000 MW	Total Site 3,000 MW
128,400	256,800	770,400 3/yr

At 6000gal/tank truck 21 truck loads/yr per unit

at 700gal/truck: 183 loads/yr/500mw

3.2.2.2 Delivery - Oil will be delivered to the plant by rail and/or tank truck.

3.2.2.3 Storage - Oil will be stored in closed fuel oil tanks surrounded by retaining walls capable of retaining the entire contents of a tank should a leak develop.

3.2.2.4 Availability - Current U. S. Federal Energy Administration allocation program allows for 100 percent of requirements of No. 2 middle distillate oil for lighting of the coal-fired unit and for flame stabilization. In the unlikely event adequate oil is not available from this allocation program, spot purchases of oil normally used to operate combustion turbines will be used in the subject units.

3.2.2.5 Contracts - Gulf will file an application to contract for the necessary quantities of oil. This will be done, approximately one year prior to boiler startup in the fourth quarter of 1979.

3.2.2.6 Drainage and Spillage - Gulf will store oil in closed storage tanks surrounded by retaining walls to contain oil that may spill from handling or from leaking oil tanks. The enclosures will have sufficient capacity to contain 100 percent of the tank storage. Runoff water contained by the enclosures will be processed through an oil-water separator, before being mixed with any other water or runoff, and then passed to the detention pond "B". Before discharge, water quality from detention pond "B" will meet applicable State and Federal requlations. (See figure 3.5-7.)

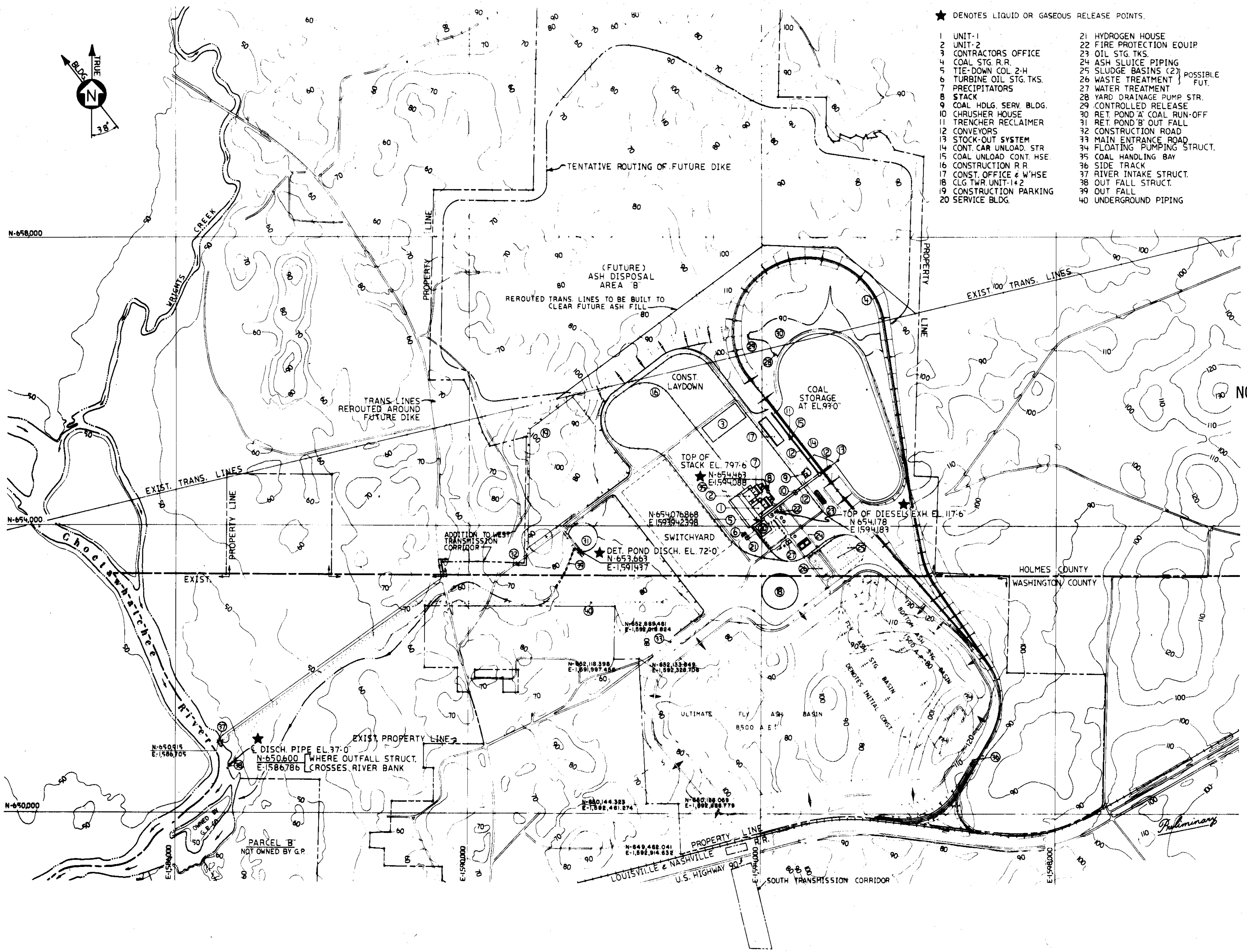
Oil unloading stations for rail and/or tank truck are designed to contain leakage and spills in order to recover the oil and prevent discharging of oil off site.

Plant site drainage ditches discharge through detention ponds which will be provided with an oil skimmer at the discharge structure. In the unlikely event of an onsite oil spill or transport tank rupture, the oil will be confined in detention pond "B" via drainage ditches. In such an event the oil would be removed from the pond by vacuum hoses, oil skimmers, and oil absorbent material.

Oil storage and handling is regulated as part of an oil pollution prevention program in an Oil Spill Prevention Control and Countermeasure Plan under U. S. Environmental Protection Agency Regulations, Part 40, Code of Federal Regulations 112.

3.2.3 Alternative Coal Delivery

Alternatives to the delivery of fuel by unit train are delivery by truck or by barge. To provide the required amount of coal (40,600 tons/week/1,000 MW) would require 225 truck loads per day. This alternative is not considered feasible due to the excessive cost (as compared to delivery by rail) and the excessive amount of truck traffic that would be generated over the life of the plant. Delivery of coal to the plant by barge is not considered feasible in that the Choctawhatchee River is not commercially navigable.



NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

CARYVILLE PLANT SITE
COORDINATES N-645,000; E-1,594,000

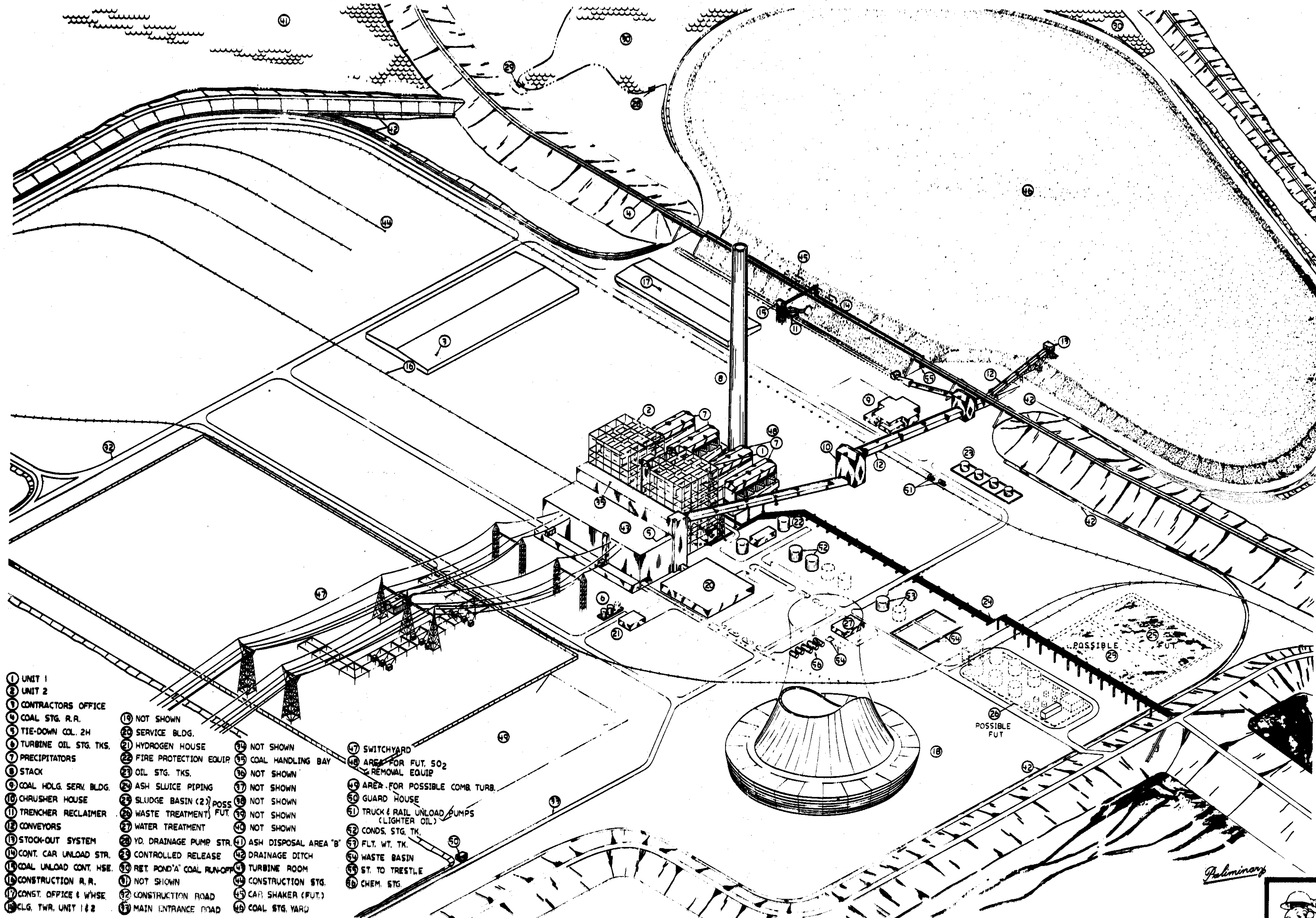
AMENDMENT 2 8/75

GULF POWER COMPANY

GULF POWER CO.
CARYVILLE STEAM PLANT

LIQUID AND GASEOUS EMISSIONS

FIGURE 3.1-1

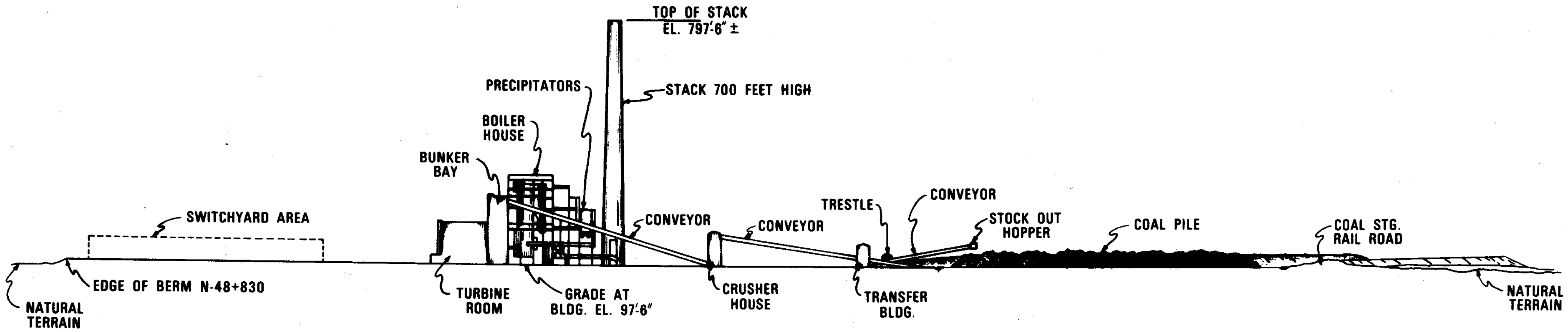


AMENDMENT 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

ARTIST'S VIEW OF PLANT

FIGURE 3.1-2



SCALE ½" = 200'

GULF POWER CO.
CARYVILLE STEAM PLANT

PLANT PROFILE

FIGURE 3.1-3

3.2.4 References

(1) Bituminous Coal Facts, National Coal Association, Washington, D. C., 1972.

3.3

3.3 Plant Water Use

3.3.1 Water Sources

Water will be supplied to the plant from the Choctawhatchee River and from the Floridan aquifer via deep wells.

3.3.1.1 Well Water - Gulf will install two 750-gallon-per-minute (GPM) capacity wells for Unit No. 1 (one for service and one spare) and one additional well for Unit No. 2. A total of four wells will be developed for the 3,000 megawatt (MW) plant site, thus yielding a total installed capacity of 3,000 GPM. The wells will supply water for the make-up demineralizer influent, potable and plant service use, fire protection, and construction.

One demineralizer plant will be shared between each pair of plant generating 2
Units to process water to a demineralized water storage tank. Demineralized water will be used for boiler make-up, demineralizer backwash and regeneration, and for small miscellaneous uses such as sampling and laboratory needs.

The plant's potable chlorinated well-water supply will be contained in 3
and drawn from potable water storage tanks located on the building roofs. This water will be used for drinking, showers, the plant kitchen, lavatories, and miscellaneous plant service. The potable water storage tank serving
the concrete batch plant during the construction period will be retained 3
as a permanent potable water storage tank.

Two 300,000 gallon storage tanks will be provided for fire protection for the 3,000 MW site. Capacity to fill a 300,000 gallon tank in eight hours will be provided.

3.3.1.2 River Water - For Unit No. 1, two 7,500 GPM pumps will be installed on the Choctawhatchee River. One pump will be in service and one will act as a spare. A total of six pumps will be installed for the 3,000-MW plant site (three 7,500 GPM and three 15,000 GPM with one of each size acting as a spare), thus providing a total active pumping capacity of 45,000 GPM. The pumps will supply make-up water for the heat dissipation system.

3.3.2 Consumption and Analysis 2

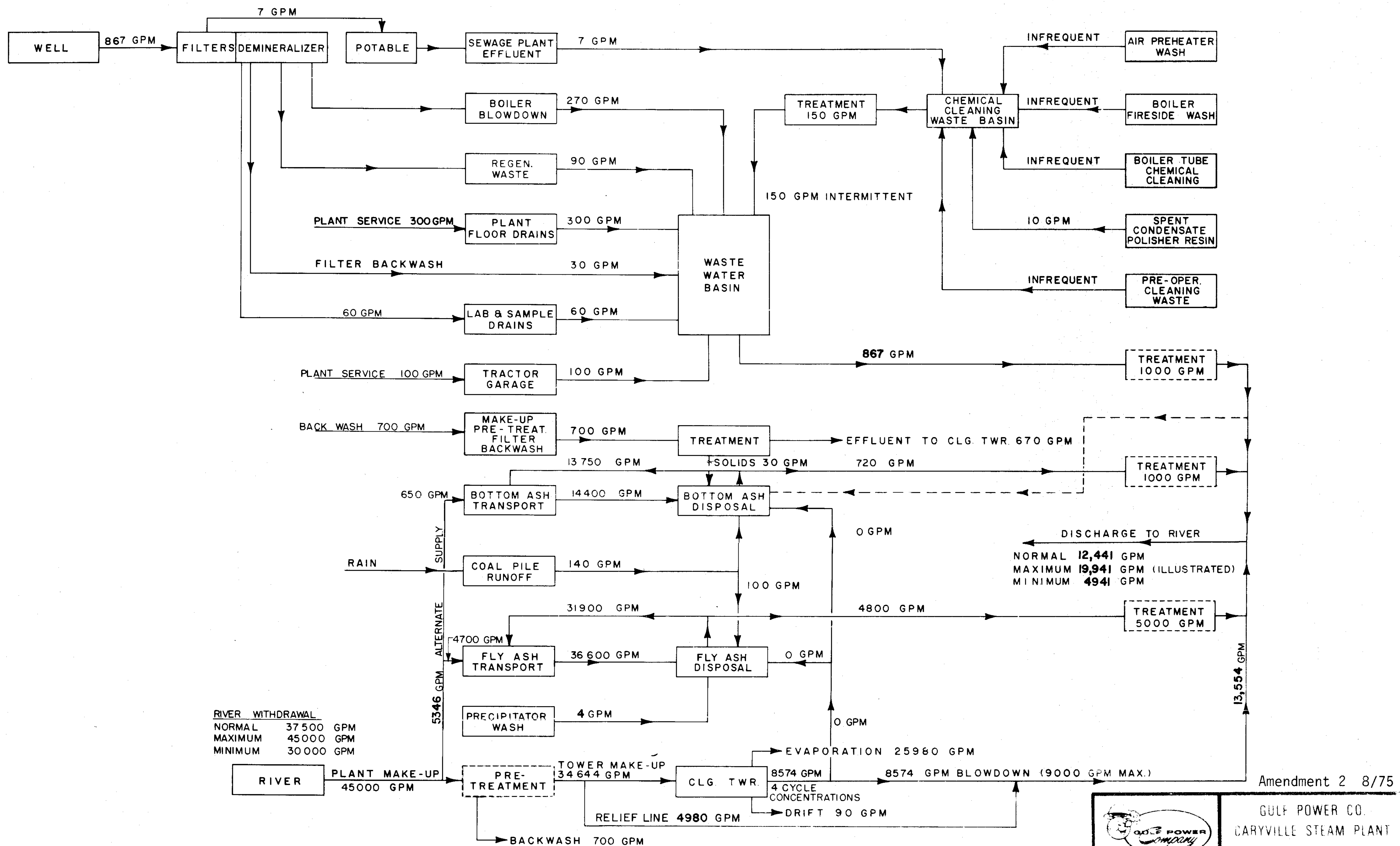
Although the potential is provided for withdrawing 3,000 GPM from the deep 3
aquifer, Gulf does not anticipate such withdrawal during normal routine operation. Included in this 3,000 GPM capacity is one 750 GPM well that acts as a spare in the event a natural or mechanical malfunction should render a well inoperable. This spare also ensures availability of water in the event of an abnormally high surge demand. Since water drawn from the wells is not directly returned to the aquifer, all well water use may be termed as consumptive. The quantitative well water consumption

is listed in tables 3.3-1 through -4 for maximum, average, minimum, and shutdown conditions. As shown, the actual consumptive use is much smaller than the pumping potential. The design well water analysis is shown in table 3.3-5.

A well load factor of about 33 percent is desirable to prevent overpumping the individual wells. The spare will serves as a reliability factor. In future years, however, as the well system develops, experience may prove a spare well to be unnecessary. Maximum well water demand for the 3,000 MW plant site will be about 2,600 GPM. In normal routine operation, Gulf expects the 3,000 MW plant site pumping demand to be about 1,000 GPM. This will be about 40 percent of maximum demand or about 33 percent of installed capacity. As subsequent generating units are added to develop the 3,000 MW site, the need for additional wells will be evaluated to 3
determine if they are necessary based on plant consumption, system installed capacity, and system load factor.

Presently, the exact well capacity of those to be drilled and the number of wells required is not known. Further testing may show that the capacity of each well will be more or less than 750 GPM.

For the 3,000 MW site, a maximum pumping capacity of 67,500 GPM will be installed to supply a maximum site demand of 45,000 GPM withdrawal from 2
the Choctawhatchee River. At full load operation (3,000 MW), a withdrawal of 40,000 GPM will normally be expected, thus providing a 12.5 percent pump margin. Except of losses due to cooling tower evaporation and drift, essentially all water withdrawn from the river and wells will be returned directly to the river. Quantitative river water consumption is shown in tables 3.3-1 through -4 for maximum, average, minimum, and shutdown conditions. Water flow to and from each system designed for two 500 MW Units is shown in figure 3.3-1. Refer to table 3.4-1 for river water analyses.



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GULF POWER CO.
CARYVILLE STEAM PLANT

3,000 MW WATER BALANCE

FIGURE 3.3-1

TABLE 3.3-1

WATER CONSUMPTION 100 PERCENT LOAD FACTOR (MAXIMUM DEMAND)

	Unit 1 500 MW	Unit 1 & 2 1,000 MW	Total Site 3,000 MW	
1. Well Water				
A. Demineralized for Boiler Make-Up (GPM)	260	520	1,560	2
B. Potable and Plant Service (GPM)	150	300	900	
C. Make-Up Demineralizer Back-wash and Regeneration (GPM)	25	50	150	
D. Fire Protection (infrequent) (GPM)	625	625	1,250	
E. Construction Water (offset by no operation) (GPM)	75	75	NA	
F. Total (less items D and E) (GPM)	435	870	2,610	2
2. River Water				
A. Cooling Tower Evaporation (GPM)	4,330	8,660	25,980	2
B. Cooling Tower Drift (Maximum) (GPM)	15	30	90	
C. Total (GPM)	4,345	8,690	26,070	2

GPM = Gallons Per Minute
MW = Megawatts
NA = Not Applicable

TABLE 3.3-2

WATER CONSUMPTION
50 PERCENT LOAD FACTOR (AVERAGE)

	Unit 1 500 MW	Unit 1 & 2 1,000 MW	Total Site 3,000 MW	
1. Well Water				
A. Demineralizer for Boiler Make-Up (GPM)	50	100	300	
B. Potable and Plant Service (GPM)	150	300	900	
C. Filter Backwash and Demineralizer Regeneration (GPM)	13	26	78	
D. Fire Protection (infrequent) (GPM)	625	625	1,250	
E. Construction Water (offset by no operation) (GPM)	75	75	NA	
F. Total (less items D and E) (GPM)	213	426	1,278	
2. River Water				
A. Cooling Tower Evaporation (GPM)	2,630	5,260	15,780	2
B. Cooling Tower Drift (Maximum) (GPM)	15	30	90	
C. Total (GPM)	2,645	5,290	15,870	2

GPM = Gallons Per Minute
MW = Megawatts
NA = Not Applicable

TABLE 3.3-3

WATER CONSUMPTION
40 PERCENT LOAD FACTOR (MINIMUM)

	Unit 1 500 MW	Unit 1 & 2 1,000 MW	Total Site 3,000 MW	
1. Well Water				
A. Demineralizer for Boiler Make-Up (GPM)	40	80	240	
B. Potable and Plant Service (GPM)	150	300	900	
C. Filter Backwash and Demineralizer Regeneration (GPM)	10	20	60	
D. Fire Protection (infrequent) (GPM)	625	625	1,250	
E. Construction Water (offset by no operation) (GPM)	75	75	NA	
F. Total (less items D and E) (GPM)	200	400	1,200	
2. River Water				
A. Cooling Tower Evaporation (GPM)	2,529	5,058	15,174	2
B. Cooling Tower Drift (Maximum) (GPM)	15	30	90	
C. Total (GPM)	2,544	5,088	15,264	2

GPM = Gallons Per Minute
MW = Megawatts
NA = Not Applicable

TABLE 3.3-4

WATER CONSUMPTION
SHUTDOWN

	Unit 1 500 MW	Unit 1 & 2 1,000 MW	Total Site 3,000 MW
1. Well Water			
A. Demineralizer for Boiler Make-Up (GPM)	0	0	0
B. Potable and Plant Service (GPM)	150	300	600
C. Filter Backwash and Demineralizer Regeneration (GPM)	0	0	0
D. Fire Protection (infrequent) (GPM)	625	625	1,250
E. Construction Water (offset by no operation) (GPM)	75	150	NA
F. Total (less items D and E) (GPM)	150	300	600
2. River Water			
A. Cooling Tower Evaporation (GPM)	0	0	0
B. Cooling Tower Drift (GPM)	0	0	0
C. Total (GPM)	0	0	0

GPM = Gallons Per Minute
MW = Megawatts
NA = Not Applicable

TABLE 3.3-5

WELL - WATER ANALYSIS

	MG/L as $CaCO_3$	
Calcium (Ca)	117.5	
Magnesium (Mg)	31.2	
Sodium (Na)	3.7	
Potassium (K)	1.2	
Sulfate (SO_4)	1.3	2
Chloride (Cl)	4.2	
Bicarbonate (HCO_3)	148.1	
Dissolved Silica (SiO_2)	12.0 (as SiO_2)	
pH	7.6	
Free CO_2	7.8 (as CO_2)	

MG/L = Milligrams Per Liter
$CaCO_3$ = Calcium Carbonate

Reference: Caryville Steam Plant - Potable Water Supply Test Well No. 2 2

3.4

3.4 Heat Dissipation System

3.4.1 Each of Two 500-Megawatt Units

3.4.1.1 Main Circulating Water System - A closed-loop system will provide cooling water for the main condenser and auxiliary heat exchanger. Make-up water will be supplied to the circulating water system from the Choctawhatchee River. (See table 3.4-1.) The main condenser of each 500 megawatt (MW) unit is a single pass multipressure design consisting of two series operating shells. Condensers will have admiralty tubes in the main bank and 90-10 copper-nickel tubes in the air cooler section with a total surface area of 250,000 square feet. Each condenser is sized for a heat load of 2.376 x 10^9 British Thermal Units (B.T.U.'s) per hour and a circulating water flow of 168,250 gallons per minute (GPM). The heat exchangers for each 500 MW unit will be arranged in parallel with the main condenser and operated independently of the main turbine. The heat exchangers for each unit are sized for a heat load of 6.4 x 10^7 B.T.U. per hour and a cooling water flow of 8,500 GPM. 3

3.4.1.2 Natural Draft Cooling Towers - Evaporative Type - One natural draft cooling tower designed to be shared by two 500 MW units (Units 1 & 2) will be constructed with the initial 500 MW unit. This tower will operate at one-half its total capacity until unit 2 is in operation. 2

At maximum unit capacity, the main circulating water system for each 500 MW unit will dissipate to the atmosphere its total heat load of 2.44 x 10^9 B.T.U.'s per hour by means of one natural draft cooling tower. The arrangement and location of the cooling tower is shown in figures 3.1-1 and -2. A flow diagram for the tower make-up water system is shown in figure 3.4-1. The tower will have an internal concrete support structure with cement asbestos fill material. Pertinent tower performance specifications and operating conditions are shown in table 3.4-2 and illustrated in figure 3.4-2. 3

The level of total dissolved solids (TDS) in the circulating water system will be controlled by continuously extracting a portion of the concentrated circulating water and replacing it with fresh water. The extraction process is called blowdown and the replacement process is called make-up. The amount of make-up is equal to the sum of cooling tower evaporation, drift, and blowdown. The turbine plant design provides for a variable rate of blowdown up to 1,429 GPM per 500 MW unit and is automatically controlled to maintain four to seven cycles of concentration with a circulating water conductivity fixed at 400 to 450 micromhos. This rate corresponds to 268 to 301 milligrams per liter dissolved solids. Constituents contained in the cooling tower blowdown are shown in table 3.4-3. The concentration at which the tower is operated is dependent on the quality of make-up water. Variation extremes of TDS and constituent levels in the make-up water are shown in table 3.4-1.

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When the make-up water contains high levels of dissolved solids, the tower is operated at approximately 4.7 cycles of concentration, and when the make-up water contains a medium or low level of TDS, the tower will be operated at approximately 6.2 to 6.6 cycles.

The make-up flow is variable up to 5,774 GPM per 500 MW unit depending on (a) cooling tower evaporation rate which varies with turbine load and ambient humidity, (b) drift, and (c) blowdown. At maximum unit capacity, a maximum evaporation of 4,330 GPM and a maximum drift of 15 GPM is expected for each 500 MW unit regardless of the concentration. Table 3.4-4 shows the make-up and blowdown requirements for maintaining the various cycles of concentration. Material in Section 2 of Appendix C describes the make-up water temperature, including monthly changes in stratification.

Before use as tower make-up, the surface water will require filtration to remove iron and suspended solids. The filters should obviate the 2
need for a mechanical cleaning system for the main condensers. Backwash water from the filters will be routed to a backwash treatment system for removal of suspended solids. To assure maximum water usage, the processed backwash water will be forwarded to the backwash storage compartment for 3
reuse as filter backwash water and the separated solids will be routed to the bottom ash disposal area. Removal of any silt and mud that may accumulate in the tower basin will be accomplished during scheduled outages by draining to the bottom ash disposal area.

To control the growth of algae and slime in the circulating water system, liquid chlorine will be introduced to the water on the cold side of the condenser and at the make-up water pumps. The design is to limit chlorine use to a minimum and to maintain strict controls on feeds and levels in the water system. A further discussion of chlorine and other chemical additives is contained in section 3.5, "Chemical and Biocide Waste."

3.4.1.3 Intake Structure - One intake structure will be constructed to supply water for the total 3,000 MW site. For the initial 500 MW unit, two 7,500 GPM pumps will be installed on the river: one in service and one a spare. An additional 7,500 GPM pump will be installed for the second 500 MW unit and an ultimate active pumping capacity of 45,000 GPM will be installed for the total 3,000 MW site requirements. The intake structure will be located on the east bank of the Choctawhatchee River at coordinates N-650,915; E-1,586,705. (See figure 3.1-2.) This location was chosen after giving due consideration to (a) river cross section profiles and subsequent low river flow conditions, (b) suitable foundation conditions, (c) piping and maintenance costs, and (d) environmental factors. The intake structure is designed to minimize entrapment and impingement of aquatic organisms and to maintain intake velocities below one-half

foot per second. Stationary screens will be installed that are designed to minimize entrapment of debris. Therefore, no trash or debris will be removed from the river. (See figure 3.4-3.)

3.4.1.4 Outfall Structure - The use of cooling towers and plant design for recycling of water minimizes the discharge of plant wastes to the river. However, an average of approximately 1,500 GPM per 500 MW must be released. Section 3.5, "Chemical and Biocide Wastes," discusses the composition of this release. Plant effluent will be released to the Choctawhatchee River by a single 30 inch diameter pipe located on the river's east bank at coordinates N-650,600; E-1,586,786. At the discharge structure, the pipe diameter will be reduced to 24 inches to assist mixing. (See figure 3.4-4.) Discharge flows are expected to remain relatively constant throughout the year.

The centerline of the 24 inch diameter discharge pipe will be set at 37 feet above mean sea level. Based on the average monthly flows presented in section 2.5, "Hydrology," submergence depth of the discharge is expected to vary as shown in table 3.4-5.

3.4.2 3,000 Megawatts

At the present time, the design criteria for the 2,000 MW future expansion has not been established. The basic system design and requirements for a 3,000 MW plant are based on using proposed equipment for the initial 1,000 MW and using natural draft evaporative type cooling towers for the future 2,000 MW. Table 3.4-6 summarizes the heat dissipation system for the 3,000 MW site. All circulating water flows and condenser surface areas are assumed to be directly proportional to the 500 MW units. 2

3.4.3 Alternate Heat Dissipation Methods

Ultimately, all waste heat generated by a steam plant must be discharged either to the atmosphere, a river, a man-made or natural lake, or combinations thereof. Alternate methods for dissipating this heat are wet type mechanical draft cooling towers, once through cooling, cooling pond, dry type cooling towers, and evaporative type cooling spray modules. A discussion of each method studied for the Caryville site follows:

3.4.3.1 Wet Type Mechanical Draft Cooling Towers - Wet type mechanical draft cooling towers were originally the design and economic choice for use at the Caryville site. Rapidly escalating fuel costs over the life of the plant encouraged reexamination of their use and thus subsequent replacement. An economic study comparing wet type mechanical draft cooling towers and wet type natural draft cooling towers is summarized below. Considerations of the study included cost of all equipment (cooling towers, condenser, pumps, motors, piping, etc.), power requirements, and heat-rate differential costs. Two generating units on one natural draft tower is the economic choice over the mechanical draft tower system.

Plant Capacity (MW)	Wet Natural Draft	Wet Mechanical Draft (Additional Cost Over Wet Natural Draft)
500	Base Cost	$1,424,500
1,000	Base Cost	$6,950,000
3,000	Base Cost	$20,850,000

3.4.3.2 Once Through Cooling - Economically, once through cooling is the most favorable method provided that adequate river flow volume is available. Environmentally, however, this method is considered questionable due to thermal effects on and possible damage to aquatic organisms. Flow requirements for the once through cooling system for a 500-, 1,000-, and 3,000- MW plant are as follows:

Plant Capacity (MW)	Once Through System Flow Requirements (Cubic Feet Per Second (CFS))
500	398 (178,185 GPM)
1,000	794 (356,371 GPM)
3,000	2,382 (1,069,115 GPM)

The minimum flow recorded for the Choctawhatchee River at Caryville during the 42-year period of 1927 to 1971 is 604 CFS. A comparison of this minimum flow with the flow demands of the once through cooling system listed above clearly indicates that, during periods of low river flow, the Choctawhatchee could not supply the required cooling flow rate for a plant of 1,000 MW or larger. Based on this inadequate river flow, the once through cooling scheme is not considered to be a viable alternate at the Caryville site. 2

3.4.3.3 Cooling Ponds - The use of cooling ponds at the Caryville site was precluded on the basis of their large additional acreage requirements, high land costs, and topography. The required acreage for a 500-, 1,000-, and 3,000-MW plant are as follows:

Plant Capacity (MW)	Required Surface Area for Cooling Pond (Acres)
500	725
1,000	1,470
3,000	4,590

For the operation of 3,000 MW, the land requirement for cooling ponds would be approximately two and one-half times the base design.

To obtain this large surface area would require either the draining of Wrights Creek or extensive diking and subsequent high cost: economically and environmentally.

3.4.3.4 Dry Type Cooling Towers - There is presently only minimal use of dry type cooling towers by electric utilities in the United States. Of the units in service, a majority are of an experimental nature aimed at establishing dry type cooling tower technology.

This system, optimized for maximum economic advantage, generally requires condensing pressures in the range of eight to 20 inches of mercury. Domestic turbine generator manufacturers currently do no offer units of the 500-MW size with condensing pressures greater than five to five and one-half inches of mercury. In general, dry type cooling towers and the turbine generators required for the high condensing pressures are currently in the development stage.

Since dry cooling towers and high condensing turbine generator technology has not been fully developed, and since units for 500-MW power units are not currently available from domestic suppliers, this scheme has been omitted as a viable cooling system option for the Caryville plant. 2

3.4.3.5 Evaporative Type Cooling Spray Modules - Electric utilities have experienced numerous problems with spray module systems. Some of the problems experienced are (a) motor overload from plugging of nozzles, (b) pump bearing failures, (c)pump bowl erosion, and (d) impeller failures. Additionally, use of these nozzles also require substantial acreage for ponds. These reasons are sufficient to preclude spray modules from further consideration as a cooling system for the Caryville plant.

3.4.3.6 Conclusion - Viable options for a condenser cooling water heat dissipation system for use at the Caryville site are limited to the use of wet type mechanical draft or wet type natural draft cooling towers. Present economic evaluations favor the natural draft towers primarily on operating costs over the life of the plant. For this reason, the wet type natural draft cooling towers were selected.

TABLE 3.4-1

CHOCTAWHATCHEE RIVER WATER ANALYSIS VARIATION

	HIGH TDS	MEDIAN TDS	LOW TDS
Date	June 25, 1969	November 20, 1968	March 13, 1968
Discharge (cubic feet per second)	1,720	2,830	4,630
Temperature (^{o}F)	90.8	51.8	50.9
	MG/L As $CaCO_3$	MG/L As $CaCO_3$	MG/L As $CaCO_3$
Calcium (Ca)	30.4	18.5	16.2
Magnesium (Mg)	6.2	5.0	4.1
Sodium (Na)	6.3	7.3	6.3
Potassium (K)	1.2	1.3	0.1
Total Cations	44.1	32.1	26.7
Bicarbonate (HCO_3)	36.0	19.7	17.2
Sulfate (SO_4)	3.7	4.2	3.3
Chloride (Cl)	4.4	7.8	5.9
Nitrate (NO_3)	0.0	0.4	0.3
Total Anions	44.1	32.1	26.7
Total Hardness as $CaCO_3$	36.8	23.5	20.3
Silica (as SiO_2)	7.5	8.2	7.6
Iron (as Fe)	0.0	0.04	0.09
Total dissolved solids	56.0	50.0	42.0
Conductance, micromhos	92.0	70.0	62.0
pH	6.5	6.7	6.7
Color, Platinum Cobalt	5.0	10.0	10.0
Free CO_2 (as CO_2)	22.0	7.7	7.2

Source: U.S. Geological Survey Data

TDS = Total Dissolved Solids
$CaCO_3$ = Calcium Carbonate
MG/L = Milligrams Per Liter

TABLE 3.4-2

COOLING TOWER PERFORMANCE

Parameters	Unit 1 500 MW	Units 1 & 2 1,000 MW
A. design wet bulb (°F at 60 percent relative humidity)	80	80
B. approach (°F)	10	10
C. range (°F)	28.6	28.6
D. water to tower (°F)	118.6	118.6
E. water from tower (°F)	90	90
F. water flow (GPM) (maximum)	176,750	353,500
G. water volume (feet cubed)	790,000	790,000
H. drift (GPM) (maximum)	15	30
I. evaporation (GPM) (maximum)	4,330	8,660
J. air flow (pounds per hour) (estimated)	98×10^6	136×10^6
K. exit air temperature (°F) (estimated)	100	104.6
L. exit air velocity (feet per second) (estimated)	11.2	12.3

2

MW = Megawatts
GPM = Gallons Per Minute

TABLE 3.4-3

COOLING TOWER BLOWDOWN CONSTITUENTS*

Element	PPM as $CaCO_3$
Calcium (Ca)	114.7
Magnesium (Mg)	31.0
Sodium (Na)	45.2
Potassium (K)	8.1
Bicarbonate (HCO_3)	122.1
Nitrate (NO_3)	2.5
Chloride (Cl)	48.4
Sulfate (SO_4)	26.0
pH	7.4
Carbon Dioxide (As CO_2)	7.7
Silica (as SiO_2)	50.8
Iron (as Fe)	0.25

2

PPM = Parts Per Million
$CaCO_3$ = Calcium Carbonate
* Calculated at 6.2 cycles of concentration and design make-up water.

TABLE 3.4-4

MAKE-UP AND BLOWDOWN REQUIREMENTS FOR VARYING CYCLES OF CONCENTRATION

TOWER MAKE-UP (GPM)

Cycles of Concentration	500 MW Unit 1	1,000 MW Units 1 & 2	3,000 MW Site Total
4	5,774	11,548	34,644
5	5,413	10,826	32,478
6	5,196	10,392	31,176
7	5,052	10,104	30,312

2

TOWER BLOWDOWN (GPM)

Cycles of Concentration	500 MW Unit 1	1,000 MW Units 1 & 2	3,000 MW Site Total
4	1,429	2,858	8,574
5	1,068	2,136	6,408
6	851	1,702	5,106
7	707	1,414	4,242

MW = Megawatt
GPM = Gallons Per Minute
Evaporation = 4,330 GPM/500 MW Maximum
Drift = 15 GPM/500 MW Maximum

TABLE 3.4-5 2

SUBMERGENCE DEPTH OF DISCHARGE

Month	River Flow (CFS) Stage (Feet)			Submergence Depth of Discharge Pipe From Water Surface To ℄ Pipe Feet		
	High	Average	Low	High	Average	Low
JAN.	23,510/53.2	7,022/48.1	1,925/42.3	16.2	11.1	5.3
FEB.	16,600/51.5	7,566/48.4	2,994/44.1	14.5	11.4	7.1
MARCH	22,500/53.1	9,125/49.1	1,777/41.9	16.1	12.1	4.9
APRIL	22,010/53.0	8,637/48.9	2,343/43.0	16.0	11.9	6.0
MAY	15,700/51.3	6,016/47.5	1,618/41.5	14.3	10.5	4.5
JUNE	9,236/49.2	3,392/44.7	1,349/40.9	12.2	7.7	3.9
JULY	10,130/49.5	3,805/45.4	1,408/41.0	12.5	8.4	4.0
AUG.	17,120/51.7	4,366/46.0	1,046/40.1	14.7	9.0	3.1
SEPT.	16,650/51.6	3,525/44.9	905/39.8	14.6	7.9	2.8
OCT.	14,000/50.7	3,014/44.1	721/39.3	13.7	7.1	2.3
NOV.	11,700/50.0	3,335/44.6	992/40.6	13.0	7.6	3.6
DEC.	24,150/53.3	4,653/46.3	1,395/41.0	16.3	9.3	4.0

℄ = Centerline 2

TABLE 3.4-6 |2

3,000 MW SUMMARY

		Unit 1 500 MW	Units 1 & 2 1,000 MW	Site Total 3,000 MW
1.	Cooling tower evaporation (maximum) (GPM)	4,330	8,660	25,980
2.	Cooling tower drift (0.008 percent maximum) (GPM)	15	30	90
3.	Cooling tower blowdown @ 4 cycles (GPM)	1,429	2,858	8,574
4.	Cooling tower make-up @ 4 cycles (GPM)	5,774	11,548	34,644
5.	River water consumption (GPM)	4,345	8,690	26,070
6.	Ash sluice make-up (GPM)	776	1,552	4,656
7.	River water withdrawal (GPM)	6,550	13,100	39,300
8.	River pump margin (GPM)	950	1,900	5,700
9.	River pump capacity (GPM)	7,500	15,000	45,000
10.	Heat dissipated to atmosphere ($X\ 10^9$ BTU per hour)	2.44	4.88	14.64
11.	Circulating water (recycle)	176,750	353,500	1,060,500
12.	Number of river pumps (including spare)	2	3	6

GPM = Gallons Per Minute
MW = Megawatt
BTU = British Thermal Unit

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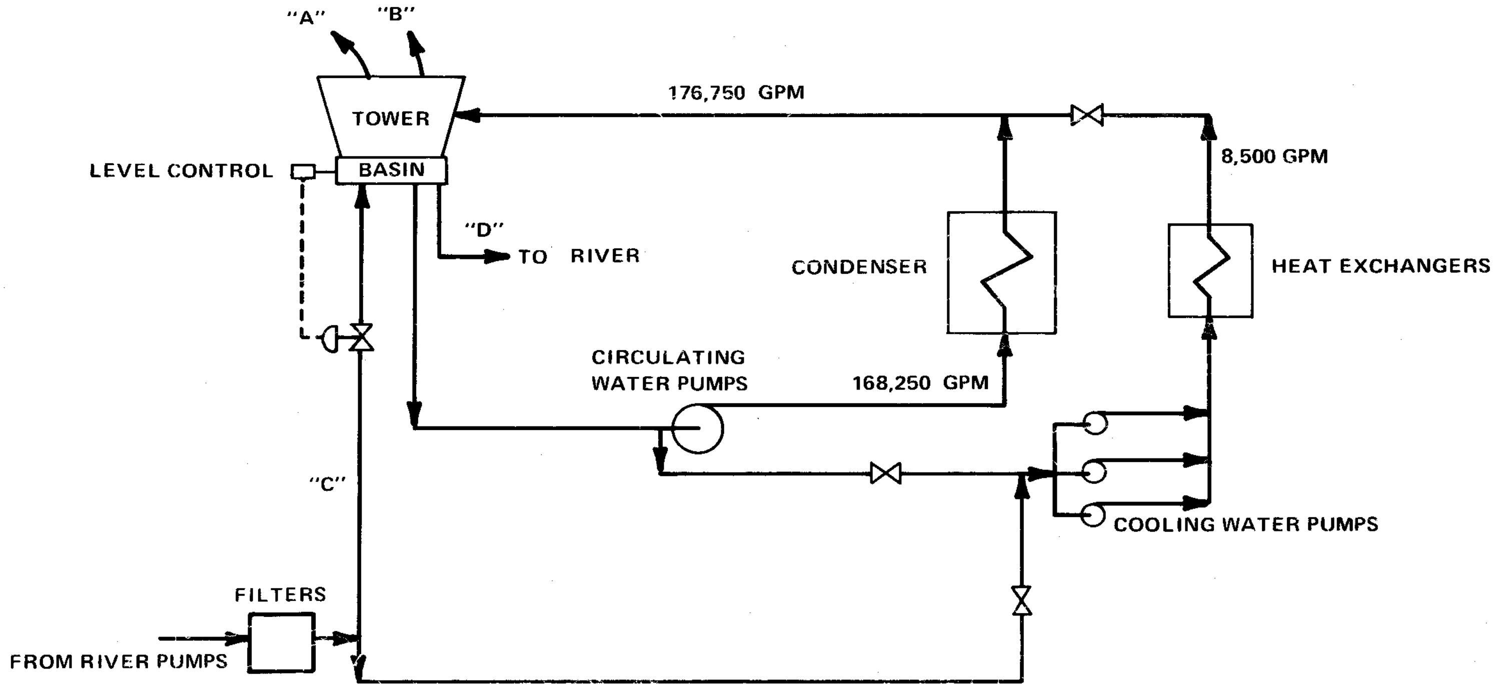

SYMBOL	DESCRIPTION		CYCLES OF CONCENTRATION 4	5	6	7
A	TOWER DRIFT	GPM	15	15	15	15
B	TOWER EVAPORATION	GPM	4,330	4,330	4,330	4,330
C	TOWER MAKE-UP	GPM	5,774	5,413	5,196	5,052
D	TOWER BLOWDOWN	GPM	1,429	1,068	851	707

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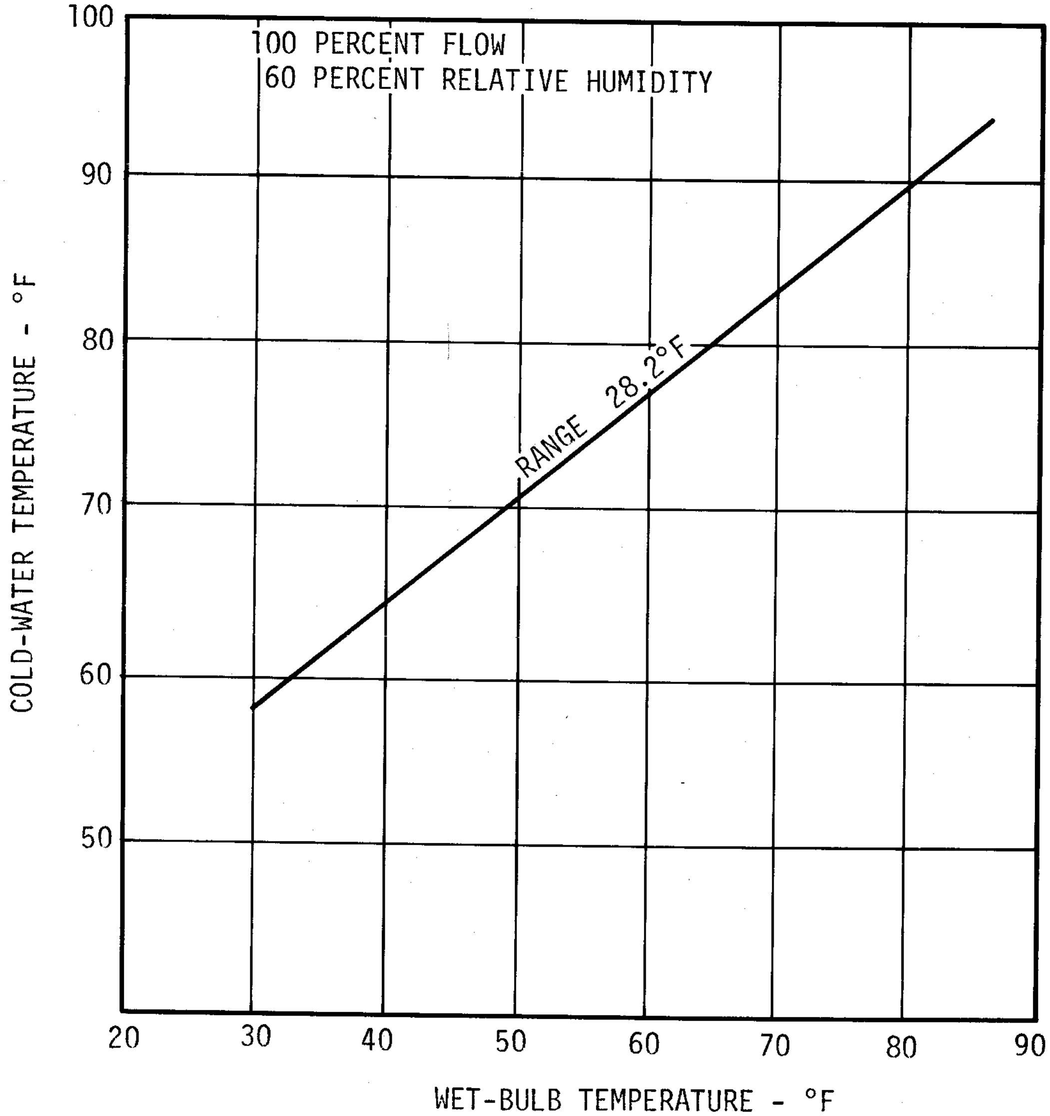
GPM = GALLONS PER MINUTE

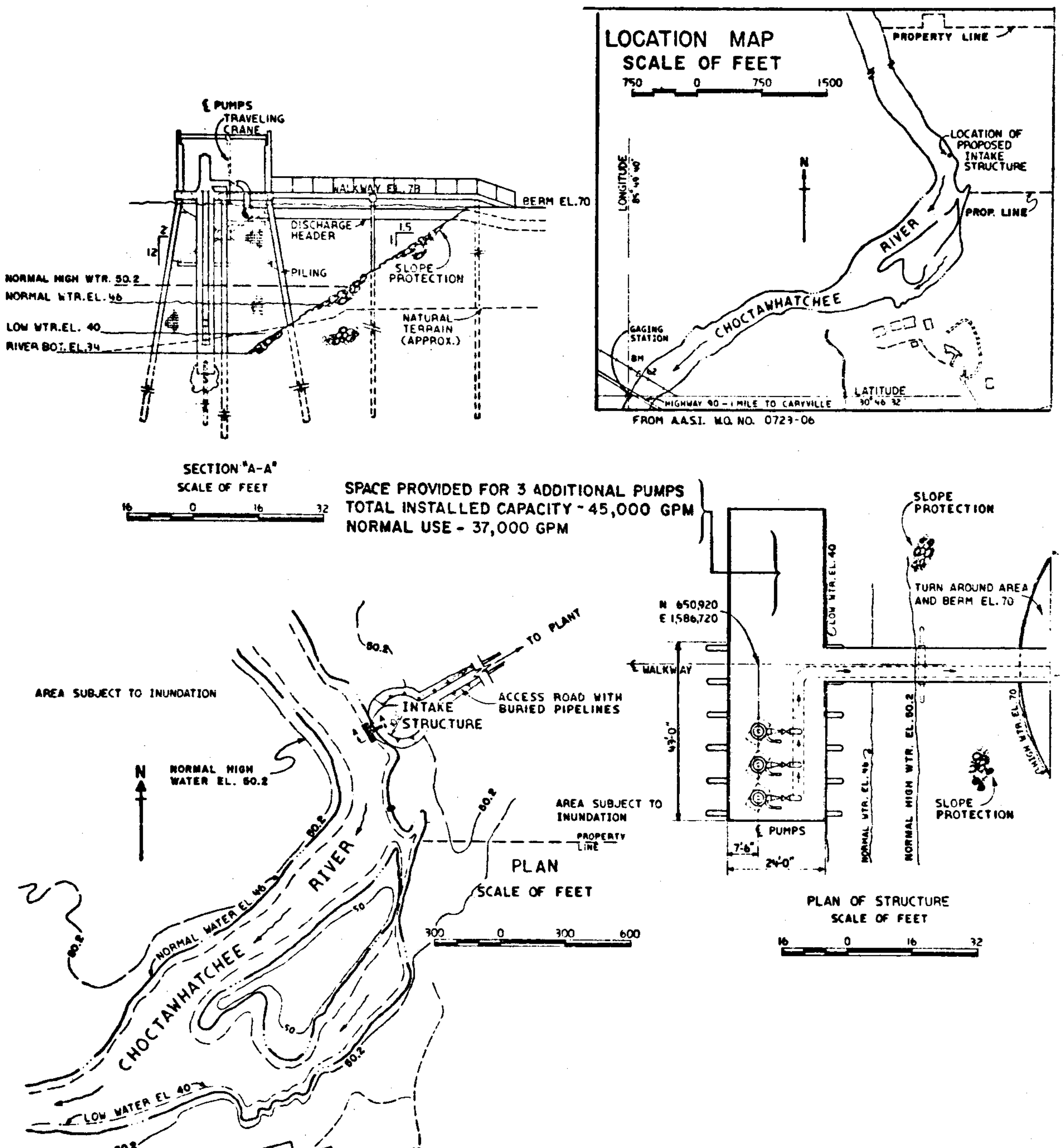
GULF POWER CO.
CARYVILLE STEAM PLANT

TOWER FLOW DIAGRAM
PER 500 MW

FIGURE 3.4-1



GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	COOLING TOWER PERFORMANCE CURVE FIGURE 3.4-2



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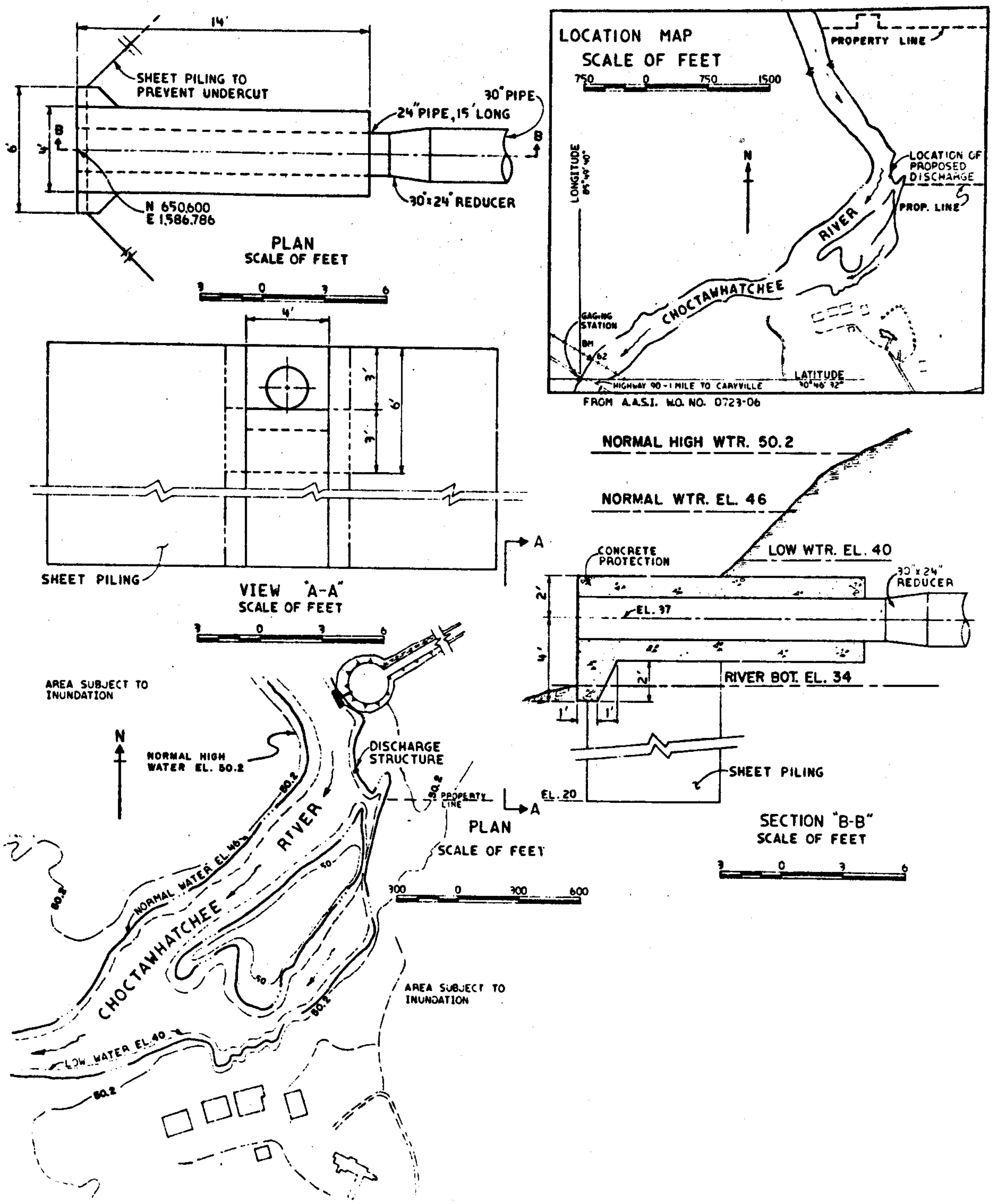
GULF POWER CO.
CARYVILLE STEAM PLANT

INTAKE STRUCTURE

FIGURE 3.4-3



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GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	DISCHARGE STRUCTURE FIGURE 3.4-4

3.5

3.5 Chemical and Biocide Waste

The following chemicals and biocides will be used during the operation of the Caryville steam plant: (Figures 3.5-1 through -6 show the chemicals used for the plant's major equipment.)

A. Plant Operating Chemicals and Biocides

1. hydrochloric acid (See figure 3.5-1.) 3
2. sodium hydroxide (See figure 3.5-1 and -3.)
3. hydrazine (See figure 3.5-6.)
4. morpholine (See figure 3.5-6.)
5. laboratory reagents and chemicals
6. oil and grease
7. hydrogen and carbon dioxide gases (See figure 3.5-4.)
8. chlorine and supplementary biocides (See figure 3.5-5.)
9. lime (See figure 3.5-2.)
10. alum, ferric chloride, and ferric sulfate (coagulant aids) (See figure 3.5-2.)
11. chelating agents (See figure 3.5-6.) 3

B. Plant Cleaning Chemical (See figure 3.5-3.)

1. hydrochloric acid
2. trisodium phosphates 3
3. caustic soda
4. ammonium bifluoride
5. detergents
6. sodium sulfite
7. potassium and/or sodium bromate
8. hydrofluoric acid
9. ammonium bicarbonate
10. ammonium hydroxide
11. emulsifiers 3

3.5.1 Bulk Chemical Storage

3.5.1.1 Acid and Caustic for Water Treatment Building, and Acid for Chemical Cleaning Waste Treatment System (Per 1,000 Megawatt (MW))

3.5.1.1.1 Acid and Caustic for Water Treatment Building - A concentrated chemical storage facility will be provided at the water treatment building to accept delivery of and store bulk caustic and acid. Bulk storage provided will consist of two 20,000-gallon tanks for caustic (20 percent NaOH) and one 8,000-gallon tank for 25 percent hydrochloric acid. All bulk chemical storage tanks shall have retaining walls capable of containing 100 percent of the tank capacity to prevent unrestricted chemical spills. A caustic pump and an acid pump with associated piping, valves, and controls will be installed to tranfer chemicals from tank truck deliveries. Water will be provided for dilution of caustic from 50 percent NaOH as delivered to 20 percent NaOH storage. 3

3.5.1.1.2 Chemicals for the Chemical Cleaning Waste Treatment System - Waste treatment equipment with a small acid storage day-tank will be provided for the recarbonation of the chemical cleaning waste treatment system effluent stream. Facilities will be provided for storage of small amounts of bagged lime and, if required, small amounts of bagged soda ash. 3

3.5.1.2 Hydrazine and Morpholine For Feedwater Chemical Feed System - Hydrazine, caustic soda, and morpholine will be stored in drums on the turbine building base slab in the chemical mix and storage rooms for use in feedwater chemistry control. Sodium sulfite and trisodium phosphates required for feedwater control will be stored in bags. 3

3.5.1.2.1 Hydrazine - Hydrazine may be added to the feedwater as an oxygen scavenger. Three parts of 35 percent hydrazine (N_2H_4) reacts with one part oxygen. Hydrazine residual at the economizer inlet is expected to be about 15 to 20 micrograms per liter. Complete reaction of hydrazine with oxygen produces nitrogen and water. Hydrazine will be used to protect equipment during periods of non-operation.

3.5.1.2.2 Morpholine - Morpholine will be added to the feedwater to reduce iron pickup by neutralizing carbon dioxide and raising the pH. Morpholine is a nitrogen-containing neutralizing volatile compound which does not add to the boiler dissolved solids. About two milligrams per liter (MG/L) of morpholine neutralizes one MG/L of carbon dioxide. The residual at the economizer inlet is expected to be about two to three MG/L with feedwater pH in the range of 8.8 to 9.0 for feedwater heaters tubed with copper alloy tubes.

3.5.1.3 Laboratory Chemicals - The plant laboratory will maintain a reasonable stock of reagent chemicals, in small quantities, for use in performing raw water analysis, boiler water analysis, and other necessary laboratory testing work.

3.5.1.4 Oil and Grease

A. Oil will be stored for main turbine and auxiliary drive turbine lubrication and hydraulic systems in approximately 2,000-gallon capacity lube oil tanks (two tanks per two units).

B. The boiler ignitor No. 2 fuel oil will be stored in approximately 150,000-gallon capacity tanks (one tank per unit).

C. All storage tanks will be provided with adequate fire protection systems and retaining walls to contain any leakage and prevent the migration of oil into other systems, such as yard drainage.

D. The switchyard transformers will be filled with approximately 32,000 gallons of oil total per 500 MW. The transformers located in the turbine building will contain approximately 1,100 gallons of Pyranol, or equivalent, non-flammable liquid.

E. All transformers will have retaining curbs to contain spills. The Pyranol, or equivalent, non-flammable liquid will be drummed for shipment back to its manufacturer for disposal.

F. Oil and grease for normal plant lubrication requirements will be stored in an oil storage room of fireproof construction.

G. Electro-hydraulic control system fluid will be stored in drums.

3.5.1.5 Hydrogen, Carbon Dioxide, and Nitrogen - Hydrogen gas is used as a coolant in the generator and is stored in a separate facility away from the turbine building. The system will be designed for handling this gas with appropriate safety precautions. Carbon dioxide will be used in the generator purge system and fire protection system. Nitrogen may be stored on site for "nitrogen blanketing" of equipment to prevent corrosion during a plant shutdown.

3.5.1.6 Chlorine - Chlorine will be used as the biocide for plant cooling water systems. It will be stored on site in one-ton capacity containers located in appropriate storage facilities designed in accordance with the recommendations of the Chlorine Institute, Inc. Solvay type chlorine leak detectors will be provided at points of storage to alarm in the main control room in event of a chlorine leak. Self-contained breathing apparatus will be provided in storage at readily available locations to enable plant personnel to approach and control chlorine containers for maintenance in event of a chlorine leak.

3.5.2 Chemicals Used in Cooling Tower Operation

3.5.2.1 Chlorine - The tower system chlorination frequency may vary as much as twice per day in the warm summer months to once per week in the winter months. Chlorine will be used on an intermittent basis at the river pump intake to maintain piping free of slime and algae. Chlorine will be introduced to the cooling tower condenser system at the condenser circulating water pump suction. A chlorine residual controller with feedback, installed on the condenser discharge, will be used to limit the free residual at the condenser discharge to less than 1.0 MG/L to optimize feed for economy.

A chlorine storage and feed facility will be installed for chlorine injection in the circulating water system for each pair of units. A chlorinator and storage for eight one-ton containers will be installed for Units 1 and 2. A chlorinator and storage for 16 one-ton containers will be installed for future 2,000 MW expansion. A chlorinator and four one-ton containers will be installed for chlorination at the river-pump intake, for the ultimate 3,000 MW, to prevent fouling in the make-up water lines.

3.5.2.2 Supplementary Biocides - There exists the possibility that chlorine alone will not be entirely sufficient as a tower water biocide. In the event that a special biocide is required, the use and disposal of such material will be consistent with applicable State and Federal regulations.

3.5.2.3 Tower Water Silt Control - In order to remove suspended solids and other particulate matter from the river water, dual media, compartmented filters will be used. The filters will be automatic backwashing type, initiating backwash upon high differential pressure across the filter bed. Interlocking controls will prevent simultaneous backwashing of two or more compartments. Any mud or silt that may accumulate in the tower basins will be removed to the bottom ash disposal area. 3

3.5.3 Plant Wastes

The generating plant waste volumes are given on a 500- or 1,000-MW generating capacity design basis. Since the proposed plant site is designed to provide a total of 3,000-MW generating capacity, the total plant site waste volumes will be six times greater than the 500-MW volumes. Table 3.5-1 gives the anticipated maximum discharge rates for the plant waste for the proposed generating plant up to 3,000-MW total capacity. Waste from the normal operating processes of the plant include the following:

A. Plant Operating Wastes

1. boiler blowdown
2. condensate polisher exhausted resins
3. make-up demineralizer regenerant waste
4. filter backwash
5. laboratory drains
6. power building floor drains (less oil and grease)
7. coal pile runoff
8. plant site rain water runoff
9. sanitary waste treatment effluent
10. oil and grease
11. spent make-up demineralizer resins
12. lime softener sludges 3
13. cooling tower blowdown and drift

B. Plant Cleaning Wastes

1. preoperational cleanup waste (acid, alkali, and fresh water)
2. periodic boiler cleaning waste
3. air preheater, boiler fireside, and precipitator wash
4. cooling tower desilting sump drains
5. periodic cooling tower basin cleanup waste (mud and other particulate material)

6. miscellaneous (wash water for vehicles, equipment, dirt, dust, etc.)

3.5.3.1 Plant Operating Wastes

3.5.3.1.1 Boiler Blowdown (Per 500 MW) - Boiler blowdown will normally be intermittent and will average approximately 10 gallons per minute (GPM) over a month's time. Boiler water pH is expected to average 10 and to contain 10 MG/L of phosphate in the form of trisodium phosphate. Some sodium sulfate and sodium silicate are expected to be present.

3.5.3.1.2 Condensate Polisher Exhausted Resin - By using a Powdex-type condensate polisher, exhausted resins are not chemically regenerated, but are replaced by new resins. This deletion of the need for chemical regeneration greatly reduces the amount of strong wastes generated by the plant. The exhausted Powdex resins will be transferred to the chemical 3 cleaning waste treatment system and any remaining exchange capacity in the resins will contribute to the treatment of the waste water. The resins will be removed from the softener with the lime sludge.

3.5.3.1.3 Make-Up Demineralizer Regenerate Waste (Per 1,000 MW) - The make-up demineralizer (well water influent) will normally require regeneration once per day. Each demineralizer train regeneration will have a total waste volume of approximately 20,000 gallons, making a total of 40,000 gallons waste volume for the regeneration of both trains of the demineralizer. This waste will be discharged to a regeneration waste basin for neutralization and forwarded to the waste water basin. Based on regeneration with HCL and NaOH, the waste will contain the following constituents:

	Milligrams per Liter as $CaCO_3$
Ca	4,174
Mg	1,108
Na	636
K	43 3
HCO_3	203
Cl	5,712
SO_4	46
pH	7
SiO_2 (as SiO_2)	426

3.5.3.1.4 Filter Backwash Waste (Per 1,000 MW) - The generating plant river make-up water, the plant make-up demineralizer, and the chemical cleaning waste treatment system will require filtration equipment to remove organic and suspended material.

The river make-up filters will have a capacity of 15,000 GPM and will normally be backwashed once per day. The backwash volume for these filters will be approximately 325,000 gallons. The backwash will be processed by a backwash treatment system.

The make-up demineralizer will have two, 260 GPM capacity, anthracite
filters that will require backwashing once per day. The backwash volume
will be approximately 6,500 gallons per filter. The gravity flow mixed 3
media filters in the chemical cleaning waste treatment system will have
a 150 GPM capacity and will normally be backwashed once a day. The
backwash volume for these filters will be approximately 3,250 gallons.
Filter backwash will be cycled from a backwash collecting sump to the
chemical cleaning waste basin.

3.5.3.1.5 Plant Laboratory Drains and Sampling Wastes - Waste from
the plant laboratory and sampling will be relatively insignificant in
volume to the other plant waste. The drains will be piped to the plant 3
waste water basin.

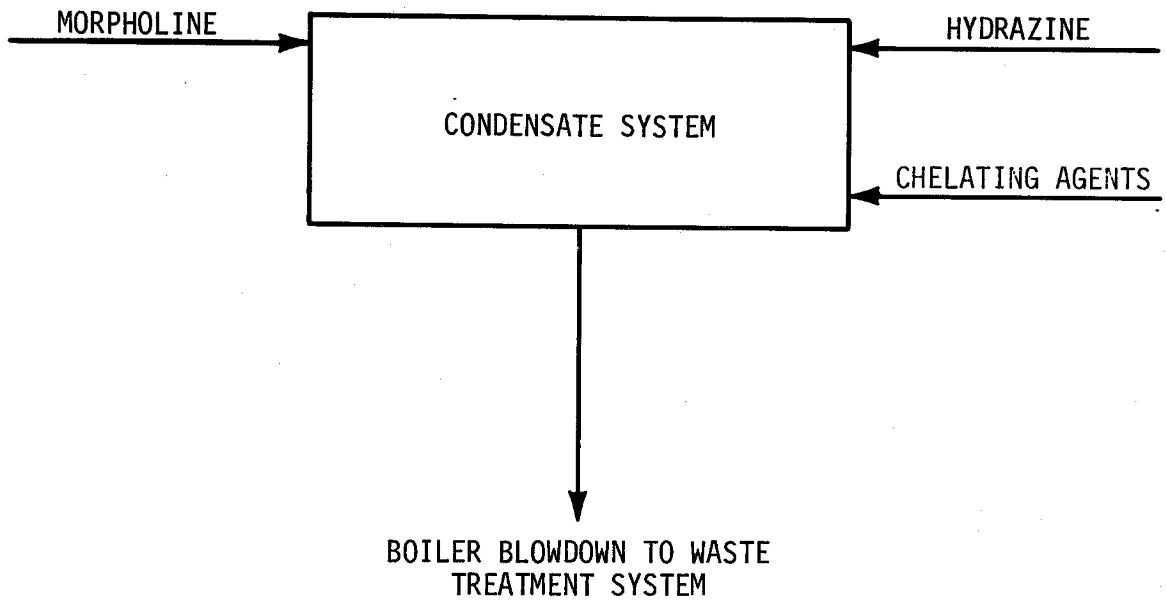
3.5.3.1.6 Power Building Floor Drains - Any drainage system such as plant floor drains subject to contamination by oil spills or leaking oil from equipment will be routed through oil/water separator equipment to remove oil before such water streams are combined for any additional treatment.

3.5.3.1.7 Coal Pile Runoff - Rainwater runoff associated with up
to a 10-year/24-hour rainfall event, and orginating from the coal storage
pile and coal conveyor drainage area, will be routed to detention Pond
"A." The pond will temporaily contain the runoff and allow for settling
of suspended solids. After settling, the water from the pond will be
pumped to either: (a) the bottom ash disposal area as make-up to the
bottom ash sluice system, (b) the fly ash disposal area as make-up to
the fly ash sluice system, or (c) the plant make-up water filters to 3
supplement plant make-up water. The water will be routed to the bottom
ash and fly ash disposal areas on an "as required" basis. Continuous
low-volume coal pile seepage collected between rainfall events will be
pumped to the bottom ash disposal area.

All rainfall runoff associated with more than a 10-year/24-hour rainfall event will overflow from Detention Pond "A" to Detention Pond "B." All overflow will be recorded by a weir head event recorder and monitored for suspended solids and pH.

What level rainfall will cause overflow in/hr.

3.5.3.1.8 Site Rain Water Runoff and Silt - To prevent unrestricted wash of silt into the navigable waters, rainwater runoff will be collected and routed to detention pond "B" via drainage ditches located throughout the site. (See figure 3.5-7.) Detention pond "B" temporarily contains rainwater runoff to provide a settling basin for silt and suspended material. After settling, the water will be control released and allowed to flow on its natural drainage course. All released water will be monitored to assure compliance with applicable State and Federal regulations.



GULF POWER CO.
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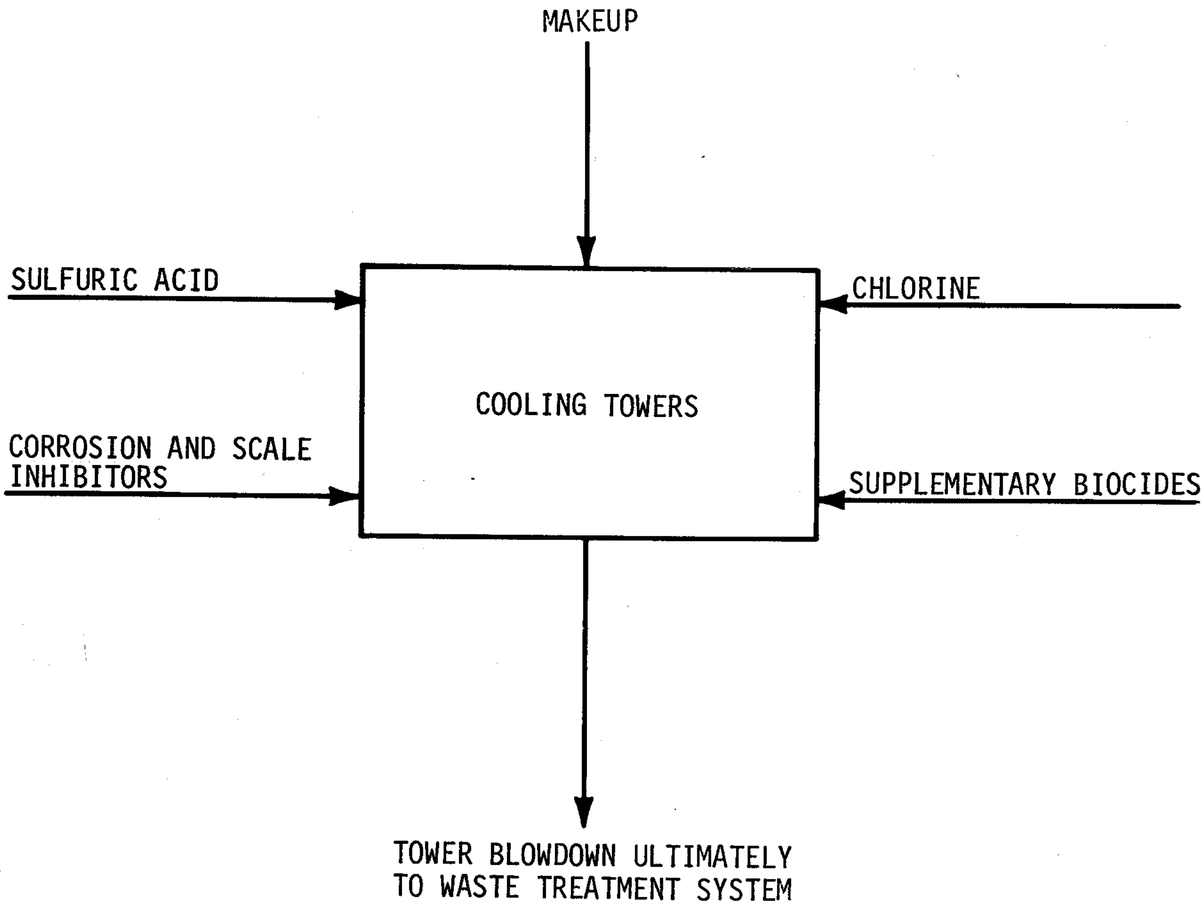
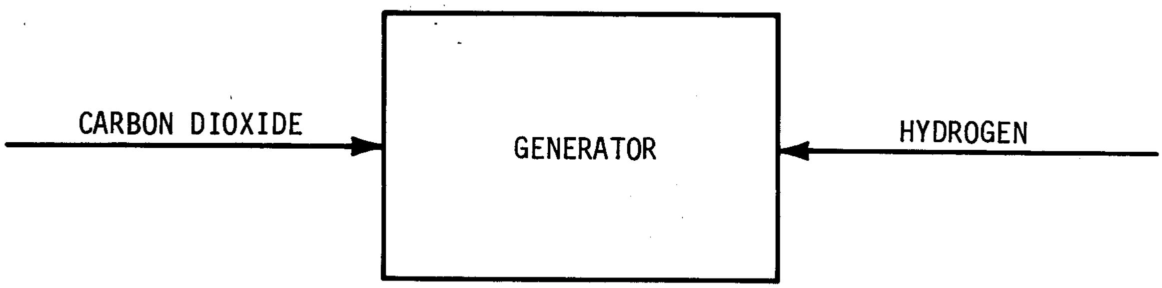
CHEMICAL USAGE - CONDENSATE SYSTEM

FIGURE 3.5-6



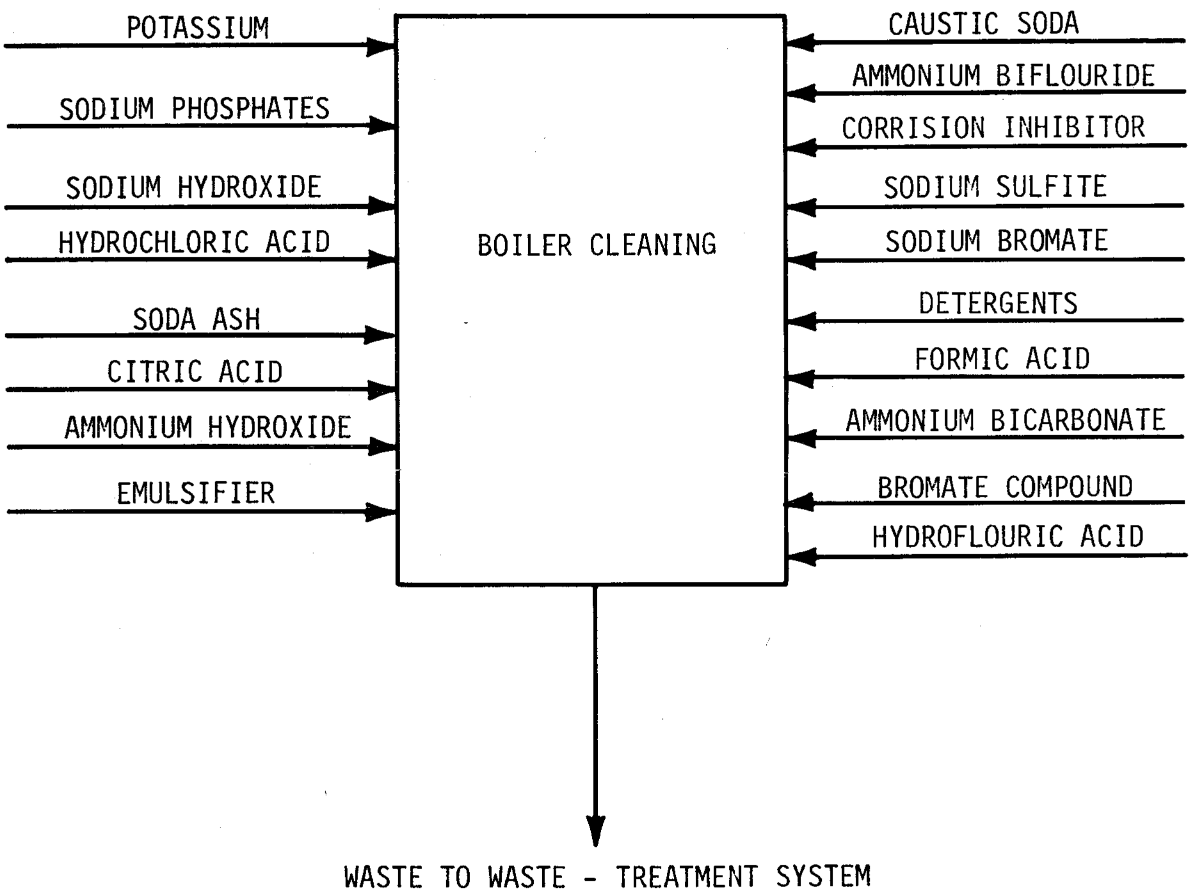
	GULF POWER CO. CARYVILLE STEAM PLANT	CHEMICAL USAGE - COOLING TOWERS
		FIGURE 3.5-5



GULF POWER CO.
CARYVILLE STEAM PLANT

GAS USAGE - GENERATOR

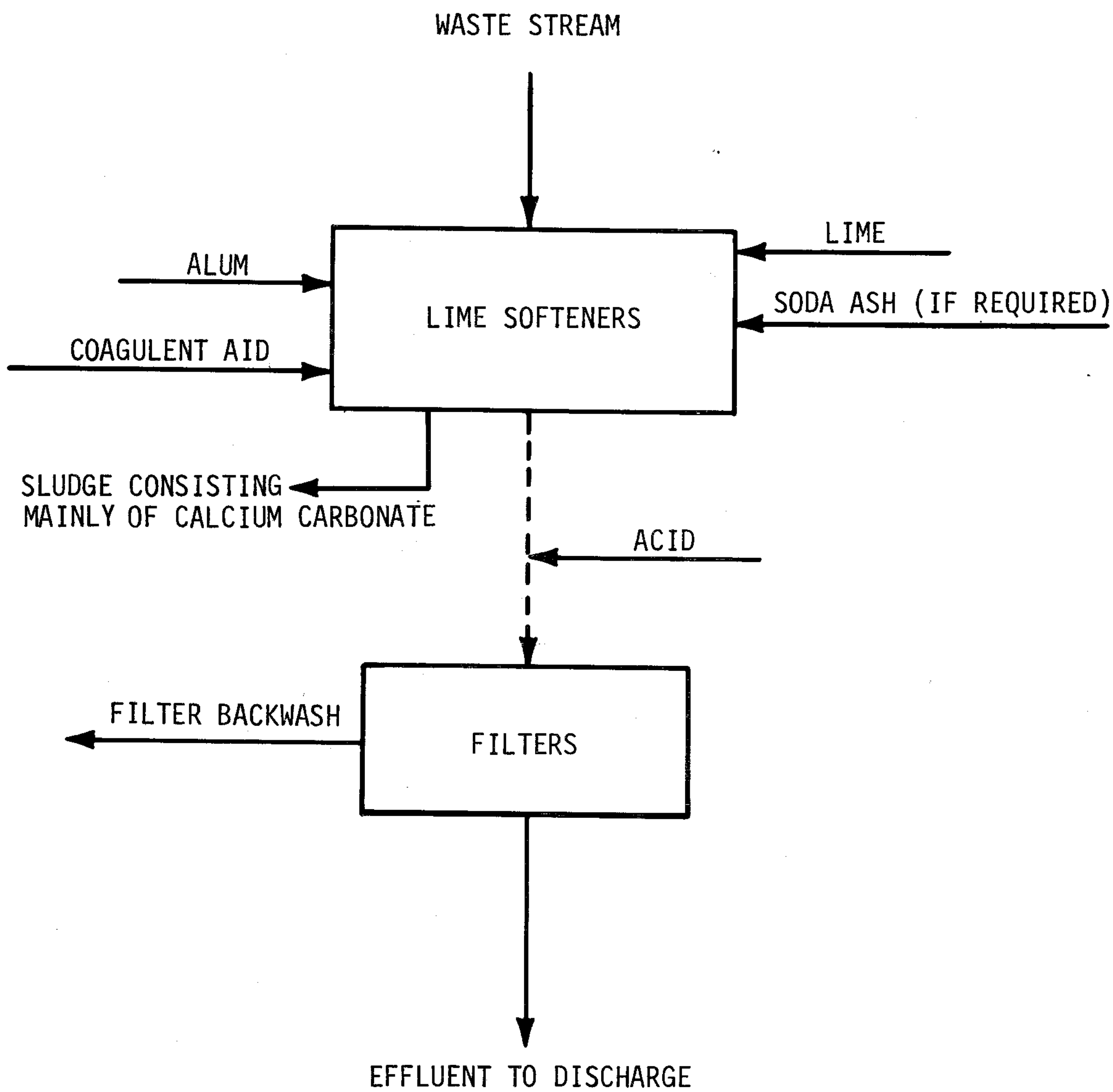
FIGURE 3.5-4



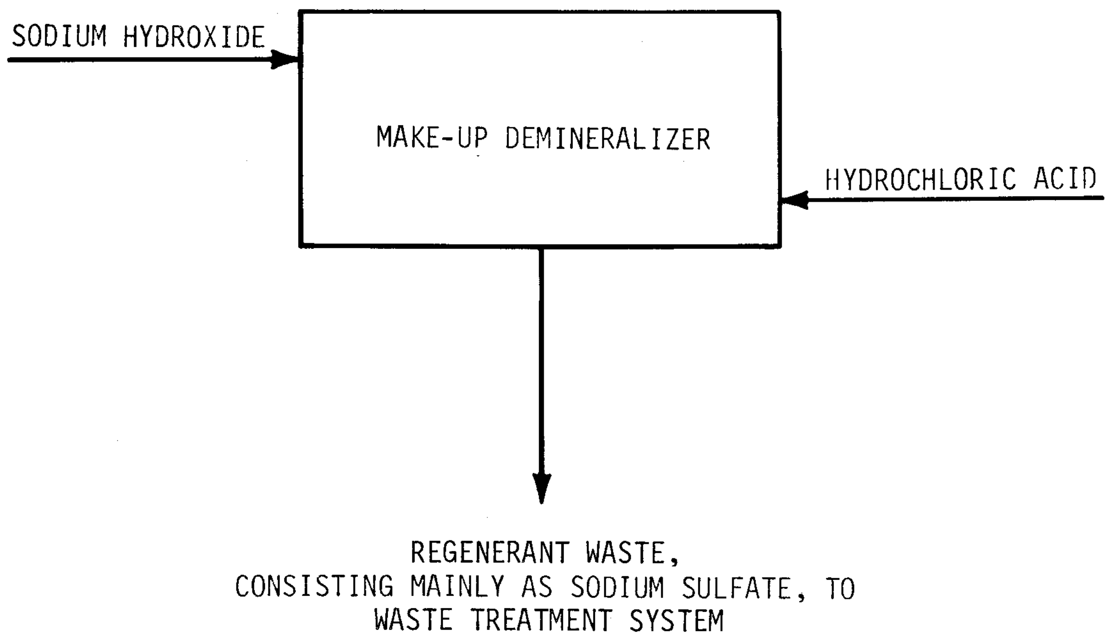
GULF POWER CO.
CARYVILLE STEAM PLANT

CHEMICAL USAGE - BOILER CLEANING

FIGURE 3.5-3



GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	CHEMICAL USAGE PLANT WASTE TREATMENT SYSTEM
		FIGURE 3.5-2



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GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	CHEMICAL USAGE MAKE-UP DEMINERALIZER FIGURE 3.5-1

TABLE 3.5-9

PREDICTED QUALITY AND QUANTITY OF TREATED WASTE WATER DISCHARGE FROM PLANT

Highest TDS Level

	Unit 1 500 MW	Units 1 & 2 1,000 MW	Total Site 3,000 MW
Discharge - GPM (CFS)	480 (1.07)	960 (2.14)	2,880 (6.42)
TDS (MG/L)	545	545	545
Constituents (MG/L)			
Calcium (CA)	14.0	14.0	14.0
Magnesium (Mg)	9.0	9.0	9.0
Sodium (Na)	118.5	118.5	118.5
Potassium (K)	5.4	5.4	5.4
Sulfate (SO_4)	271.8	271.8	271.8
Chloride (Cl)	30.1	30.1	30.1
Carbonate (CO_3)	1.3	1.3	1.3
Hydroxide (OH)	0.0	0.0	0.0
Silica (SiO_2)	26.4	26.4	26.4
Bicarbonate (HCO_3)	68.0	68.0	68.0
pH	8.3	8.3	8.3

MW = Megawatts
GPM = Gallons Per Minute
CFS = Cubic Feet Per Second
TDS = Total Dissolved Solids
MG/L = Milligram Per Liter

TABLE 3.5-8

PREDICTED QUALITY AND QUANTITY OF TREATED WASTE WATER DISCHARGE FROM PLANT

HIGHEST GALLONAGE

	Unit 1 500 MW	Units 1 & 2 1,000 MW	Total Site 3,000 MW
Discharge - GPM (CFS)	1,500 (3.34)	3,000 (6.68)	9,000 (20.06)
TDS (MG/L)	305	305	305
Constituents(MG/L)			
Calcium (CA)	6.5	6.5	6.5
Magnesium (Mg)	8.6	8.6	8.6
Sodium (Na)	52.2	52.2	52.2
Potassium (K)	5.6	5.6	5.6
Sulfate (SO_4)	114.0	114.0	114.0
Chloride (Cl)	23.5	23.5	23.5
Carbonate (CO_3)	1.3	1.3	1.3
Hydroxide (OH)	0.0	0.0	0.0
Silica (SiO_2)	25.0	25.0	25.0
Bicarbonate (HCO_3)	68.0	68.0	68.0
pH	8.3	8.3	8.3

MW = Megawatts
GPM = Gallons Per Minute
CFS = Cubic Feet Per Second
TDS = Total Dissolved Solids
MG/L = Milligrams Per Liter

TABLE 3.5-7

POUNDS OF SOLID CONTAINED IN COOLING TOWER DRIFT 3,000 MW

Cycles of Concentration

Make-Up Water	4	5	6	7	8	9	10
	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR
High Solids	240	300	372	438			
Medium Solids				384	438	492	
Low Solids					366	414	462

TABLE 3.5-6

POUNDS OF SOLIDS CONTAINED IN COOLING TOWER DRIFT 1,000 MW

Cycles of Concentration

Make-Up Water	4	5	6	7	8	9	10
	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR
High Solids	80	100	124	146			
Medium Solids				128	146	164	
Low Solids					122	138	154

TABLE 3.5-5

POUNDS OF SOLIDS CONTAINED IN COOLING TOWER DRIFT 500 MW

Cycles of Concentration

Make-Up Water	4	5	6	7	8	9	10
	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR	LBS/HR
High Solids	40	50	62	73			
Medium Solids				64	73	82	
Low Solids					61	69	77

TABLE 3.5-4

COOLING TOWER DRIFT CONSTITUENTS
LOW DISSOLVED SOLIDS MAKE-UP WATER

ELEMENT	CYCLES OF CONCENTRATION IN TOWERS (milligrams per liter as $CaCO_3$)		
	8	9	10
Calcium	129.6	145.8	162.0
Magnesium	32.8	36.9	41.0
Sodium	50.4	56.7	63.0
Potassium	0.8	0.9	1.0
Bicarbonate	135.7	149.6	161.5
Sulfate	28.4	36.2	44.0
Chloride	47.2	53.1	59.0
Nitrate	2.4	2.7	3.0
Silica (as SiO_2)	60.8	68.4	76.0
Free CO_2	7.2	7.2	7.2
pH	7.49	7.44	7.3
Total Dissolved Solids	337.0	381.0	425.0

TABLE 3.5-3

PREDICTED QUALITY OF PLANT DISCHARGE*

	MG/L AS $CaCO_3$
Calcium (Ca)	288
Magnesium (Mg)	35
Sodium (Na)	61
Potassium (K)	35
Bicarbonate (HCO_3)	44
Nitrate (NO_3)	2
Chloride (Cl)	40
Sulfate (SO_4)	329
Iron (PPM as Fe)	0.5
Silica (PPM as SiO_2)	2.0
pH	7.0

MG/L = Milligrams Per Liter
$CaCO_3$= Calcium Carbonate
PPM = Parts Per Million
*Calculated at normal discharge quantity of 12,441 gallons per minute per 3,000 megawatts. 27 cfs

TDS - ?

Phosphorous
chlorine
Suspended Solids

3

TABLE 3.5-2

CONSTITUENTS IN COOLING TOWER DRIFT
AT DESIGN CONDITIONS

POUNDS PER HOUR

	Unit 1 500 MW	Units 1 & 2 1,000 MW	Total Site 3,000 MW
Calcium (Ca)	18.7	37.4	112.2
Magnesium (Mg)	3.1	6.2	18.6
Sodium (Na)	8.5	17.0	51.0
Potassium (K)	2.6	5.2	15.6
Bicarbonate (HCO_3)	60.9	121.8	365.4
Sulfate (SO_4)	10.2	20.4	61.2
Chloride (Cl)	13.9	27.8	83.4
Nitrate (NO_3)	1.3	2.6	7.8
Silica (SiO_2)	20.8	62.4	187.2
Iron (Fe)	0.1	0.2	0.6

MW = Megawatts

3

TABLE 3.5-1

PLANT OPERATING AND CLEANING WASTE

Type of Plant Waste	Maximum Discharge Rate			
	Unit 1 500 MW	Units 1 and 2 1,000 MW	Total Site 3,000 MW	
Boiler Blowdown (gallons per minute)	10	20	60	
Make-Up Demineralizer Regenerant Waste (gallons per minute)	28	56	168	
Filter Backwash Waste (gallons per minute)	8	16	48	
Lime Softener Sludge (pounds per hour) (Dry basis)	60	60	60	3
Boiler Preoperational Cleaning Waste (gallons per minute)	300	300	300	
Condensate and Feedwater System Preoperational Cleaning Waste (gallons per minute)	300	300	300	
Boiler Acid Cleaning Waste (gallons per minute)	300	300	300	
Air Preheater, Boiler "Fireside," and Precipitator Cleaning Waste (gallons per minute)	300	300	300	
Sanitary Waste Treatment Effluent (gallons per minute)	3	5	7	3

1,000 MW	Base	$6,400,000
3,000 MW	Base	$19,200,000

3.5.3.4.4 Reverse Osomosis/Evaporation System - The varied conditions of the waste product streams to be treated will require extensive pretreatment and filtration to ensure the proper operation and life of the membranes used in the reverse osmosis system. A basic design of a reverse osmosis system requires a waste reject stream. This reject stream will be about 10 percent of the influent waste flow, contain 90 percent of the solids of the influent, and will require evaporation prior to final disposal. Based on the required treatment of the reject stream and including the high economic cost differential, as shown below, the reverse osmosis/evaporation does not make a viable alternative for the waste treatment at the proposed steam plant.

Site Size	Lime Softener	Reverse Osmosis/ Evaporation Additional Cost over Lime Softener
500 MW	Base	$4,200,000
1,000 MW	Base	$8,400,000
3,000 MW	Base	$25,200,000

3.5.3.4.5 Conclusion - Lime softener treatment was chosen to be the most econonmical, technically feasible, and environmentally viable waste treatment process for the proposed plant. The system requires no extensive pretreatment for the majority of plant wastes treated (99 percent by volume). Also, this treatment system has been operated effectively in a number of industries and has low operating and equipment costs associated with it.

3.5.3.5 Plant Discharges - The plant will have two monitored points of discharge: (a) the treated waste water effluent and (b) detention pond "B." (See figure 3.5-7.)

3.5.3.5.1 Plant Waste Treatment Discharge - Treated waste from the waste treatment system will travel to the Choctawhatchee River via one pipe line. Refer to table 3.5-8 and 3.5-9 for quality and quantity of treated waste discharge. A detailed discussion of the waste treatment system is contained in subsection 3.5.3.3, "Plant Waste Treatment Systems." All discharged water will be monitored for potential pollutants. (See figure 3.5-7.)

3.5.3.5.2 Detention Ponds - Detention pond "B" and associated drainage ditches will accommodate yard rain water runoff and associated oil free drainage to prevent unrestricted washing of silt into the public waterways. Water collected by this pond will be monitored upon controlled release and allowed to flow through the natural course.

There will be an emergency overflow spillway from the ash water wet pit to detention Pond "B". This overflow will be monitored and will normally have zero flow. The spillway is intended for use only in event of an extremely large and/or prolonged rainfall event as protection for ash basis dikes. This very infrequent discharge will be routed through the plant detention pond. (See the plant monitoring diagram shown in figure 3.5-7.)

3.5.3.3.6 Low-Volume Waste - The following low-volume wastes produced by the plant will be routed to the waste water basin:

A. Boiler Blowdown
B. Make-up Demeralizer Filter Backwash
C. Oil-Free Turbine and Boiler Building Floor Drains
D. Oil-Free Sample Drains
E. Treated Chemical Cleaning Waste
F. Oil-Free Tractor Garage Floor Drains
G. Lab Drains

The collected composite waste will be monitored for pH, flow, suspended solids, and oil and grease before being routed to the cooling tower blowdown line for discharge. If any of the monitored parameters are in violation of EPA or FDER rules, appropriate equipment will be selected and installed for treatment and compliance.

While boiler blowdown is not classified by EPA as a low-volume waste, it is treated as such in this waste management scheme due to its volume and quality. The proposed plan would provide a monthly grab sample of boiler blowdown to monitor for iron and copper to prove that these materials are within effluent limits for discharge. 3

3.5.3.3.7 Alternate Waste Treatment - As discussed in subsection 3.5.3.3.5 above, installation of waste treatment equipment, except for treatment associated with waste streams of a known quality, has been deferred until additional design information has been collected. This deletion will assure the installation of necessary, efficient, and environmentally and economically acceptable treatment equipment.

3.5.3.4 Plant Discharge - The plant will have teo monitored points of discharge: (a) tower blowdown with composite waste and (b) detention pond "B." (See figure 3.5-7.)

Tower blowdown with waste water from the waste water basin and ash sluice bleed-offs will be discharged to the Choctawhatchee River via one pipeline. Refer to table 3.5-3 for quality and quantity of waste discharge. All discharged water will be monitored for potential pollutants. (See figure 3.5-7.)

Detention pond "B" and associated drainage ditches will accommodate yard rain water runoff and associated oil free drainage to prevent unrestricted washing of silt into the public waterways. Water collected by this pond will be monitored upon controlled release and allowed to flow through the natural course. 3

There will be an emergency overflow spillway from the bottom ash and fly ash disposal areas to detention Pond "B." This overflow will be monitored and will normally have zero flow. The spillway is intended for use only in event of an extremely large and/or prolonged rainfall event as protection 3

for ash basin dikes. This very infrequent discharge will be routed through the plant detention pond. (See the plant monitoring diagram shown in figure 3.5-7.)

The softener effluent will require recarbonation for pH adjustment and filtration for the removal of the carry-over of suspended solids. The filter effluent will be monitored for flow, pH, suspended solids, iron copper, and oil and grease. If any of these parameters are in violation of applicable regulations, the waste will be recycled to the chemical cleaning basin for retreatment. If the parameters are within the established limits, the waste will be routed to the waste water basin for ultimate discharge.

When a lime slurry is needed for pH adjustment in the neutralizer system, treatment of the chemical cleaning waste will be discontinued. Plant service water will then be processed through the lime softener and filtered without the recarbonation process. The filter effluent, at a pH of approximately 11, will be pumped to the regenerant waste neutralizer as a supply of alkalinity. The process would provide the needed alkalinity at less expense than using sodium hydroxide to neutralize excess acidity in the make-up demineralizer wastes.

When processing cleaning waste, lime softener sludge will be continuously rejected from the softener at approximately eight to ten percent solids by weight. The sludge will be processed through a concentrator to be dewatered to approximately 35 percent solids by weight. Approximately three pounds per minute of operation of sludge at 35 percent solids will
be produced. However, the waste requiring treatment will be produced on 3
an infrequent basis. The liquid from the dewatered sludge will be collected with the treatment system's filter baskwash and recycled to the chemical cleaning waste basin.

The softener sludge will exist mainly as calcium carbonate; however, due to the nature of the waste treated, heavy metal contaminates are expected to be present. To prevent any leaching of the metals from the sludge due to landfill disposal operations, the sludge will be placed in sealed, leak-proof containers.

3.5.3.3.3 Lime Softener Sludge - Lime softener sludge existing mainly as calcium carbonate ($CaCO_3$) will be continuously rejected from the softener at approximately eight to ten percent solids by weight. The sludge will be processed through a concentrator to be dewatered to about 35 percent solids by weight. The liquid from the dewatered sludge will be routed to the chemical cleaning waste basin.

3.5.3.3.4 Filtration - In order to remove any suspended solids that carry over from the softener, the line softener effluent from the treatment system will be filtered. Spare capacity to allow for a compartment being backwashed is included.

Filter backwash is collected in a backwash collecting sump and is returned to the chemical cleaning waste basin. Effluent from the filters is routed to the waste water basin.

3.5.3.3.5 Plant Operating Waste Treatment - The basic philosophy of the operating waste treatment plan is to provide sufficient flexibility in the plant design for the future installation of additional waste treatment equipment, if required, while closely adhering to the rules and regulations adopted by the Environmental Protection Agency (EPA) and Florida Department of Environmental Regulation (FDER). This philosophy of permitting design flexibility was adopted due to the peculiarities associated with the treatment of waste produced by fossil-fired electric generating units.

Each fossil-fired plant produces waste streams that are unique in quality and constituent levels. There is no method to accurately predict which constituent or parameter in a waste stream, if any, will exist in polluting quantities. Therefore, there is no standard or optimum method of treatment which can be applied universally to process these wastes and comply with discharge standards.

Only after a unit is operating will a waste stream be produced. Thus, the design of a waste treatment method must be selected after operation to assure reliable, efficient, and economical waste control. Present design plans include the initial installation of waste treatment equipment to process waste streams that, based on historical operating data, contain known constituents.

3.5.3.3.5.1 Ash Sluice Bleed-Off - Under CFR (Code of Federal Regulations) Title 40, Parts 425.15 (d) and (e), bottom ash transport water and fly ash transport water are addressed as separate waste streams with separate restrictions on the quality and quantity of transport water discharged. To best comply with these limitations, bottom ash and fly ash transport water remain segregated throughout the ash sluicing process. However, due to the many variables involved which influence the resulting characteristics of the waste streams, waste treatment equipment has not been installed. Selection of this equipment has been deferred until an accurate waste stream analysis has been obtained so the necessity and type of treatment required can be evaluated. Provisions have been included in the plant design to allow for future installation of treatment equipment.

3.5.3.3.5.2 Backwash Treatment System - Due to the large amount of filtering capacity (45,000 GPM) required for future plant make-up, approximately 700 GPM per 3,000 MW of filter backwash will be produced. To reduce water wastage in the plant system, a 1,000 GPM tube settler clarifier treatment system will be installed for removing suspended solids from the backwash. The treatment system will reject the suspended solids in a concentrated stream at approximately 30 GPM. The concentrated stream will be routed to the bottom ash disposal area to allow settling of the solids and serve as partial make-up to the bottom ash sluicing system. The treatment system's processed effluent (approximately 670 GPM) will be routed to the pretreatment filter to serve as make-up to the circulating water system. This system will use maximum water usage and minimum water wastage.

To ensure the neutralization of acid used in cleaning, the boiler will
be rinsed twice with water and boiled out with an alkaline solution such
as caustic soda and sodium phosphate. The total volume of the operational
boiler cleaning operation is estimated to be 360,000 to 540,000 gallons
per boiler.

This waste will be collected in the chemical cleaning waste basin for
treatment by the 150 GPM chemical cleaning waste treatment system and 3
ultimate discharge.

<u>3.5.3.2.2.2 Air Preheater, Boiler Fireside, and Precipitators Wash
(Per 500 MW)</u> - The surfaces of the air preheater, boiler fireside furnace
walls, and precipitator hoppers will be washed down during unit outages.
Wash water from these operations will be collected in a waste sump for
treatment through the chemical cleaning waste treatment system. Wash- 3
water volume for the air preheater wash is estimated to be 60,000 to
120,000 gallons, the boiler wash 120,000 to 240,000 gallons, and the
precipitator hopper 60,000 gallons.

<u>3.5.3.2.2.3 Cooling Tower Desilting Sump Drains</u> - The cooling
tower cold water basin will have desilting sumps to flush silt and small
debris from the tower basin on a periodic basis, depending on the rate
of silt buildup. This sump drain will be piped to the bottom ash disposal
area for disposal. 3

<u>3.5.3.2.2.4 Cooling Tower Basin Cleanup Waste</u> - In addition to the
desilting sump drain, during scheduled outages, the cold water basin of
the towers may require periodic cleanup of sand, mud, and debris. This
material will be trucked to a suitable place on the site, the bottom ash 3
disposal area, or the lime sludge disposal area.

<u>3.5.3.2.2.5 Miscellaneous Plant Cleaning Waste</u> - Plant cleaning
operations such as equipment wash down, cleaning of floors, etc., will
have to be performed at the plant. The drain system will take this type
of waste to the waste water basin, bottom ash disposal area, or detention 3
pond depending on the quality of the waste stream.

<u>3.5.3.3 Plant Waste Treatment Systems</u>

<u>3.5.3.3.1 Regenerate Waste Neutralization System</u> - A neutralizing
system will be used to systematically collect and neutralize chemical
wastes generated by equipment cleaning and the make-up deminerlizer
regenerate waste. 3

The regenerate waste (180,000 gallons per day 3,000 MW maximum) will be
collected in a common regeneration waste basin and will be pumped to
the waste water basin via one of the following three routes:

Route No. 1 - From the regeneration waste basin, through the batch neutralizers, to the waste water basin;

Route No. 2 - From the regeneration waste basin, through the chemical cleaning waste treatment system, to the waste water basin; or

Route No. 3 - From the regeneration waste basin directly to the waste water basin.

Route No. 1 will be the normal procedure followed when processing the regenerate waste. The composite waste is expected to be acidic and will require neutralization before being routed to the waste water basin. Provisions will be installed for routing a lime slurry from the chemical cleaning waste treatment system to the neutralizer, resulting in the addition of alkalinity and a neutral pH value. The waste will than be routed to the waste water basin.

In the event the neutralizer is out of service, the lime slurry will be routed directly to the regeneration waste basin. The valves and piping from the basin would be adjusted to a recycle mode to allow the basin's forwarding pumps to circulate the waste and ensure mixing. A pH indicator will be located in the recycle piping. When the waste reaches a neutral pH value, the recycle mode will be discontinued and the solution forwarded to the waste water basin.

Route No. 2 will be used on an abnormal emergency basis. In the event more regenerate waste is produced than the capacity of the regeneration waste basin, the excess flow will be routed to the chemical cleaning waste treatment system. The treated waste will then be forwarded to the waste water basin.

Route No. 3 will be used when the collected regenerate waste is at a neutral pH. The neutralizer and the chemical cleaning waste treatment system will be bypassed and the waste routed directly to the waste water basin.

3.5.3.3.2 Chemical Cleaning Waste - All waste produced from preoperational boiler tube cleaning, periodic boiler tube cleaning, boiler fireside washes, and air preheater washes will be collected in a chemical waste basin. Before entering the chemical cleaning waste basin, all waste will be processed through an oil/water separator for the removal and drumming of any oil contaminants. After the waste is collected, a grab sample will be taken to determine the pH. If the solution is extremely acidic, a lime slurry mixture will be added to the basin and the waste circulated until the pH is adjusted to a minimum of 5.5. When a suitable pH is reached, the waste will be processed by a 150 GPM lime softener for the removal of metals, hardness, and suspended solids.

Detention pond "B" will be constructed during the initial stage of plant
development to contain rainwater runoff during construction as well as
after plant completion.

3.5.3.1.9 Sewage Plant - The sewage from the plant will be processed
by an aerobic digestion unit. Effluent from the sewage treatment system 3
will be processed through the chemical waste treatment system. A further
discussion is contained in section 3.6, "Sanitary and Other Wastes'
Systems."

3.5.3.1.10 Plant Oil and Grease Wastes - Oil and grease wastes are
expected to be at a minimum at the plant site. Retaining walls will be
built around all large volume tanks to prevent the unrestricted flow of
oil. The liquid from the building sumps will be passed through oil
separators before going to the plant waste treatment system. Oil collected
at oil separators will be drummed and ultimately disposed of by burning
in the boiler. 3

3.5.3.1.11 Spent Make-Up Demineralizer Resins - The spent ion-exchanger
resins will be put in containers and disposed of as land fill on site.

3.5.3.1.12 Lime Softener Sludges - Refer to subsection 3.5.3.3 below.

3.5.3.1.13 Cooling Tower Blowdown - The plant cooling tower will
maintain a blowdown to control dissolved and suspended material that
would naturally concentrate in the tower system. The tower system will
be sized for a blowdown of approximately 1,429 GPM at four cycles of
concentration for a 500 MW capacity. At four cycles of concentration,
the tower blowdown will be approximately 8,574 GPM for 3,000 MW plant 3
capacity. The blowdown will be discharged to the Choctawhatchee River.

3.5.3.1.14 Cooling Tower Drift - To reduce the amount of drift
escaping from the cooling towers, state-of-the-art drift eliminators
will be used. These high efficiency drift eliminators reduce the amount
of drift to a maximum of 0.008 percent of the circulating water flow,
equaling approximately 90 GPM per 3,000 MW.

The total dissolved solids (TDS) and constituents in the drift are the 3
same as contained in the cooling tower blowdown. The quality of blowdown --
which in turn means the quality of drift--is dependent upon the make-up water
quality and the cycles of concentration at which the cooling tower is
operated. The pounds of solids contained in the drift at design conditions
are shown in table 3.5-2. Refer to section 5.2, "Effect of Chemical and
Biocide Discharges," for effects of cooling tower drift.

3.5.3.2 Plant Cleaning Wastes

3.5.3.2.1 Preoperational Cleanup Waste (Per 500 MW) - The generating
plant requires system flushing and chemical cleanup before initial
operation of the turbine generator.

3.5.3.2.1.1 Boiler - Preoperational cleaning of the boiler requires an alkaline boil out, using sodium phosphates and caustic soda or equivalent combination, and two water rinses. An acid cleaning of five percent hydrochloric acid and then a wetting agent, or equivalent combination, may preceed the two water rinses. After the acid cleaning step, if used, and water rinses, a second alkaline boil out may be required. The combined economizer and circulation system volume of the boiler requiring cleaning is 90,000 gallons. The total volume of preoperational waste is estimated at 460,000 to 550,000 gallons. This waste will be collected in a chemical cleaning waste basin and routed to the chemical cleaning waste treatment system.

3.5.3.2.1.2 Condensate and Feedwater System (Per 500 MW) - The condenser and feedwater system will require a high-velocity flushing, hot-alkaline wash, and possibly an acid cleaning before initial unit startup. The estimated volume of the condensate/feedwater piping and equipment is 136,000 gallons per 500 MW. The chemical requirements for this cleaning, in pounds, are estimated to be as follows:

A. trisodium phosphate	6,000
B. disodium phosphate	3,000
C. soda ash	11,000
D. detergent	1,000
E. hydroxyacetic - formic acid	34,000
F. citric acid	1,200

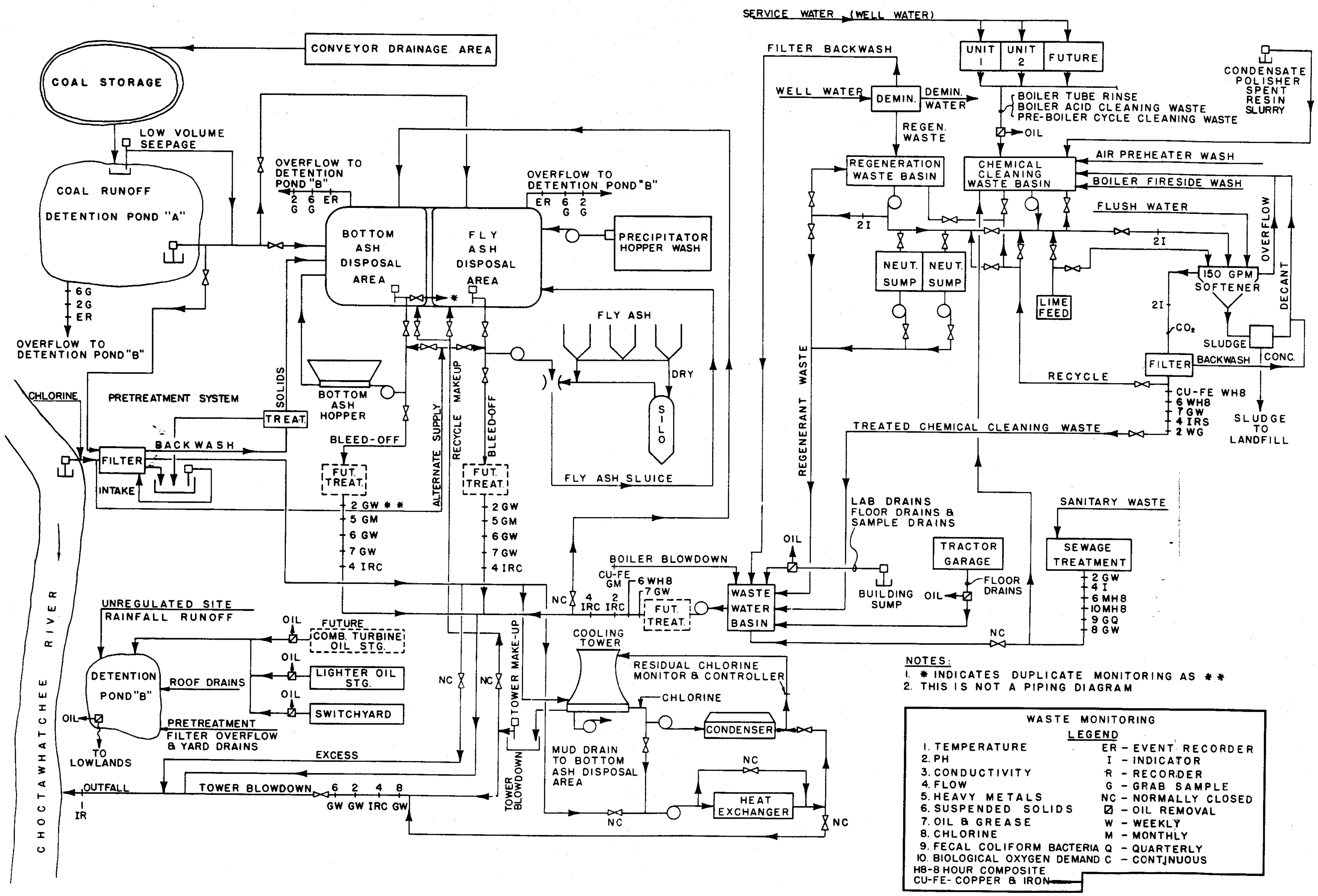
Total volume of waste from the initial system cleaning is anticipated to be 660,000 to 796,000 gallons. The plant pre-operational waste will be sent to the chemical clearing waste basin for treatment by the 150 GPM softener and ultimate discharge.

Oil and grease removed in the hot alkaline wash will be removed from the waste stream by the use of an oil skimmer.

3.5.3.2.2 Periodic Cleaning Waste

3.5.3.2.2.1 Boiler Acid Cleaning Waste (Per 500 MW) - The boiler is estimated to require chemical cleaning once every two to four years for the removal of copper iron oxides and silica bearing materials. The volume of the boiler requiring cleaning is approximately 90,000 gallons.

For removal of copper, the boiler will be cleaned with ammonium bicarbonate, ammonia, and a bromate compound. An acid cleaning using five percent hydrochloric acid with ammonium bifluoride and inhibitor will follow.



Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

WATER AND WASTE FLOW

FIGURE 3.5-7

3.6

Staff 150

3.6 Sanitary and Other Wastes' Systems

This section addresses the plant's sanitary waste water system and ash handling system. Other waste produced in the plant operation such as laboratory, operational, and chemical cleaning wastes are described in section 3.5, "Chemical and Biocide Waste."

3.6.1 Sanitary Waste Water System

Gulf will provide a sanitary waste water system consisting of a prefabricated, digestion-type sewage treatment plant capable of treating approximately 15,000 gallons per day of domestic sewage. The plant will include a comminutor and clarifier in addition to an aeration chamber. Chlorinated, effluent waters from the sanitary waste treatment system will be passed to the plant's filter/backwash collecting sump and will be processed by the waste-water treatment system before being discharged off site as treated waste water. This additional treatment will further reduce any lingering organics, suspended solids, and bacteria.

Unit too large

at 20gal/per = 3000gal

3.6.1.1 Sanitary Waste Source - During normal operation of the plant, the personal hygiene activities of personnel will produce sanitary wastes. Sources are plant kitchen, drinking fountains, toilets, showers, and lavatories.

3.6.1.1.1 Collection and Processing - Sanitary waste will be collected and processed by methods unique to the period of plant development. For example, during construction of the plant, the use of portable toilets will be employed. Urinals will also be provided on site where the waste will be collected in tanks. During plant operation, a permanent sanitary waste system will be used which has been designed to provide the on-site sewage treatment necessary for normal plant operations and shut-down periods.

Disposal of Port-O-Let wastes — ?

3.6.1.1.2 Inspection and Testing - Gulf personnel will periodically inspect and test the sanitary waste water system's effluent to ensure that the plant (a) is operating as specified, and (b) will meet the standards established by the State and County Boards of Health.

3.6.1.2 Alternatives - Alternatives to the chosen system would be (a) disposal of sewage through a local municipal system, which is not available, or (b) a septic tank/field system. The prefabricated digestion-type treatment system, subsection 3.6.1 above, eliminates any possibility of ground water contamination by sewage waste water.

3.6.1.3 Solid Waste - There will normally be no solids or sludges for disposal produced by the proposed sewage treatment system. In the event of system maintenance where sludge removal might be necessary, such sludges will be removed by a contractor licensed to handle such material.

No sludge ?

3.6.2 Ash Handling System

3.6.2.1 Bottom Ash - Bottom ash (ash which falls to the bottom of the boiler) will be collected in an ash hopper located beneath the boiler and removed by a continuous ash sluicing process. Sluice water will pass through the hopper, removing the ash, to the north end of the ash disposal area "A" for ultimate disposal. At the south end of the ash disposal area "A", sluice water will overflow into the ash sluice wet pit, combine with tower blowdown, and be recycled for ash sluicing. Variable amounts of the combined water will be bled into the waste treatment system for treatment and discharged to the river. (See figure 3.3-11.) Gulf predicts approximately 7,000,000 tons of bottom ash will be produced during the life of the 3,000 MW plant.

3.6.2.2 Fly Ash - Gulf will collect fly ash (ash carried upward by hot gases) with high efficiency electrostatic precipitators. The fly ash will then be removed from the precipitator hoppers by either sluicing to ash disposal area "A" or by blowing it into a silo and disposing of it in a landfill in a previously designated and approved area. Fly ash sluicing will employ recycled ash sluice water and can be performed independently or simultaneously with bottom ash sluicing. Gulf is pursuing an active marketing program to dispose of fly ash as a concrete additive or as roadway base stabilization. No market for this ash is currently available.

Fly ash FGD - wet limestone stabilization

3.6.2.3 Alternatives - No alternative other than those listed above are available for disposal of the ash.

3.7

3.7 Air Emissions

3.7.1 Compliance with Standards and Regulations

Gulf will comply with all Federal and State ambient air quality standards and other applicable regulations at the Caryville site. The manner of compliance is reflected in subsections 3.7.1.1 and 3.7.1.2 below.

3.7.1.1 Sources of Emissions - Coal combustion releases gaseous waste emissions into the air. Principally, these emissions include particulates (fly ash), oxides of sulfur, and oxides of nitrogen. To achieve and maintain compliance with applicable air quality regulations, Gulf's base design for control of these emissions involves using low sulfur coal, a boiler designed to reduce nitrogen oxides, electrostatic precipitators, and tall stacks to enhance atmospheric dispersion.

3.7.1.2 Comparison of Emission Control Methods

3.7.1.2.1 Particulates - There are three commonly used methods of removing particulates from flue gases: mechanical collectors, bag collectors, and electrostatic precipitators. Mechanical collectors do not have the necessary efficiency to meet air quality standards. Bag collectors are the most expensive type but, more importantly, are still relatively new and unproven to the power industry for large central stations. Properly designed, electrostatic precipitators are the most economical and efficient collectors to meet air quality standards. Gulf will install electrostatic precipitators between the boiler and the air preheater. These devices, commonly called precipitators, will meet air quality standards on particulate emissions as established in Chapter 17-2, Florida Administrative Codes, of any fuel within the ranges shown in subsection 3.2.1, "Coal."

3.7.1.2.2 Sulfur Dioxide (SO_2) - As stated in subsection 3.2.1.5, "Contracts," Gulf is presently negotiating for a low-sulfur coal as its base design to limit sulfur dioxide emissions to that required by Federal and State air quality standards. However, sufficient room is being left in the plant layout to install flue-gas desulfurization (FGD) equipment in the event low sulfur coal is not available or FGD equipment is deemed necessary to meet air quality regulations.

3.7.1.2.3 Nitrogen Oxide (NO_x) - The only proven method to limit NO_x emissions is in the combustion process. Boiler design to accomplish the reduction is a requirement placed on the boiler manufacturer (Foster Wheeler). The boilers are guaranteed by the manufacturer to limit NO_x emissions to meet air quality standards and emission limitations.

3.7.2 Stacks

Gulf will install a single stack with two steel liners to serve Units No. 1 and 2. Plans for future plant expansion include additional stacks

to serve additional units. Figures 3.1-1, -2, and -3 show the arrangement and location of the stacks. As discussed in subsection 3.1.2.4, "Stacks", modeling of gas emissions is being conducted to determine stack heights which will give good gas dispersion. However, a stack height of 700 feet above surface elevation is expected. Gulf will install stack sampling ports that meet the requirements of both the EPA and the State of Florida. 2

3.7.3 Gas Data

3.7.3.1 Gas Emission Rates - Volumes, velocities, total mass flows, and temperatures of stack gas emissions vary depending upon the load on the unit and the amount of excess air required to obtain good combustion without undue slagging of the boiler. Assuming a rather poor coal (10,000 British thermal units (BTU) per pound), using 25 percent excess air and operating at a steaming rate of 3,600,000 pounds per hour per 500 megawatts (MW), then gas volumes, velocities, total mass flows, and temperatures will be as follows:

	Unit No. 1 500 MW	Units 1&2 1,000 MW	Total Site 3,000 MW
Gas Volume (cubic feet per minute)	1,730,000	3,460,000	10,380,000
Stack Exit Gas Velocity (feet per minute)	4,500 to 6,000	4,500 to 6,000	4,500 to 6,000
Gas Mass Flow (pounds per hour)	5,424,000	10,848,000	32,544,000
Stack Inlet Gas Temperature (°F)	266±	266±	266±
Stack Exit Gas Temperature (°F)	255	255	255

3.7.3.2 Gas Emission Rate Limits - The gas temperature shown in subsection 3.7.3.1 above are expected where flue-gas desulfurization equipment is not used. Should there be a need for flue-gas desulfurization, temperatures could be some 80°F to 100°F lower, depending upon equipment design. Gas flows are not expected to exceed 110 percent of those shown in subsection 3.7.3.1 above when operating the boilers at maximum steam capacity during overpressure operation.

3.7.3.3 Gas Composition - The approximate composition of gas exiting the stack(s) is as follows:

Constituent	Micrograms Per Meter Cubed ($\mu g/m^3$)
Sulfur Dioxide	889,061

2

Constituent	Micrograms Per Meter Cubed ($\mu g/m^3$)
Particulates	74,088
Nitrogen Oxides	518,619

2

3.7.4 Other Emissions

Other gaseous emissions which will originate at the plant are from the diesel engines of fire protection equipment, plant personnel automobiles, and internal combustion engines used during construction. However, these emissions will all be small and infrequent.

3.8

3.8 Associated Transmission Facilities

The first two 500-megawatt generating units of the Caryville plant will require five new 230,000-volt (230 kilovolt (kV)) transmission lines to integrate the power output of the plant into the existing Gulf transmission system. Proposed corridor-route locations of these transmission lines and segments thereof are shown on figure 3.8-1. Figure 3.8-2 shows existing 46-kV, 115-kV, and 230-kV lines in addition to the proposed new lines.

The proposed transmission corridor system will be approximately 115 miles in length. Of this total length, only 33 miles (29 percent) of the corridor will require routing through areas where existing transmission corridor segments do not presently occur, while 82 miles (71 percent) of the corridor will parallel existing transmission route segments. This information has been tabulated by major segments for comparison purposes as shown in table 3.8-1.

3.8.1 Transmission Line Description

A. Caryville/Shoal River No. 1, 230-kV Line (CSR1) - This line will originate at the Caryville plant and terminate at the Shoal River substation south of Crestview, Florida. The length of this line will be approximately 49 miles, of which 1.42 miles will be new routing to be shared with the Caryville/Smith No. 1 and 2 lines. 2
(See figure 3.8-1, sheets 1 through 7.) Additional routing information is contained in tables 3.8-1 and -2. The proposed in-service date is 1979.

B. Caryville/Smith No. 1, 230-kV Line (CS1) - This line will originate at the Caryville plant and tap into the existing Shoal River/Smith 230-kV line. The length of this line will be approximately 16 miles, of which 1.42 miles will be new routing to be shared as described in 3.8.1A above and 3.0 miles will be new routing to be shared with the Caryville/Smith No. 2 line. (See figure 3.8-1, sheets 6 and 7.) Additional routing information is contained in tables 3.8-1 and -2. The proposed in-service date is 1979.

C. Caryville/Smith No. 2, 230-kV Line (CS2) - This line will originate at the Caryville plant and tap into the existing Shoal River/Smith 230-kV line. The length of this line will be approximately 16 miles, of which 3.0 miles will be new routing to be shared with the Caryville/Smith No. 1 line. (See figure 3.8-1, sheets 6 and 7.) Additional routing information is contained in tables 3.8-1 and -2. The proposed in-service date is 1979.

D. Caryville/Holmes Creek 230-kV Line (CHC) - This line will originate at the Caryville plant and terminate at the Holmes Creek substation north of Graceville, Florida. The length of this line will be approximately 22 miles, of which 8.95 miles will be new routing.

(See figure 3.8-1, sheets 7 through 9.) Additional routing information is contained in tables 3.8-1 and -2. The proposed in-service date is 1981.

E. Caryville/Laguna Beach 230-kV Line (CLB) - This line with originate at the Caryville plant and terminate at the Laguna Beach substation. The length of this line will be approximately 41 miles, of which 19.7 miles will be new routing. (See figure 3.8-1, sheets 7 through 15.) Additional routing information is contained in tables 3.8-1 and -2. The proposed in-service date is 1983. 2

3.8.2 Noise, Ground Currents, and Ozone

Due to the design and construction standards employed, coupled with operating experience to date, no adverse environmental impact is expected to occur during normal operation of the 230-kV transmission facilities.

3.8.2.1 Radiated Electrical and Acoustic Noise - Foreign-deposited particles such as airborne contaminants or sharp points and abrasions on electrical conductors and equipment are the usual sources of generated corona discharges on these items. In this connection, transmission line hardware and electrical equipment for operation at 230 kV are required to be factory tested and guaranteed to assure corona-free performance up to the maximum operation voltage level.

Coupled with these requirements, the normal line design and construction standards should result in essentially corona-free operation for these transmission facilities. Accordingly, radiated electrical noise generation (1,2,3,4,5) and acoustic noise generation (6,7) are expected to be minimal for normal operation of these transmission facilities.

During inclement weather and unusual atmospheric conditions, an audible humming may be heard directly under the 230-kV lines.

3.8.2.2 Induced or Conducted Ground Currents - During normal operating conditions for the balanced three-phase operation of the 230-kV lines, the ground-level electromagnetic field produced is insignificant under the line. This small field results in minimal induced and conducted ground currents. The electrostatic field produced at ground level for this operating condition is expected to be below the level of human perception (8,9).

3.8.2.3 Ozone Production - Ozone can be produced from corona discharges in the operation of transmission lines and substations, particularly at extra-high voltages.

Battelle Memorial Institute completed extensive field tests in 1972 to determine the effects of ozone in the vicinity of 765-kV lines under a variety of meteorological conditions (10). From these tests, it was concluded that no significant adverse effects on vegetation, animals, or

humans are to be expected from the levels of ozone that may be produced in this operation of transmission facilities at voltages up to 765 kV. The proposed transmission voltages associated with the Caryville plant are below this level.

3.8.3 Access Roads and Facilities

No access roads or maintenance roads into the transmission corridors will be constructed. The existing county road system as shown on figure 2.2-1 will be used for access and maintenance. The vehicles used for maintenance will be capable of transversing the transmission lines' rights-of-way in their natural state without the need for road improvements. With the exception of the new substation facilities to be constructed on the Caryville plant site proper, no new facilities will be required.

3.8.4 Land Use Along Rights-Of-Way

Presently, Gulf is not planning any other uses of its transmission line rights-of-way. Existing ground cover will be left in place and maintained. Gulf will obtain as easement from the property owners. These existing property owners will be allowed to continue to utilize the land within the rights-of-way for the growing of crops and the grazing of livestock 2
as well as recreational and other uses consistent with construction, operation, and maintenance of the transmission lines themselves. (See figure 3.8-3.)

The land crossed by the proposed associated transmission lines is used primarily for agriculture; the entire area is predominately undeveloped land with some scattered rural residences. A small percentage of the adjacent land is also devoted to residential and recreational uses such as hunting and fishing. 2

Most of the land use along the transmission line rights-of-way is either undeveloped or agriculture. The adjacent area with the most development is located where the proposed transmission line crosses Florida Highway No. 81. At that juncture, a church lies just outside the rights-of-way, and two residences -- one a mobile home, the other a permanent structure -- lie within the proposed rights-of-way. To the east of Florida Highway No. 181, a residence is located adjacent to the transmission line right-of-way. Two residences are located adjacent to the proposed right-of-way line just to the west of U. S. Highway No. 331.

Construction of the associated transmission lines will require cutting of all trees and vegetation greater than six inches in height throughout the length of the corridor. Widths to be cleared for the proposed transmission lines are listed in tables 3.8-1 and -2. No changes in 2
topography are expected from physical disturbances associated with movement and use of machinery to be employed in various aspects of clearing, construction, and maintenance of the corridor.

3.8.5 Aesthetics of Transmission Lines and Substations

Figure 3.8-4 indicates the areas where the transmission lines will be visible from frequently traveled roads and highways. The following list of ameliorative measures are those that may be used by Gulf to reduce the visibility of the lines at major paved road/transmission line junctures:

A. Gulf will ensure that the transmission line rights-of-way will utilize a distinct boundary consisting of vegetation rather than man-made fences.

B. Gulf will give attention to the design selection of the transmission line tower structures, attempting to make them blend with their surroundings.

C. Trees and foliage at these locations will be cut back only enough to provide proper clearance from conductors. The remaining trees and foliage will provide a natural screen.

D. The route used by maintenance vehicles will leave the public road and angle to the transmission lines' rights-of-way to prevent the cleared corridor from being visible from public roads.

The switchyard at the Caryville plant will be the only new substation associated with these new lines and will be within the plant site proper. Figure 3.8-5 shows a typical 230-kV switchyard. The structures in the substation will be of steel, and bus work will be low-profile tubing. (See figure 3.8-6.) The substation area will be fenced.

The respective design of the three typical types of transmission tower structures which Gulf could use is shown in figures 3.8-7, -8, and -9.

3.8.6 Comparison of Overhead and Underground 230-kV Transmission Lines

The estimated cost per mile of a 2,000 amp overhead circuit for installation in 1978 would be approximately $100,000. A study (11) showed that the per-mile cost of a similar underground circuit would be $1,090,000. With this major cost differential, Gulf cannot justify the expense to the customer of building an underground circuit where an overhead circuit could be built.

Maintenance of the lines must also be considered. An overhead metal structure line requires virtually no maintenance. Underground lines contain a gas-filled buss which is subject to frequent leaks. Such leaks are attendant with vehicular traffic, disturbance of the soil when locating the leaks, and construction-type wastes and debris created by the maintenance work.

3.8.7 Transmission Line Maintenance

During its operation phase, Gulf will operate and maintain its transmission lines, and lines' rights-of-way by the following activities:

A. annual inspection on foot or by vehicle

B. monthly aerial inspection

C. emergency patrol by vehicle and/or aerial in the event of damage to line by severe weather, etc.

D. initial clearing of vegetation using a farm-type tractor with a mowing and brush-cutting attachment and/or by hand as required. Subsequent clearing of brush in low-ground areas at intervals of one, two, or more years as necessary

E. clearing of dry areas of upland brush with mowing machinery approximately every three years or as needed

F. aerial application of herbicides as required in areas where the soil remains too wet for vegetation to be maintained by mechanical means

3.8.8 Vegetation Communities

The natural vegetation of this region has been described generally (12)
and is represented regionally in figure 3.8-10. Those vegetative
communities and their respective floral and faunal components expected
to be affected during transmission corridor routing are presented in
subsection 2.7.1.9, "Vegetation Communities and Wildlife: Analyses and 2
Description, and Vegetational Community Classifications." Vegetation
groups, community types, and subsections of 2.7.1.9 applicable to this
discussion on transmission lines are listed below.

VEGETATION GROUPS AND COMMUNITY TYPES	APPLICABLE SUBSECTIONS
Hydrophytic	2.7.1.9.1
Cypress Bayhead	2.7.1.9.1.1 and 2.7.1.9.1.2
Bayhead	2.7.1.9.1.3 and 2.7.1.9.1.4
Mixed Hardwood Swamp	2.7.1.9.1.5 and 2.7.1.9.1.6
Mesophytic	2.7.1.9.2
Mixed Mesophytic Hardwood	2.7.1.9.2.1 and 2.7.1.9.2.2
Mesophytic Pine Plantation	2.7.1.9.2.3 and 2.7.1.9.2.4

Xerophytic	2.7.1.9.3
Sandhill	2.7.1.9.3.1 and 2.7.1.9.3.2
Ruderal	2.7.1.9.4

Table 3.8-3 lists the major community types and the percentages of each occurring within a given segment of the proposed corridor. Idealized vegetational profiles of these communities, exclusive of pine flatwood, are presented as figures 2.7-12, -21, -29, -35, -40, and -44. Pine flatwood communities were not encountered during development of information for subsection 2.7.1.9; therefore, a description is presented below: 2

> These communities are open woodlands of long leaf pine (Pinus palustris), slash pine (Pinus elliottii), and pond pine (Pinus serotina). Shrubs, small trees, and a large number of herbs, especially saw palmetto (Serenoa repens), form the understory (12).
>
> Wildlife Components - The wildlife of this community should be similar to that of the mesophytic pine plantation as described in subsections 2.7.1.9.2.3 and 2.7.1.9.2.4 and also as listed in table 3.8-4 (13).

3.8.9 References

(1) Gary, C. and M. Moreau. Predetermination of the RI Level of High Voltage Transmission Lines: Part I - Predetermination of the Excitation Function, IEEE Paper No. 71 TP 661, Presented at the Summer Power Meeting, Portland, Oregon, 1971.

(2) Gary, C. and M. Moreau. Predetermination of the RI Level of the High Voltage Transmission Lines: Part II - Field Calculating Method, IEEE Paper No. 71-TP-662, Presented at the Summer Meeting, Portland, Oregon, 1971.

(3) Warburton, F. W., T. Liao, and N. Hoglund. "Power Line Radiation and Interference Above 15 MHz". IEEE Transactions on Power Apparatus and Systems, Vol. PAS-88, No. 10, pp. 1492-1501, October, 1969.

(4) Loftners, M. O. A Guide to the Correction of Fair Weather Television Interference, Conference Paper, C-74-058-4, Paper Presented at 1974 Winter Power Meeting in New York, January 27, to February 1, 1974.

(5) Clark, C. F. and M. O. Loftners. Some Observations of Foul Weather EHV Television Interference, Transactions Paper 70-TP-104-PWR, Presented at 1970 Winter Power Meeting in New York, January 25 to 30, 1970.

(6) Perry, D. E. "An Analysis of Transmission Line Audible Noise Levels Based upon Field and Three-Phase Test Line Measurements." IEEE Transactions on Power Apparatus and Systems, pp. 857-865, May-June, 1972.

(7) "A Guide for the Measurement of Audible Noise from Transmission Lines." Audible Noise Task Force of the Radio Noise Subcommittee of the IEEE T & D Committee, Paper No. 71-TP-657-PWR, dated May 11, 1971.

(8) Elek, A. "Electrostatic Induction Under 230 - and 460-kV Transmission Lines." Transmission and Distribution, May, 1963.

(9) Hedman, D. E. and R. E. Clayton. Report of a Study of Field Strengths for Gulf Power on the 115/230 kV Greenwood-Laguna Line, Power Technologies, Inc., Schenectady, New York, January, 1973.

(10) Frydman, M., A. Levy, and S. E. Miller. Oxidant Measurements in the Vicinity of Energized 765 kV Lines, IEEE T and D Committee paper T-72-SSI-0, presented at the IEEE PES Summer Meeting July 9-14, 1972, available for printing May 10, 1972.

(11) Feasibility Study for Gulf Power Company Destin to Wright 230 kV Transmission Line, Commonwealth Associate, Inc., Jackson, Michigan, October 17, 1974.

(12) Davis, J.H., Jr."General Map of Natural Vegetation of Florida." Florida Agr. Exp. Sta. Circ. S-178, 1967. 2

(13) Snedaker, S.C. and A.E. Lugo. Ecology of the Ocala National Forest, U.S. Forest Service, Atlanta, 1972.

TABLE 3.8-1

MAJOR TRANSMISSION CORRIDOR SEGMENTS COMPARING LENGTHS AND PERCENTAGES OF PARALLEL ROUTING AND NEW ROUTING REQUIREMENTS

THREE MAJOR LEGS AND SEGMENTS THEREIN	LENGTH (MILES)	LENGTH (PERCENT)	WIDTH (FEET)	AREA (ACRES)	
1. Caryville - Holmes Creek					
SEGMENTS					
Plant Switchyard (PS)-K	0.70	-	150.0	13.40	
K-H	2.50	-	75.0	22.73	
H-I	8.25	-	150.0	150.00	
I-J	10.50	-	75.0	95.50	
Parallel Routing	13.00	59.2	-	-	
New Routing	8.95	40.8	-	-	
Subtotal	21.95	100.0	-	-	
2. Caryville - Shoal River & Caryville - Smith					
SEGMENTS					
Plant Switchyard (PS)-A	1.42	-	300.0	51.65	
$A-A_1$	3.00	-	330.0	120.00	
A_1-B	6.50	-	275.0	216.90	
B-C	3.00	-	225.0	81.80	2
B-D	4.75	-	75.0	43.18	
D-E	9.00	-	100.0	109.00	
E-F	16.50	-	135.0	270.00	
F-G	8.00	-	85.0	82.42	
Parallel Routing	47.75	91.5	-	-	
New Routing	4.42	8.5	-	-	
Subtotal	52.17	100.0	-	-	
3. Caryville - Laguna Beach					
SEGMENTS					
Plant Switchyard (PS)-L	19.70	-	150.0	357.54	
L-M	21.50	-	120.0	312.73	
Parallel Routing	21.50	52.2	-	-	
New Routing	19.70	47.8	-	-	
Subtotal	41.20	100.0	-	-	
TOTALS					
Parallel Routing	82.25	71.3	-	-	
New Routing	33.07	28.7	-	-	
Total	115.32	100.0	-	1,926.85	

TABLE 3.8-2

APPROXIMATE RIGHTS-OF-WAY WIDTHS AND ACREAGE TO BE COMMITTED TO THE PROPOSED TRANSMISSION LINE CORRIDOR SYSTEM

TRANSMISSION CORRIDOR SEGMENT	APPROXIMATE WIDTH (FEET)			APPROXIMATE AREA (ACRES)		
	EXISTING	NEW	TOTAL	EXISTING	NEW	TOTAL
Plant Switchyard (PS)-A	-	300	300	-	52	52.0
$A-A_1$	100	330	430	36.4	120	156.4
A_1-B	100	275	375	78.9	217	295.9
B-C	-	225	225	-	82	82.0
B-D	100	75	175	57.6	43	100.6
D-E	150	100	250	163.6	109	272.6
E-F	200	135	335	400.0	271	671.0
F-G	250	85	335	242.4	83	325.4
Plant Switchyard (PS)-K	-	150	150	-	13	13.0
K-H	100	75	175	27.9	23	50.9
H-I	-	150	150	-	150	150.0
I-J	100	75	175	127.3	96	223.3
Plant Switchyard (PS)-L	-	150	150	-	357	357.0
L-M	100	120	220	260.6	313	573.6

2

TABLE 3.8-3

PERCENT COMPOSITION OF MAJOR COMMUNITY TYPES
WITHIN A 0.5* MILE CORRIDOR

VEGETATIONAL COMMUNITY TYPE	CORRIDOR SECTION**							
	PLANT SWITCHYARD (PS)-B	B-C	B-G	PS-I	I-J	PS-L	L-M	TOTAL**
Cypress Bayhead-Bayhead	22.9	13.8	13.8	27.3	5.2	15.6	9.6	15.5
Mixed Hardwood Swamp	7.5	0.0	0.9	0.0	0.0	2.5	2.1	1.9
Mixed Mesophytic Hardwood	21.4	3.3	2.0	4.0	11.9	2.4	3.1	6.9
Pine Flatwood	0.0	0.0	0.0	0.0	0.0	0.0	17.4	2.4
Pine Plantation	12.3	50.5	64.1	31.9	18.2	31.7	45.0	36.2
Sandhill	10.2	5.3	0.2	3.9	16.7	19.6	18.1	10.6
Ruderal	24.2	25.1	18.2	32.2	47.8	26.3	4.2	25.4
Open Water	1.5	1.9	1.0	0.7	0.2	1.9	0.5	1.1
TOTALS	100.0	99.9	100.2	100.0	100.0	100.0	100.0	100.0

*The 0.5 mile wide corridor is the zone of study. The actual transmission line rights-of-way corridor widths for the new corridors will be between 75 and 330 feet.

**All numbers shown are percentages.

2

TABLE 3.8-4

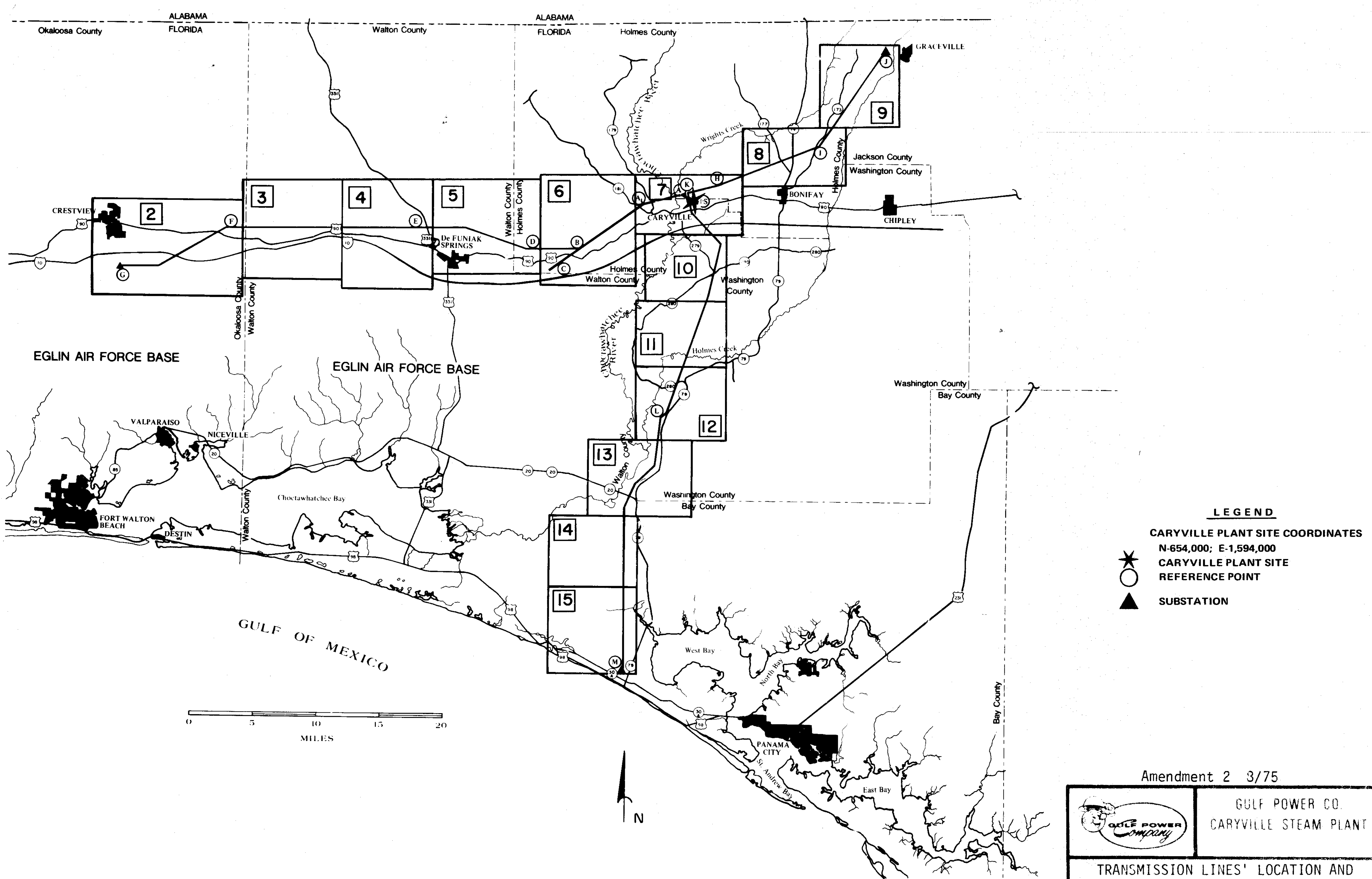
FAUNAL COMPONENT OF THE PINE FLATWOODS COMMUNITY

SCIENTIFIC NAME	COMMON NAME	
AMPHIBIANS		
Gastrophryne carolinensis	Eastern narrow-mouthed toad	
Acris gryllus	Cricket frog	
Hyla cinerea	Green tree frog	
Hyla ocularis	Little grass frog	
Pseudacris nigrita	Chorus frog	
Rana pipiens	Leopard frog	
Scaphiopus holbrooki	Eastern spadefoot	
Bufo terrestris	Southern toad	
Hyla femoralis	Piney-woods tree frog	
Hyla gratiosa	Barking tree frog	
Bufo quecicus	Oak frog	
REPTILES		
Rhadinea flavilata	Yellow-lipped snake	
Terrapene carolina	Box turtle	
Anolis carolinensis	Green anole	
Sceloporus undulatus	Eastern fence lizard	2
Ophisaurus ventralis	Eastern glass lizard	
Eumeces inexpectatus	Southeastern five-lined skink	
BIRDS		
Buteo lineatus	Red-shouldered hawk	
Grus canadensis	Sandhill crane	
Dendrocopos borealis	Red cockaded woodpecker	
Sitta pusilla	Brown-headed nuthatch	
Sturnella magna	Eastern meadowlark	
Colinus virginianus	Florida bob-white	
Parus bicolor	Rufted titmouse	
Polioptila caerulea	Blue-gray gnatcatcher	
Dendroica pinus	Pine warbler	
Richmondena cardinalis	Florida cardinal	
MAMMALS		
Sylvilagus palustris	Marsh rabbit	
Oryzomys palustris	Rice rat	
Sigmodon hispidus	Cotton rat	
Didelphis marsupialis	Opossum	
Blarina brevicauda	Short-tailed shrew	
Cryptotis parva	Least shrew	

TABLE 3.8-4 (Continued)

SCIENTIFIC NAME	COMMON NAME
Scalopus aquaticus	Eastern mole
Sylvilagus floridanus	Eastern cottontail
Sciurus niger	Fox squirrel
Peromyscus gossypinus	Cotton mouse
Peromyscus nuttalli	Golden mouse
Urocyon cinereoargenteus	Gray fox
Ursus americanus	Black bear
Procyon lotor	Raccoon
Mephitis mephitis	Striped skunk
Felis concolor coryi	Florida panther
Lynx rufus	Bobcat
Odocoileus virginianus	Whitetail deer

2

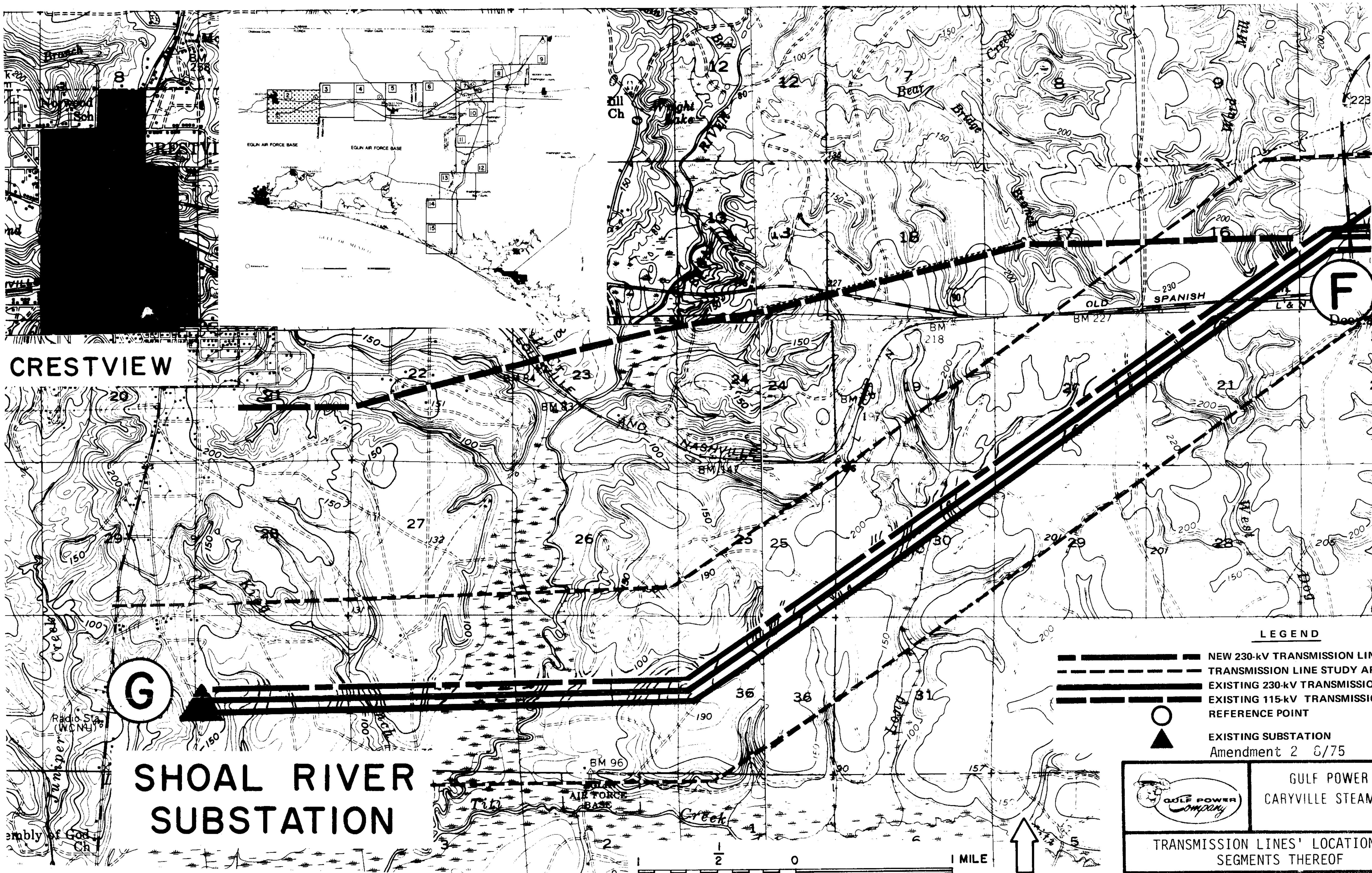


Amendment 2 3/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 1 of 15)

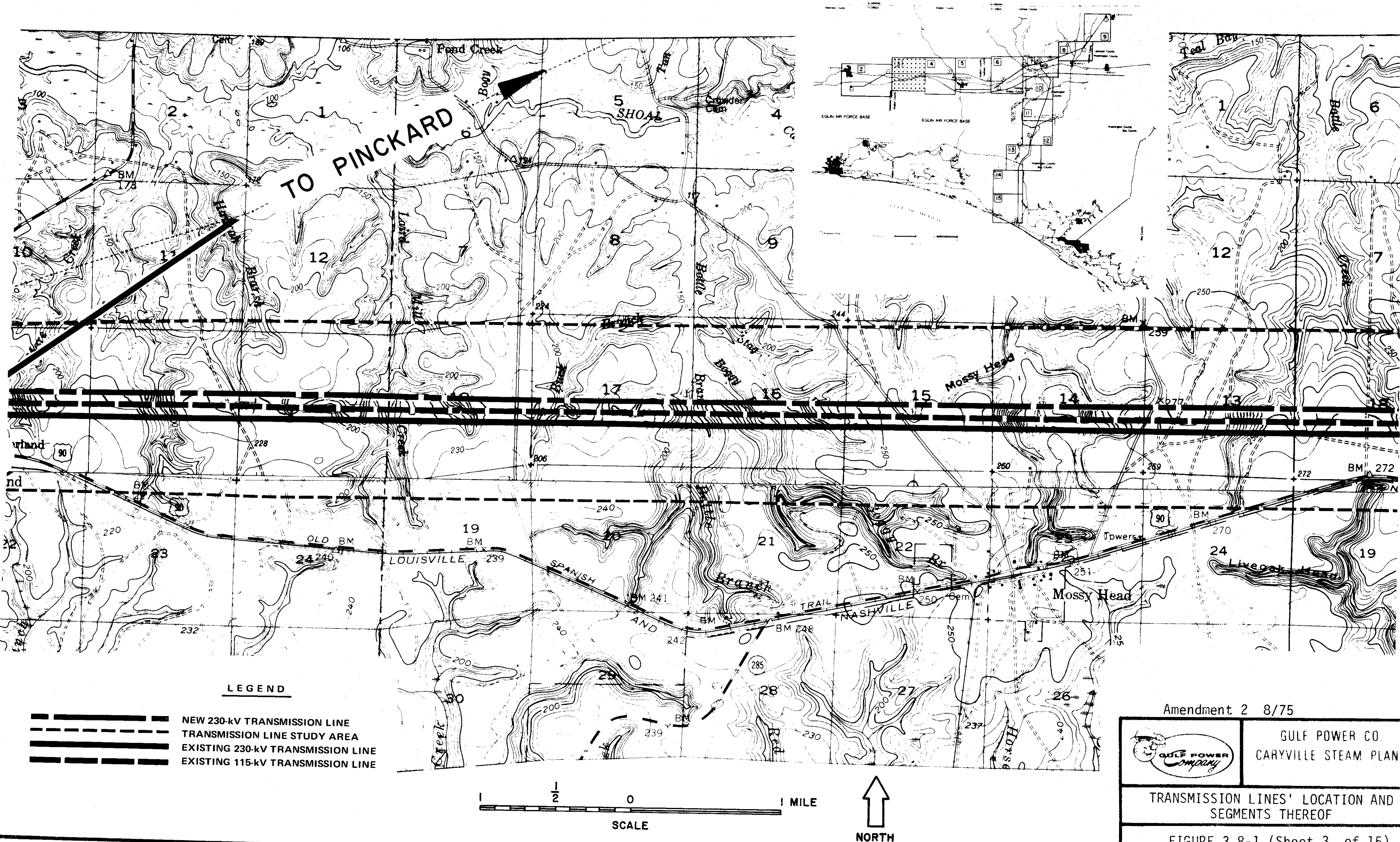


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 2 of 15)

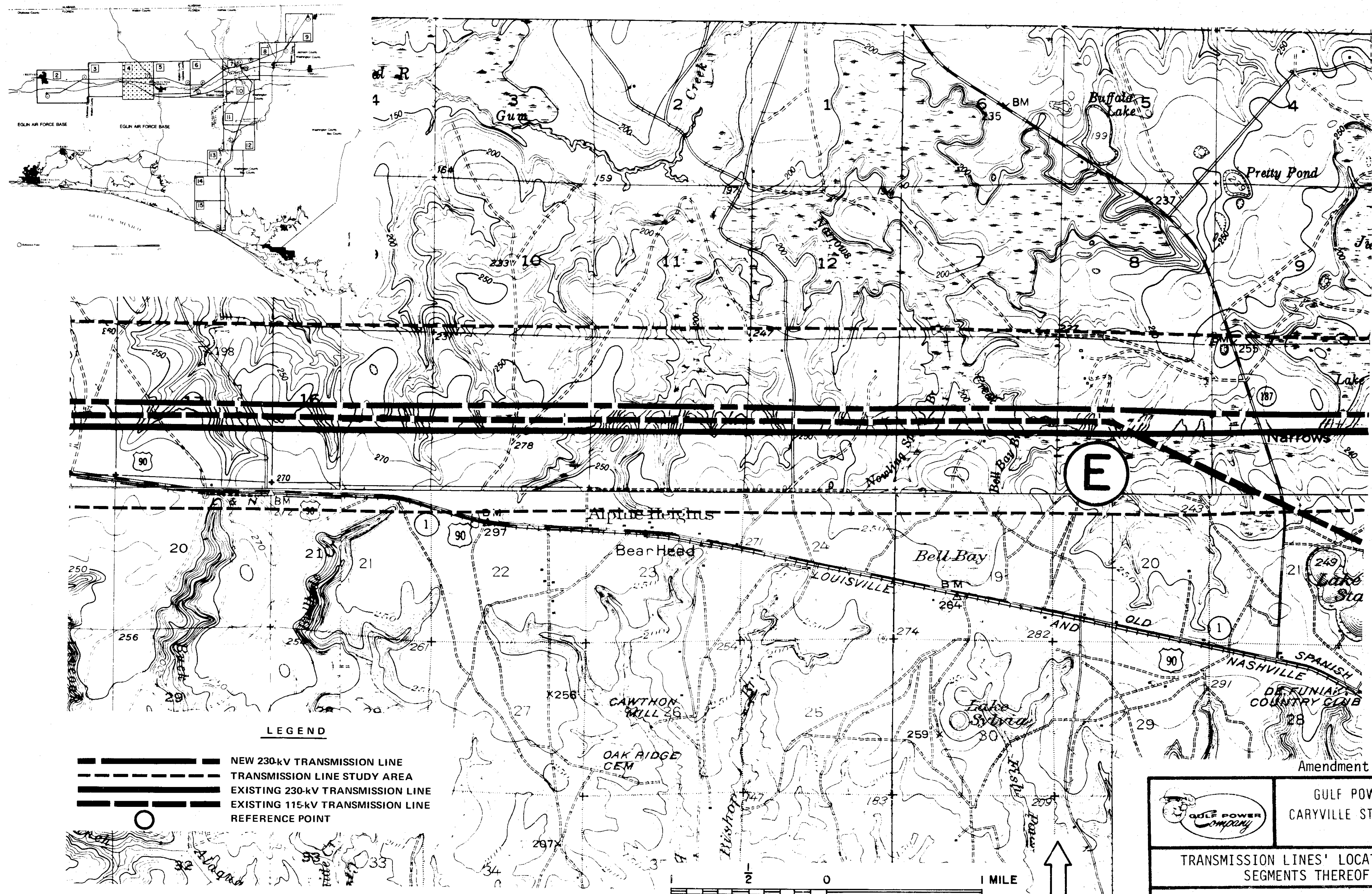


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 3 of 15)

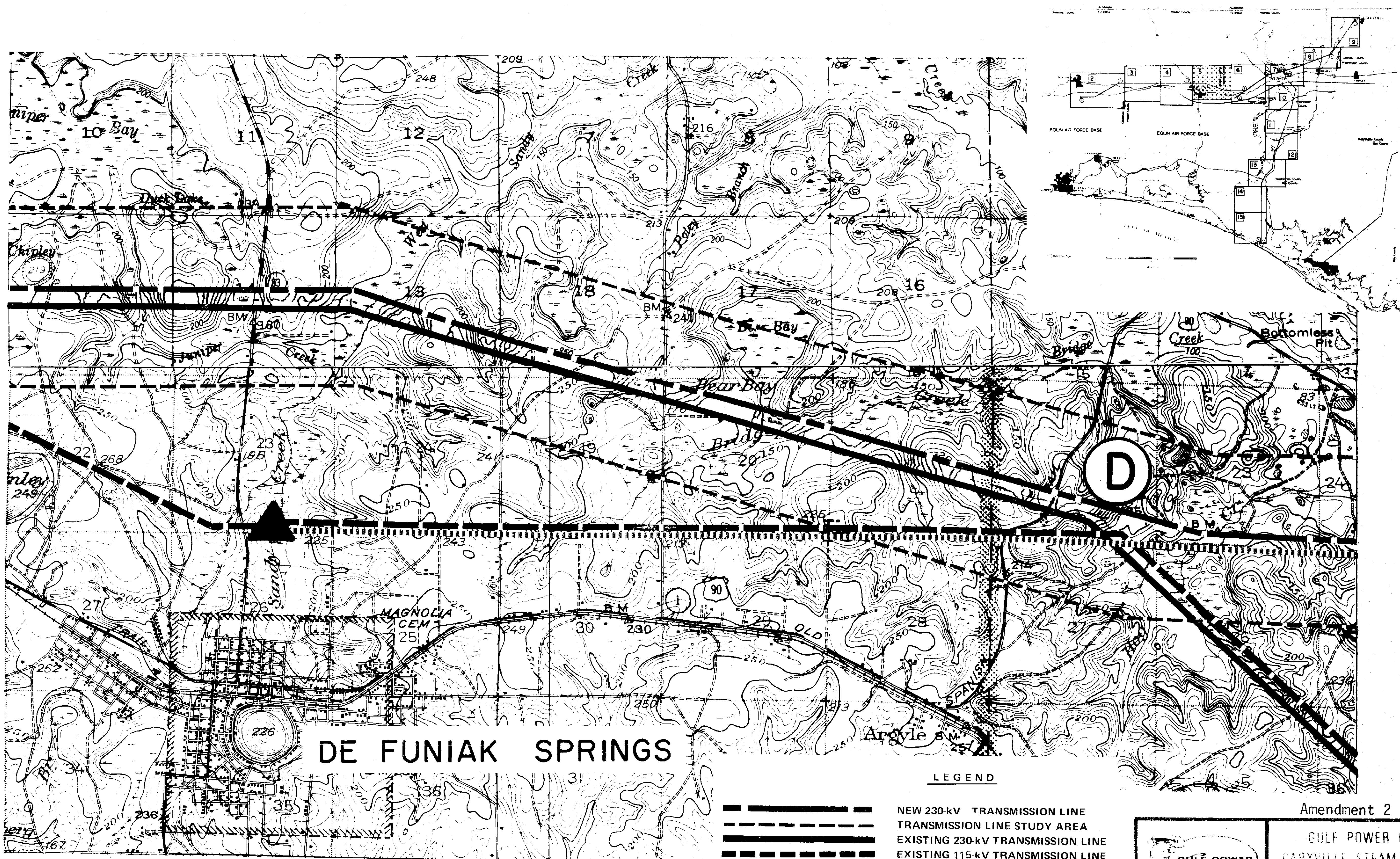


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 4 of 15)



LEGEND

- NEW 230-kV TRANSMISSION LINE
- TRANSMISSION LINE STUDY AREA
- EXISTING 230-kV TRANSMISSION LINE
- EXISTING 115-kV TRANSMISSION LINE
- EXISTING 46-kV TRANSMISSION LINE
- REFERENCE POINT
- EXISTING SUBSTATION

1 ½ 0 1 MILE
SCALE

NORTH

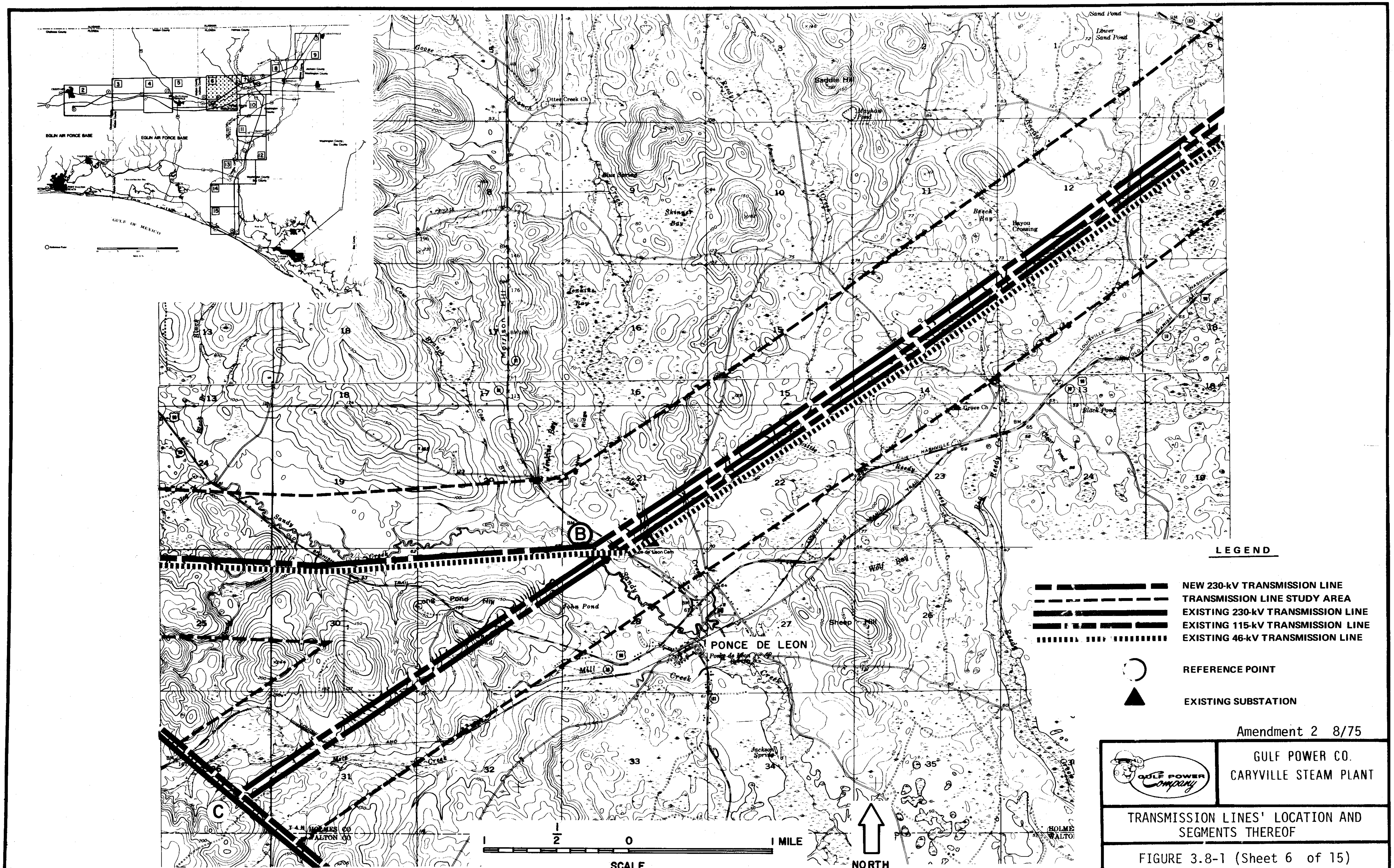
Amendment 2 8/75

GULF POWER COMPANY

GULF POWER CO
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 5 of 15)

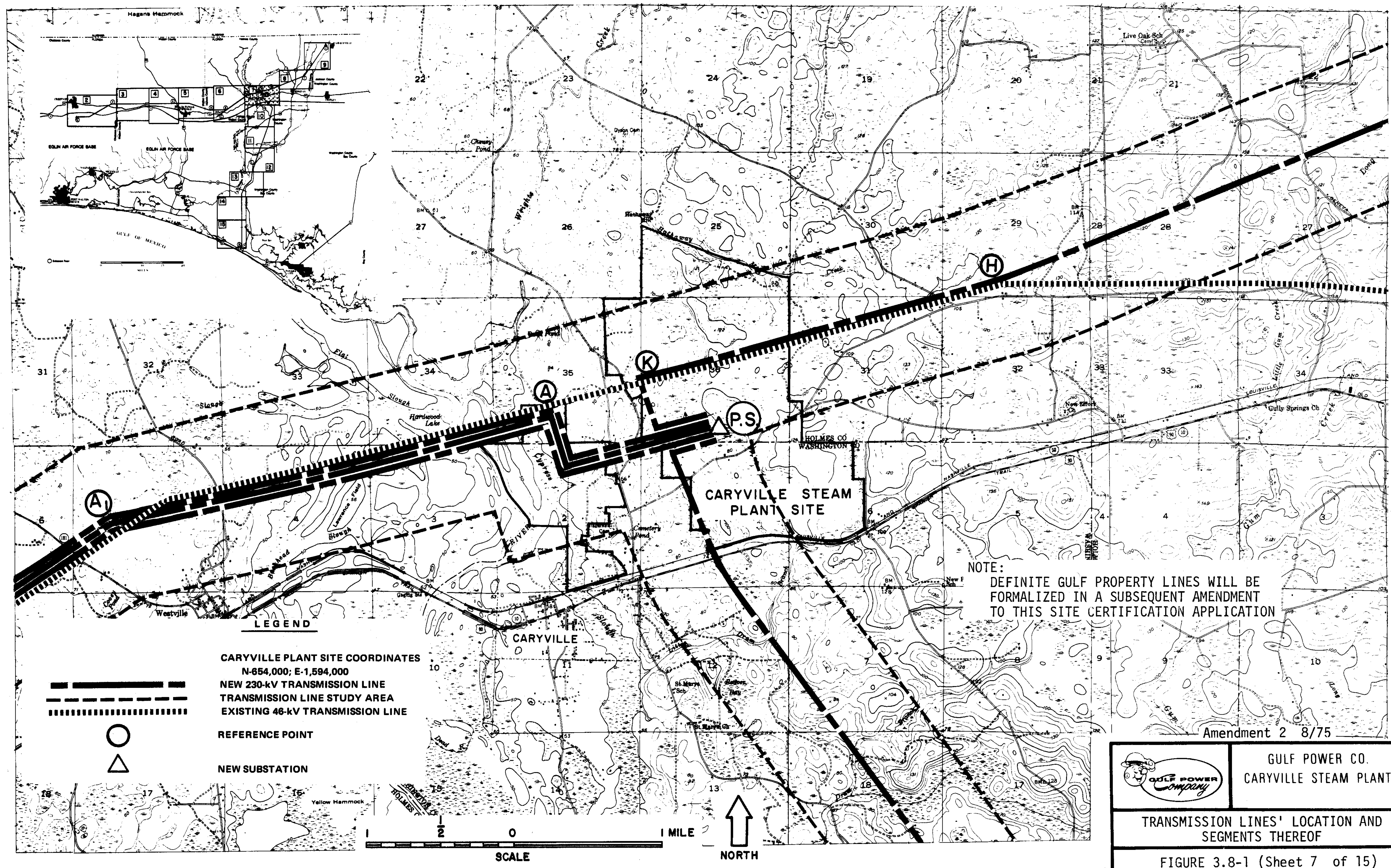


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 6 of 15)

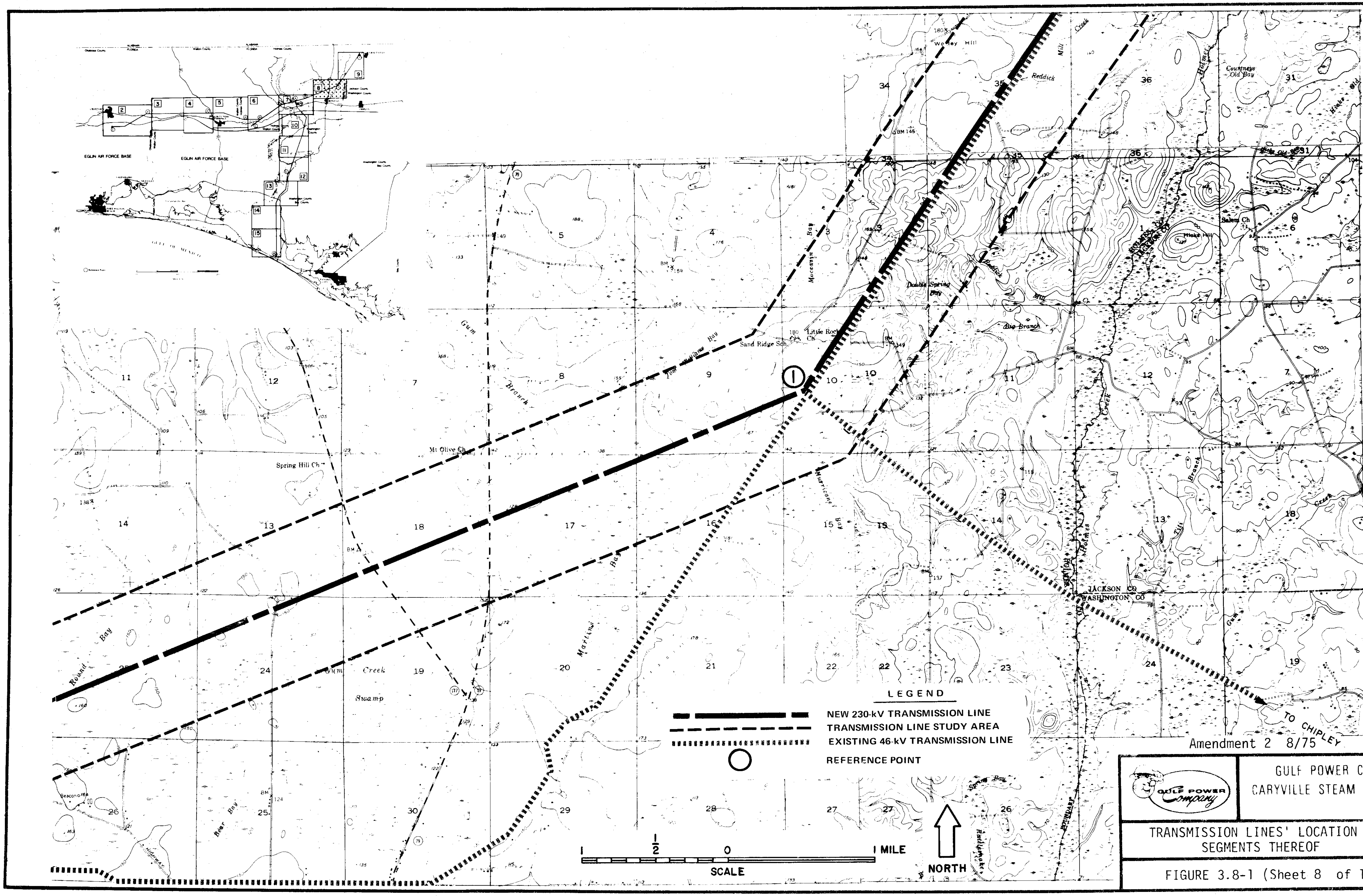


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 7 of 15)

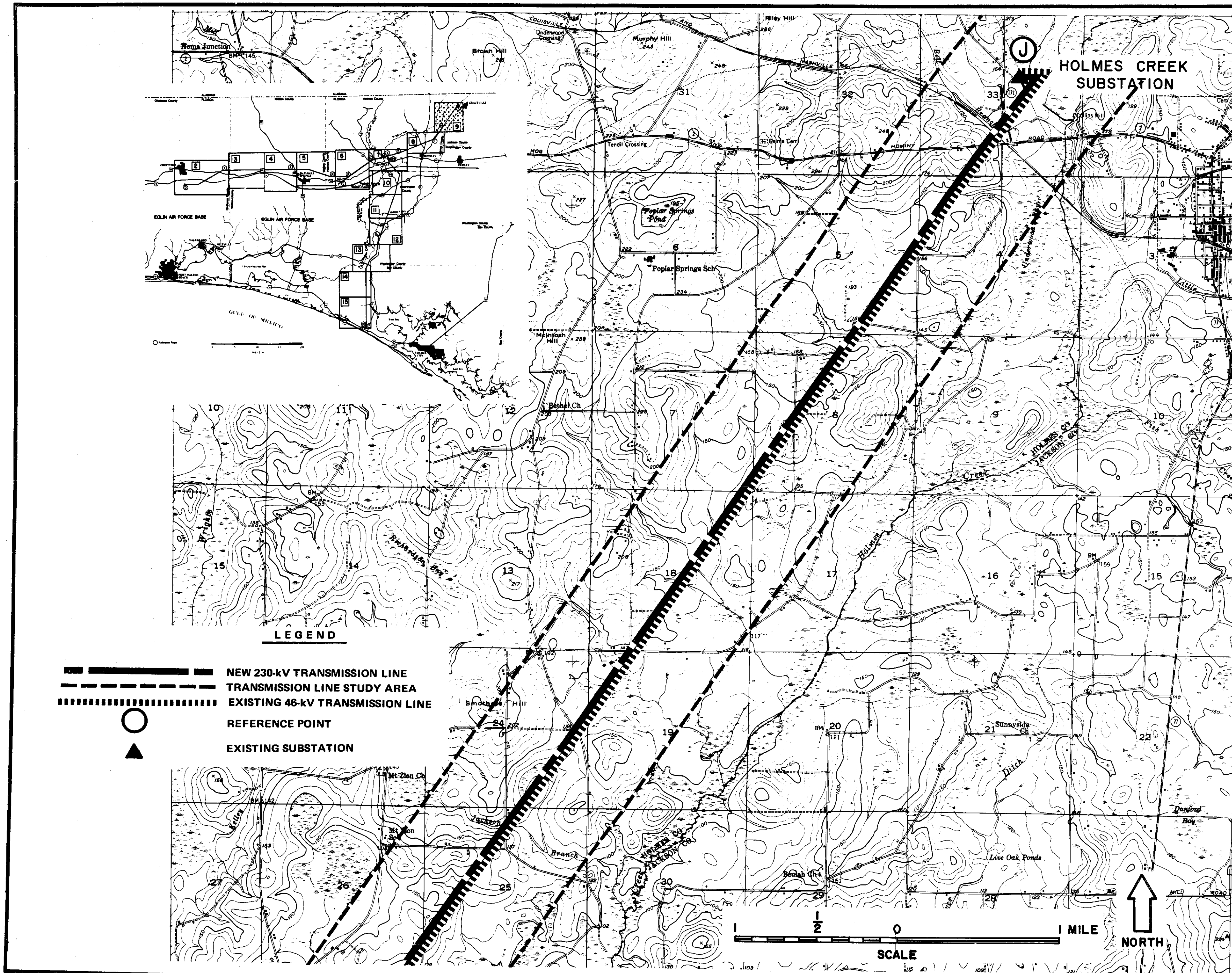


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 8 of 15)

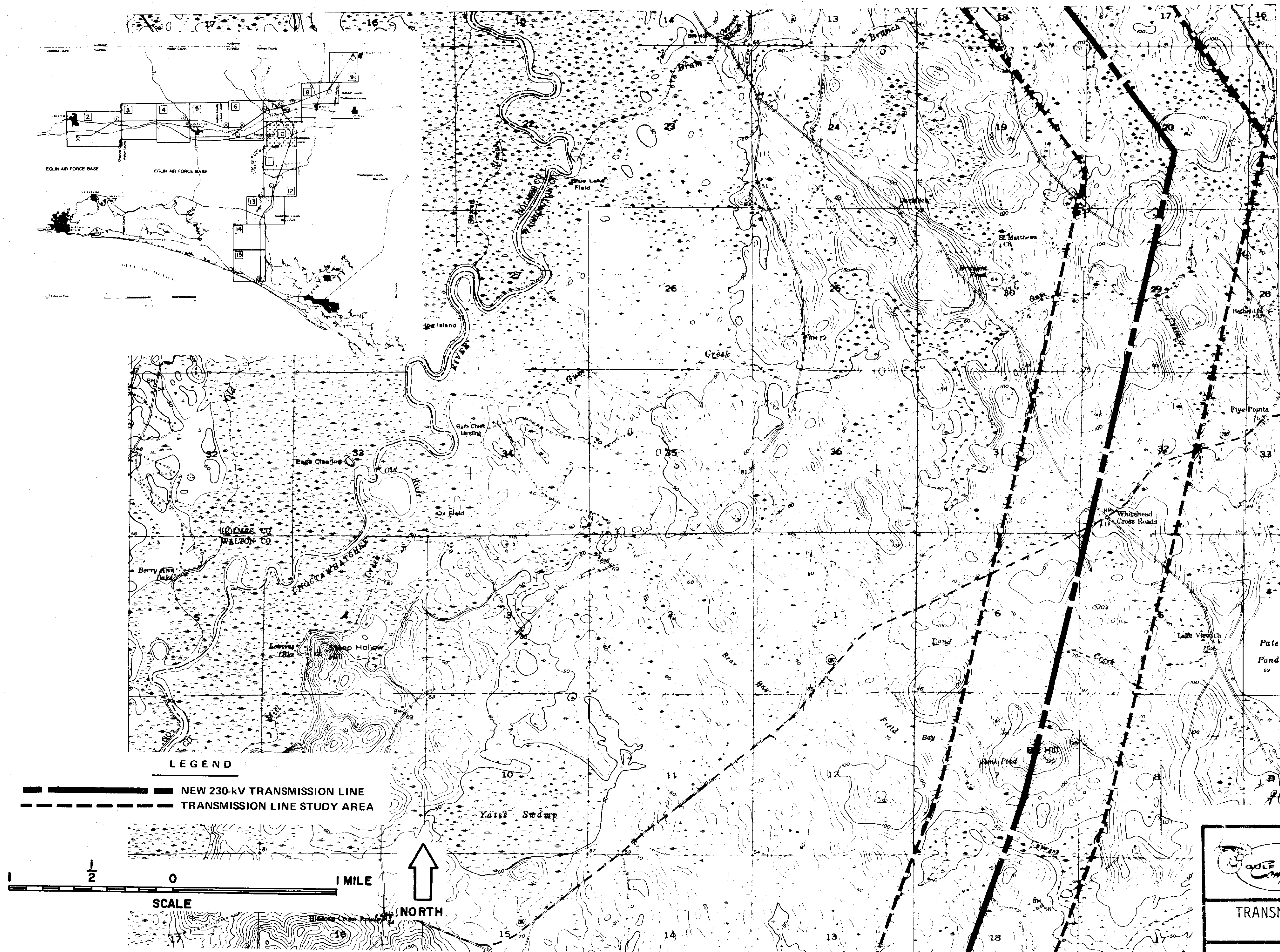


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 9 of 15)

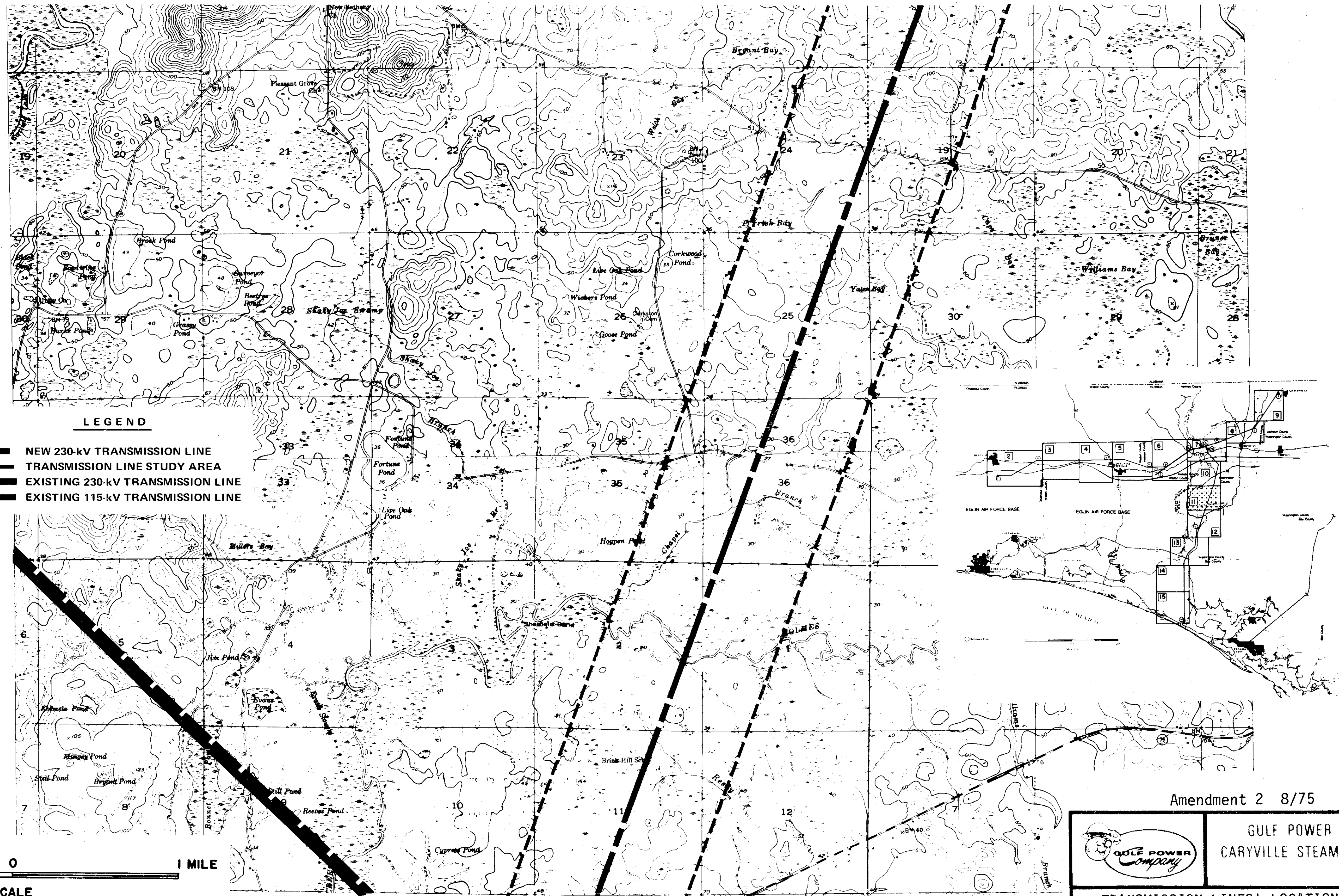


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 10 of 15)



LEGEND

- NEW 230-kV TRANSMISSION LINE
- TRANSMISSION LINE STUDY AREA
- EXISTING 230-kV TRANSMISSION LINE
- EXISTING 115-kV TRANSMISSION LINE

NORTH

1 ½ 0 1 MILE

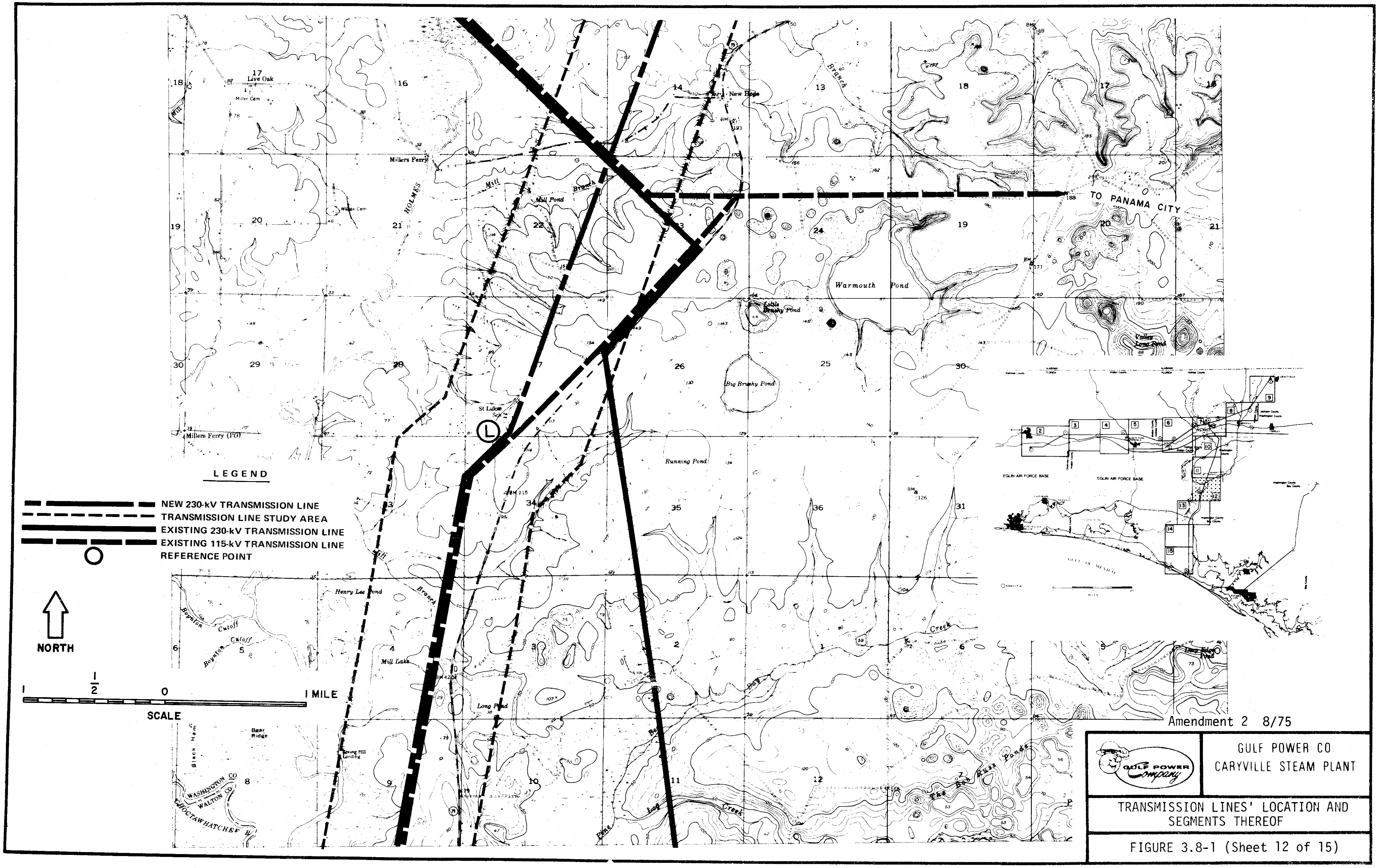
SCALE

Amendment 2 8/75

GULF POWER CO
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 11 of 15)

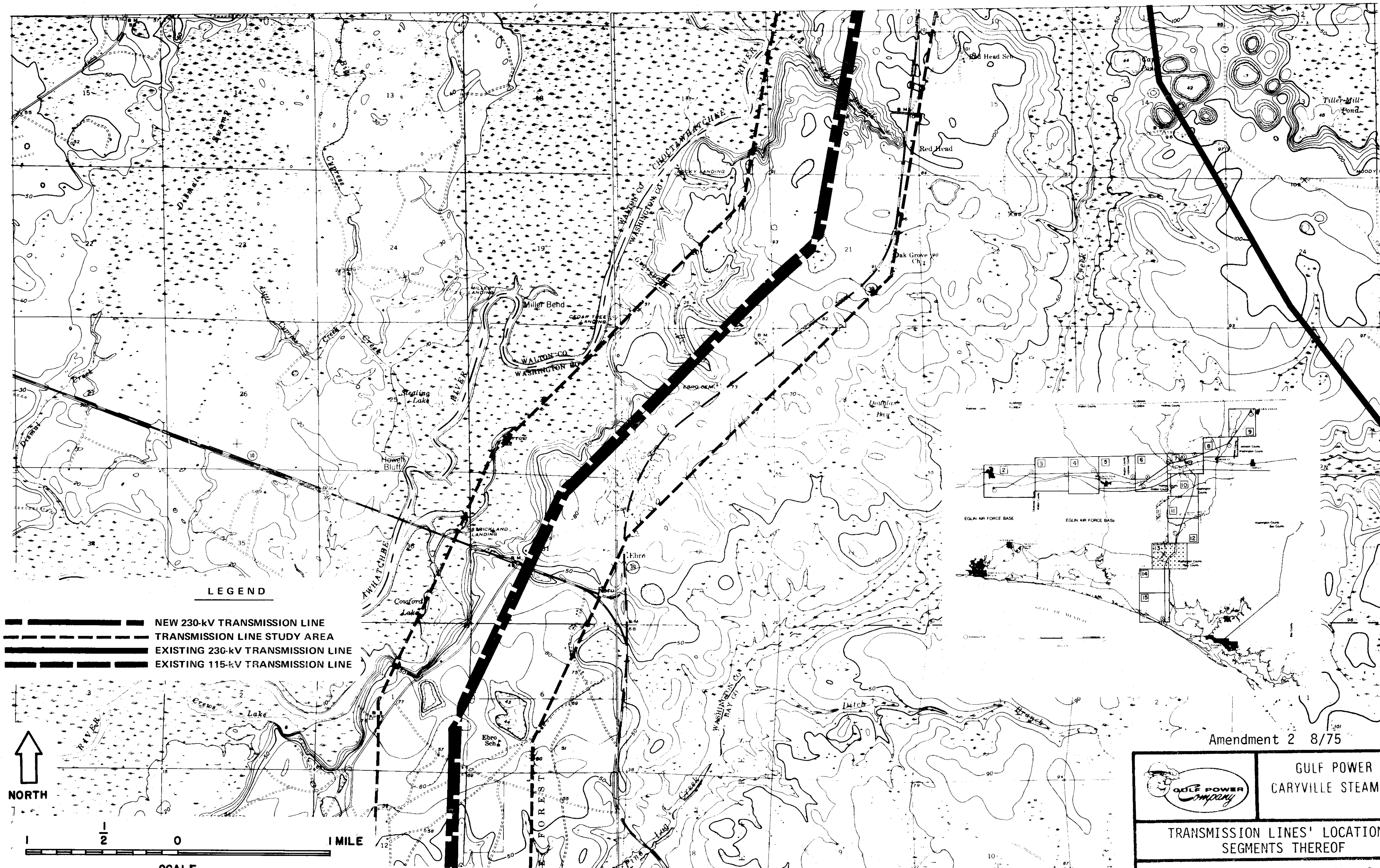


Amendment 2 8/75

GULF POWER CO
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 12 of 15)

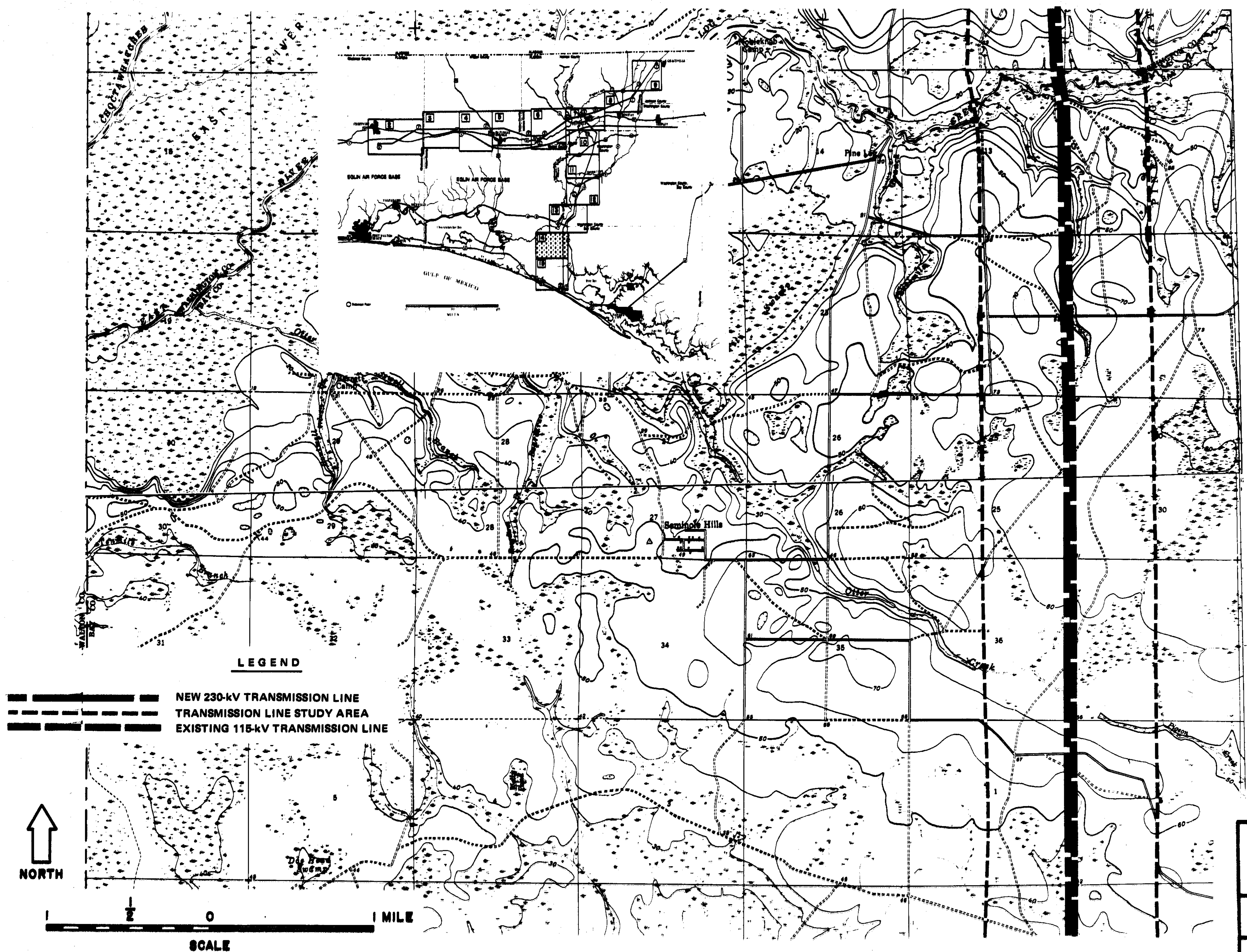


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 13 of 15)

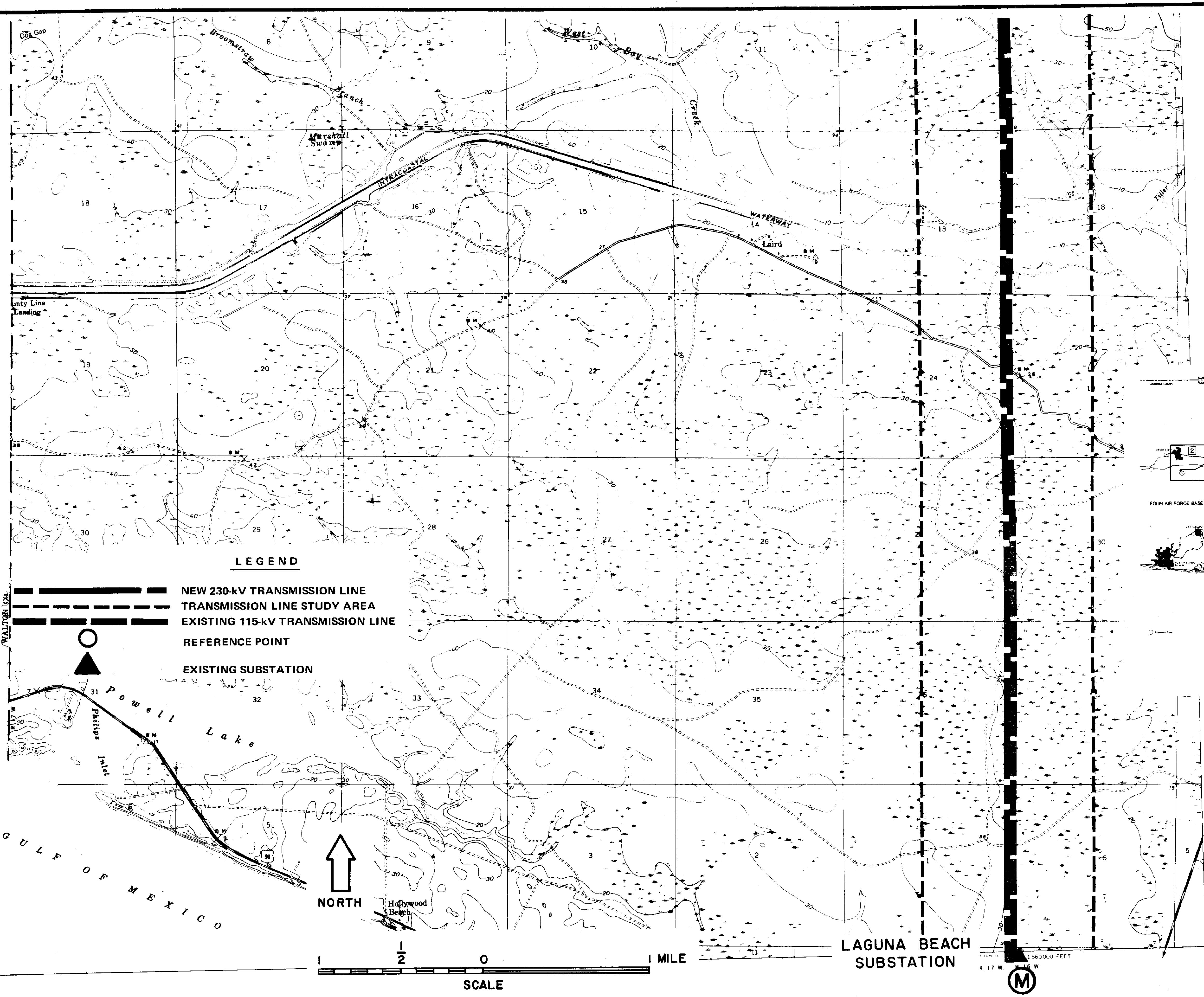


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 14 of 15)

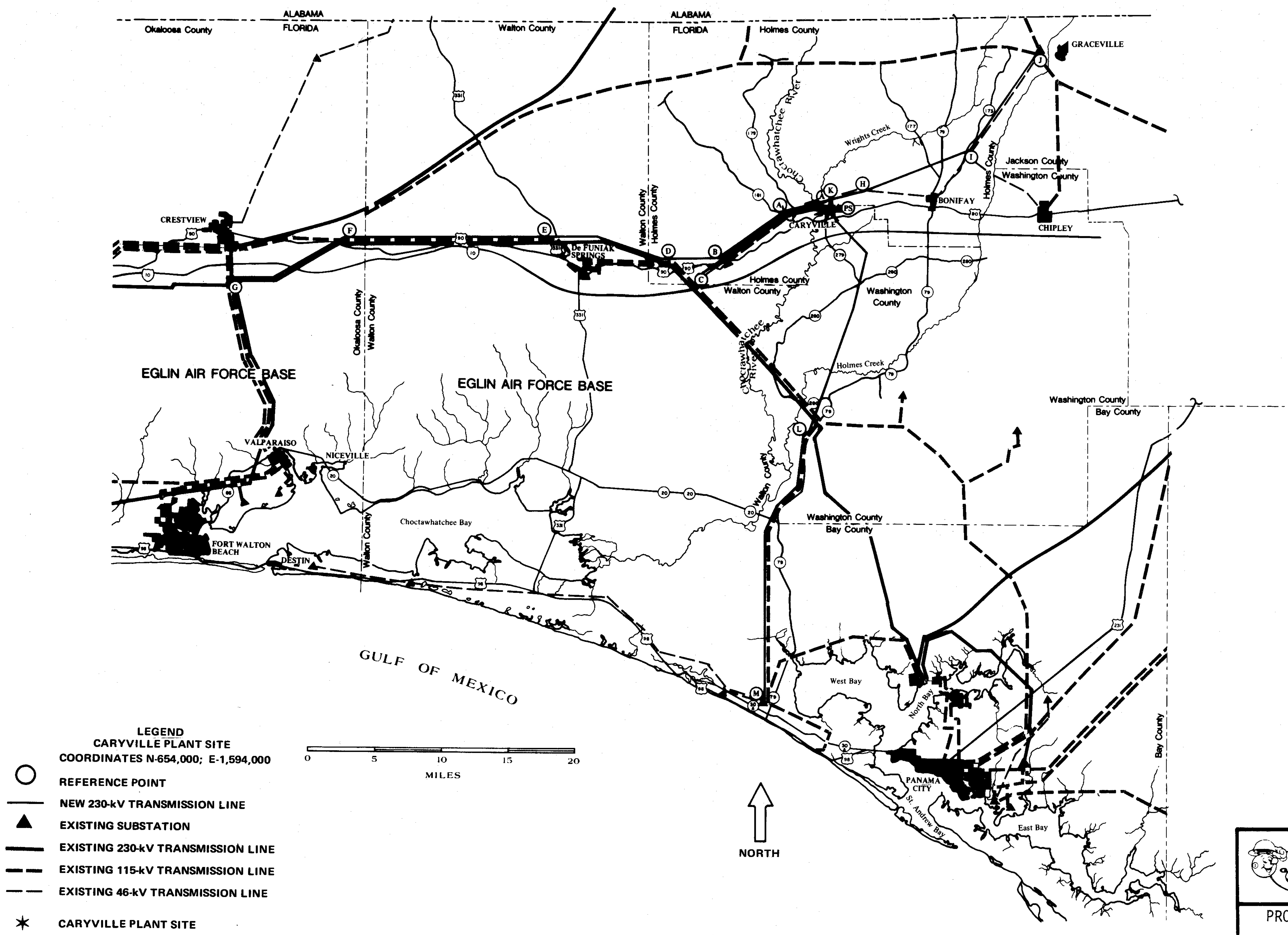


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSMISSION LINES' LOCATION AND SEGMENTS THEREOF

FIGURE 3.8-1 (Sheet 15 of 15)

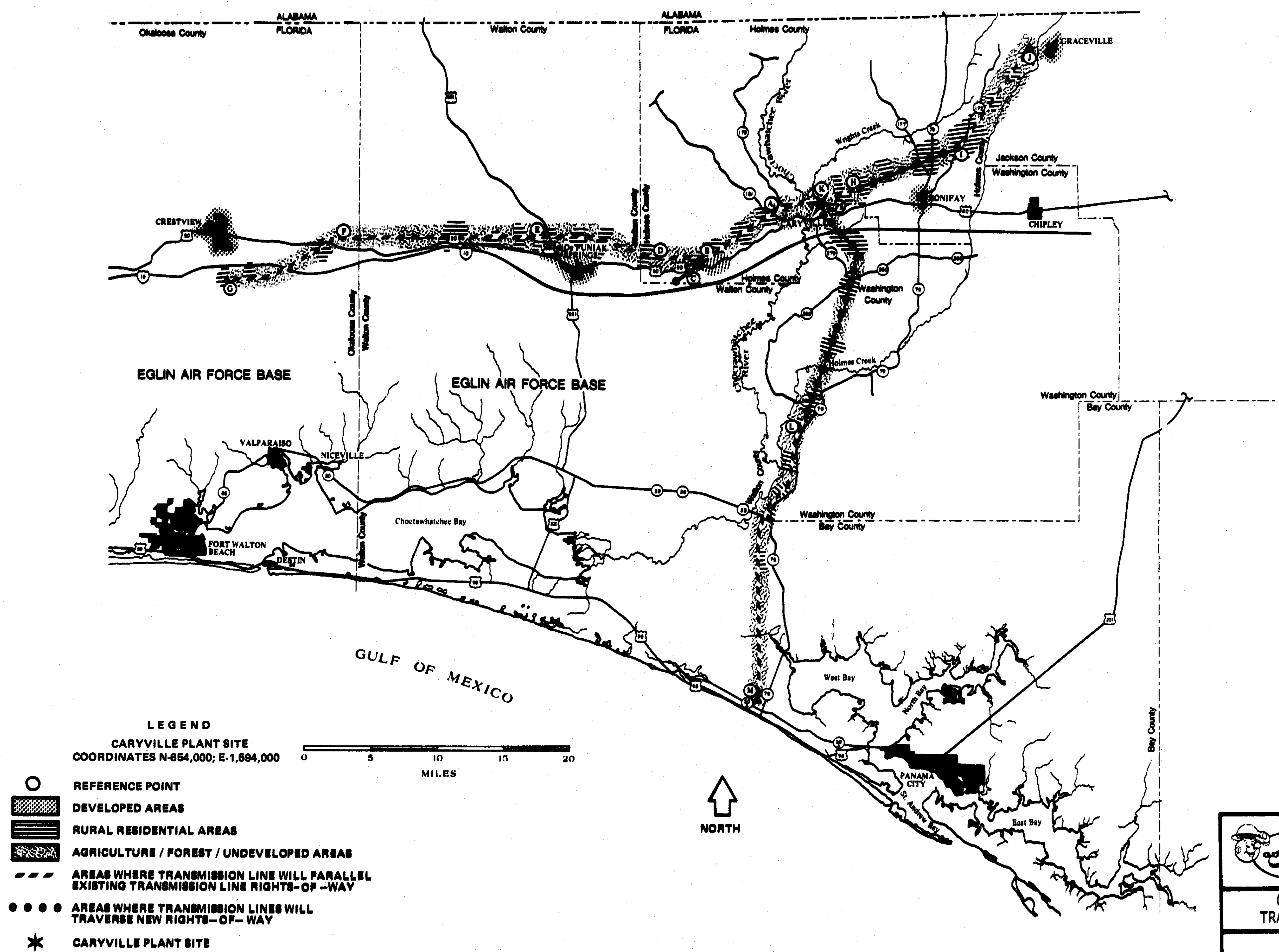


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

PROPOSED ASSOCIATED TRANSMISSION LINES FOR UNITS NO. 1 & 2

FIGURE 3.8-2

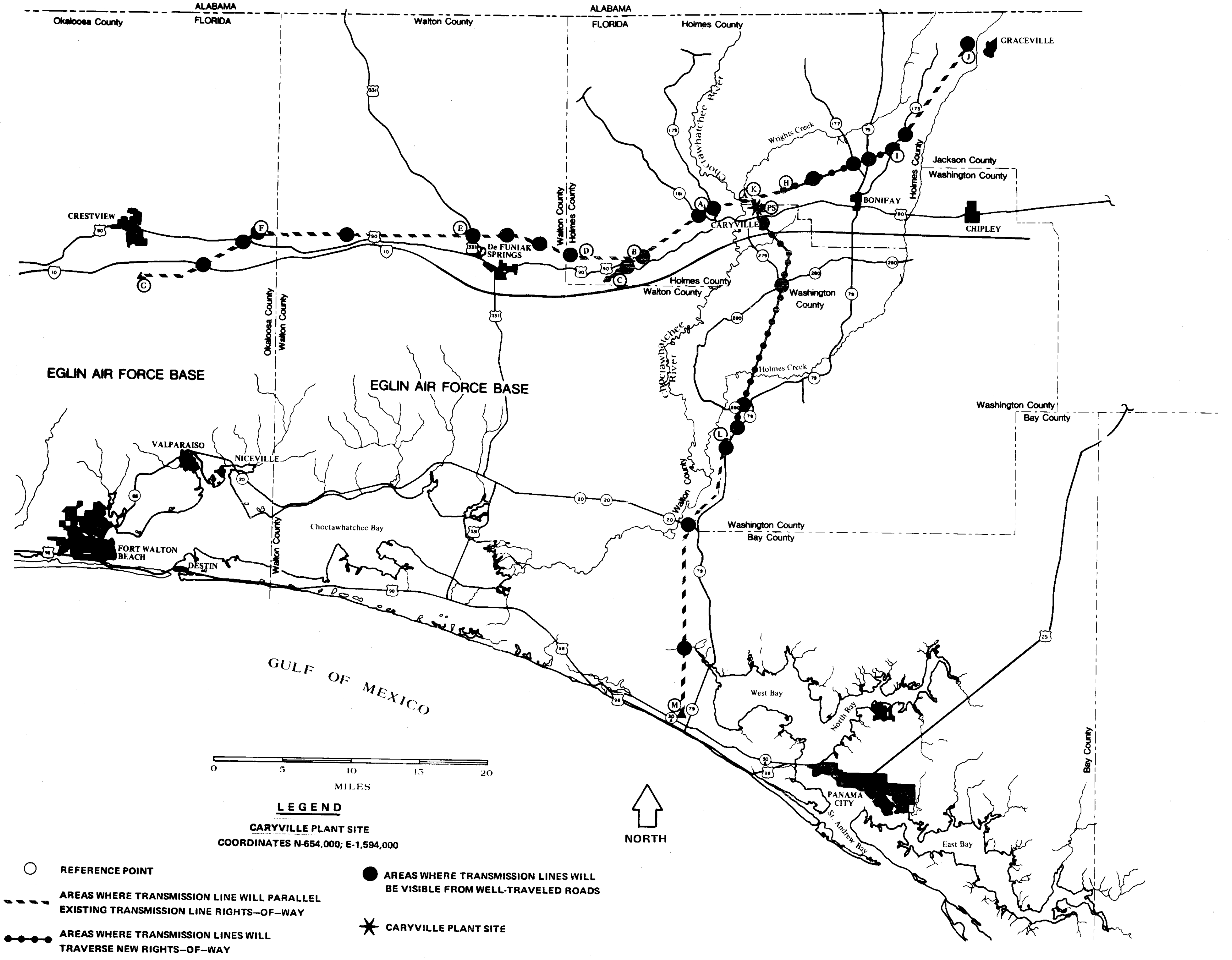


Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

GENERALIZED LAND USED ALONG TRANSMISSION LINE RIGHTS-OF-WAY

FIGURE 3.8-3

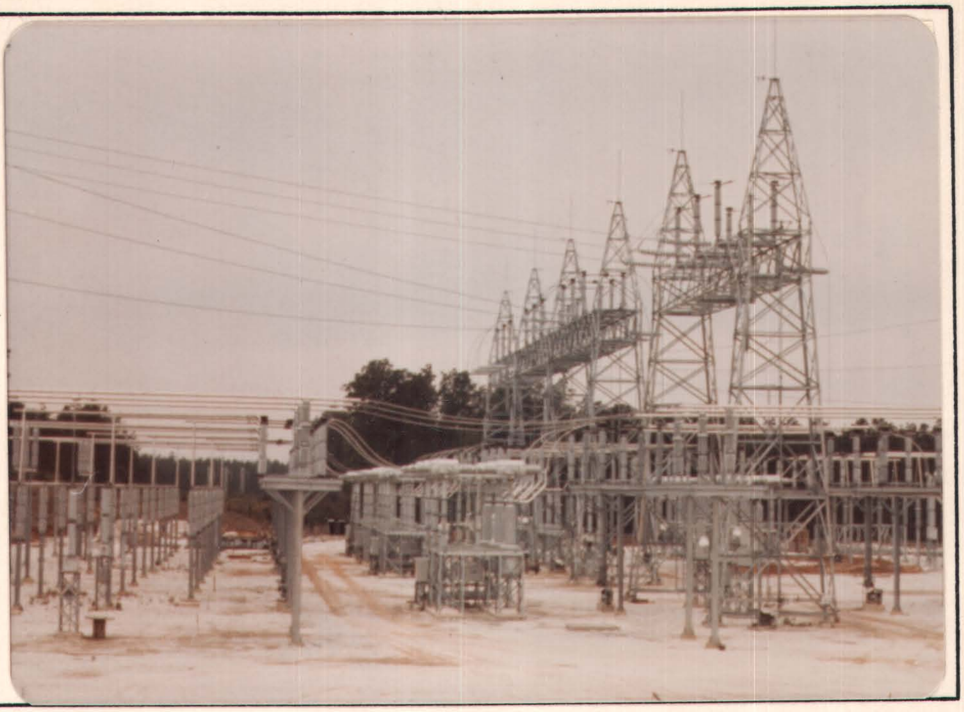


Amendment 2 8/75

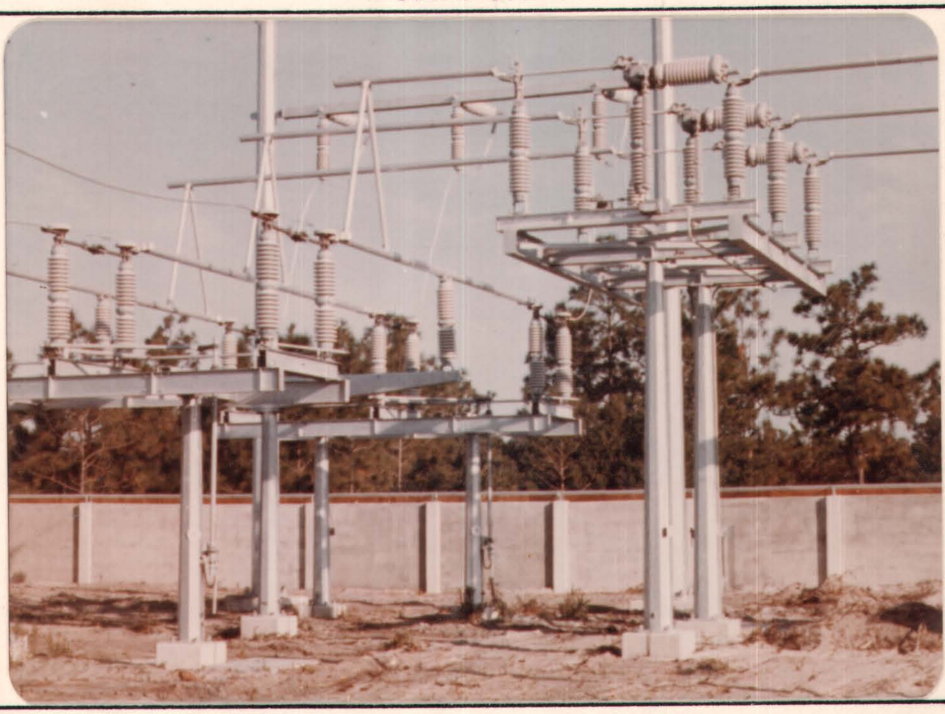
GULF POWER CO.
CARYVILLE STEAM PLANT

AREAS WHERE TRANSMISSION LINES WILL BE VISIBLE FROM WELL-TRAVELED ROADS

FIGURE 3.8-4



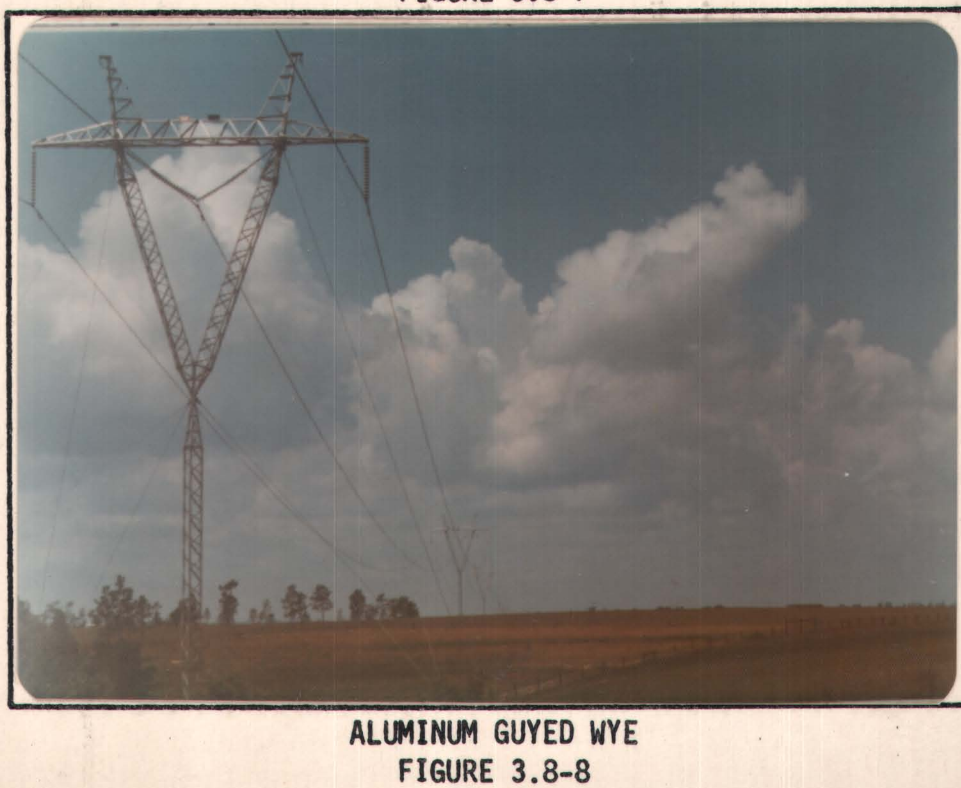
230 KILOVOLT (kV) SWITCHYARD
FIGURE 3.8-5



TYPICAL LOW PROFILE BUS WORK
FIGURE 3.8-6

GULF POWER CO.
CARYVILLE STEAM PLANT

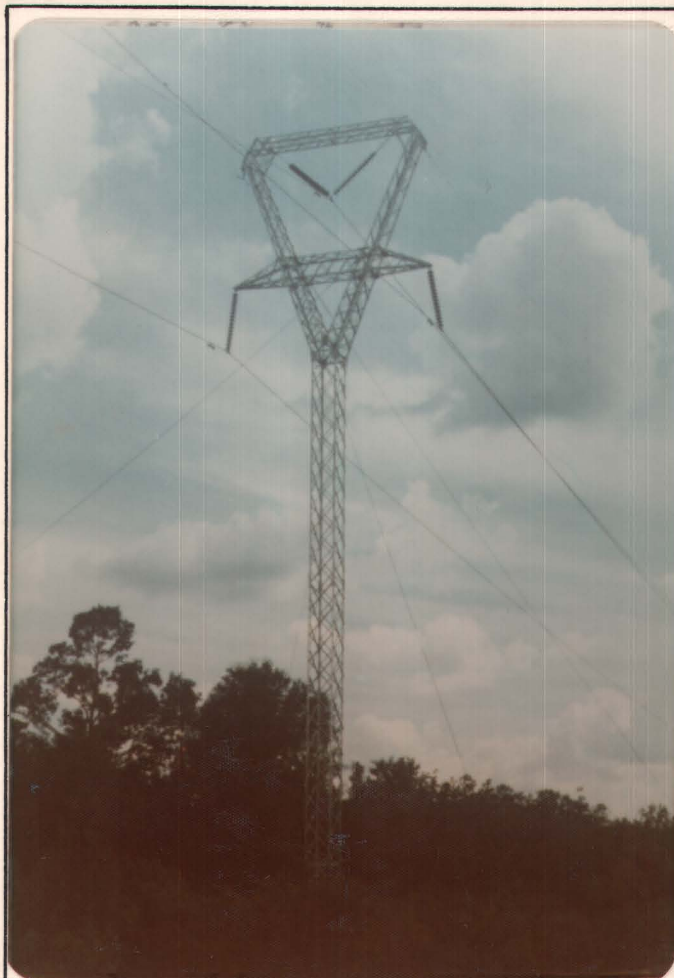
TUBULAR STEEL.
FIGURE 3.8-7



ALUMINUM GUYED WYE
FIGURE 3.8-8

GULF POWER Company

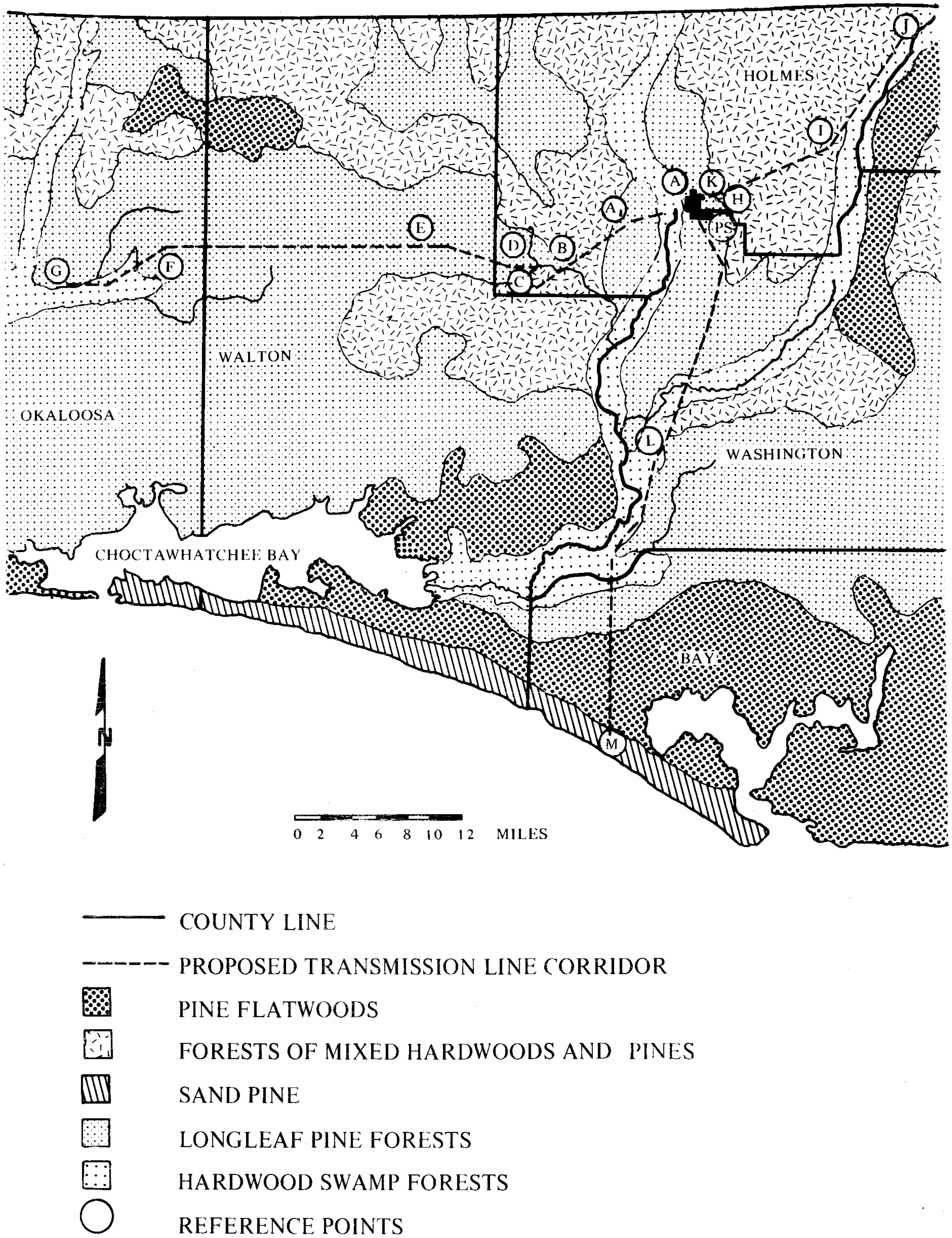
GULF POWER CO.
CARYVILLE STEAM PLANT



ALUMINUM GUYED DELTA
FIGURE 3.8-9

GULF POWER Company

GULF POWER CO.
CARYVILLE STEAM PLANT



Amendment 2 8/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	MAP OF NATURAL VEGETATION FIGURE 3.8-10

4. PREPARATION AND CONSTRUCTION

4.0 Environmental Effects Of Site Preparation, And Plant And Associated Transmission Facilities Construction

4.0 ENVIRONMENTAL EFFECTS OF SITE PREPARATION, AND PLANT AND ASSOCIATED TRANSMISSION FACILITIES CONSTRUCTION

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CHAPTER TABLE OF CONTENTS (Continued)

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4.0 ENVIRONMENTAL EFFECTS OF SITE PREPARATION, AND PLANT AND ASSOCIATED TRANSMISSION FACILITIES CONSTRUCTION

LIST OF TABLES

4.0 ENVIRONMENTAL EFFECTS OF SITE PREPARATION, AND PLANT AND ASSOCIATED TRANSMISSION FACILITIES CONSTRUCTION

LIST OF FIGURES

4.1

4.1 Site Preparation and Plant Construction

4.1.1 Land Use

Because proper construction techniques and precautions will be used during site preparation and construction, preparation and construction activities will not create any permanent adverse conditions outside the site boundaries. Within the boundaries, the terrain will be properly sculptured by clearing, grubbing, excavating, filling, grading, stockpiling, and building.

Construction of the plant will result in about 700 acres being removed from timber, livestock, and other potential agricultural production for the generation of electrical power. Other land use in the area of the site will not be materially changed. Also, it is not expected that any satellite industry will be established in the region that can be directly related to the plant construction.

Plant use 700ac

The land being acquired for the plant site is not under extensive agricultural cultivation. Other than the growth of timber, acquisition will remove approximately 10 acres presently devoted to an orchard. The remainder includes previously cultivated old fields, pasture, and cleared areas representing approximately 200 acres. In addition, cypress bayheads comprise 73 acres, bayhead 225 acres, and mixed hardwoods approximately 188 acres. Following construction, all acreage practicable which was devoted to stockpiling of building materials and construction facilities will be restored by grading and planting in consonance with the advice and consultation of the Soil Conservation Service, U.S. Department of Agriculture, and the Florida Division of Forestry.

Restore construction storage site by reforesting

Construction activities will ultimately affect about 1,175 acres of wildlife habitat. Gulf expects no lasting adverse effects from construction activities on terrestrial wildlife at the plant site. Most wildlife will leave the immediate vicinity of construction as man's activities increase, but some may be expected to return when construction is completed and man's activities subside. The clearing process will result in loss of natural habitat and potentially some animal life, especially small mammals and various herptofauna. The construction of roads, railroad spurs, and other construction activities ~~may~~ will also cause destruction of habitat. However, it is unlikely that a significant portion of the resident site population will be destroyed. Bird life will most likely relocate to surrounding areas where trees are not to be cleared. Included within the 1,175 acre area is the habitat of the gopher tortoise, a protected species, as described in terrestrial ecology studies, subsection 2.7.1, "Terrestrial Ecology." Prior to construction activities in these areas, Gulf will coordinate with the Florida Game and Freshwater Fish Commission for purposes of relocating this species.

Lose 1,175 ac to wildlife habitats - see FSU report

4.1.1.1 Effects of Site Preparation and Plant Construction - Clearing and grading operations will be confined to those areas essential for the construction of permanent plant facilities and those temporary facilities required for support of the construction.

4.1.1.1.1 Detention Ponds, Berms, and Dikes - Gulf will construct detention ponds at the outset of site clearing and preparation activities to prevent siltation of natural drainage channels from construction runoff. Berms and dikes will be constructed where needed, and cleared areas, cuts, and fills will be sodded or seeded as soon as practical. The site grading plan is such as to minimize alteration to offsite drainage patterns, and the permanent yard drainage system and placement of culverts and drainage structures will adhere to natural drainage patterns as closely as possible.

4.1.1.1.2 Hydraulic Dredging and Explosives - Gulf does not contemplate hydraulic dredging operations, the use of explosives during construction, or other unusual activities or construction techniques.

4.1.1.2 River Intake Structure - One feature of the plant related to land use will be a river intake structure which is tentatively located on the east bank of the Choctawhatchee River at Florida grid coordinate N-651,000; E-1,586,650. This pump structure will supply make-up water via pipe lines to cool the condenser in the closed cycle cooling tower system.

Three buried pipe lines ,each approximately 48 inches in diameter,collectively having a 50-foot-wide rights-of-way corridor, will lead from the pump structure to the plant site. This corridor will be incorporated, as much as possible, into the transmission line corridor, graded to restore natural drainage, and grassed.

Construction of the pump structure will require dewatering and a temporary cofferdam. Because of the cofferdam's proximity to the river, Gulf does not expect dewatering to affect ground water users or cause any adverse impacts. The river intake structure will not project out into the river channel, but will set close to the bank; consquently, no obstruction to the flow or navigation of the river are foreseen by either the temporary cofferdam or permanent structure.

The effects, if any, of construction activities on the aquatic life of the Choctawhatchee River will be only short term effects since this construction will take no more than 12 months to complete.

4.1.1.2.1 Structure's Effect on Wildlife - Gulf will confine potentially turbidity-producing activities to the cofferdam interior which will shield the river. Dewatering pumping discharges will be strictly controlled to meet applicable water quality standards prior to release either to the river or to natural drainage channels leading to the river. The cofferdam will be well flagged and lighted (at night) to prevent any hazard to boating.

River bottom life subject to destruction by the construction of the river intake structure will be confined to the limits of the cofferdam. Gulf expects no impairment to the fishing or recreational uses of the river during the intake construction, and no adverse effects on fish, wildlife, water quality, or aesthetics following construction.

4.1.1.2.2 Area Restoration for Wildlife - Following construction, Gulf will restore areas no longer needed for operational activities through replanting with appropriate native grasses, shrubs or trees, and thus make these areas available for use by wildlife as much as possible.

4.1.1.3 Mitigating Undesirable Effects - Gulf considers all of the above effects unavoidable but reversible. The use of sprinkler tank wagons for example, will be employed for dust abatement during construction, and grassing and planting during and upon the conclusion of construction can be expected to reverse this impact. Exhaust emissions from internal combustion engines during construction are considered an effect that may not be mitigated; however, this impact should decline abruptly and become negligible as construction completion approaches. ~~Controlled burning of solid wastes from cleared land will be performed at optimal times in accordance with Chapter 17-5~~ of the State of Florida Department of Pollution Control Rules and Regulations. These effects will diminish upon the completion of the land clearing phases of the construction period.

4.1.1.4 Archaeological Sites and Natural Landmarks - According to both the State of Florida's Bureau of Historic Sites and Properties and Mr. E. W. Carswell, Editor, Washington County News (Florida), and other local citizens, no historical, cultural, or natural landmarks have been identified in the area of the proposed plant site.

Figure 2.3-1 shows the preliminary identification of archaeological sites by the State of Florida. (Refer to subsection 2.3.2, "Archaeological Significance.")

4.1.2 Water Use

During the construction phase, water usage will include concrete mixing; washing down equipment; curing of concrete; sprinkling for dust abatement during grading; sprinkling for grassing as needed; sprinkling to obtain optimum water content during earthwork compacting operations; and water for equipment radiators, drinking purposes, and fire protection in that estimated volumetric order over the duration of the entire construction period. Gulf will satisfy these requirements with wells which will ultimately be incorporated into the plant's permanent well system. (Refer to section 3.3, "Plant Water Use.") While some overlapping or the above usages will occur, relatively low peak demands are contemplated during the construction period.

4.1.2.1 Water From Local Aquifers - Gulf will not excessively draw water from local aquifers during the construction period.

4.1.2.2 Overall Plan For Use of Water Bodies - Gulf will not create any clear-water reservoirs or lakes for recreational use. The small size of the proposed site requires that all surface area be used for plant operation, thus leaving no area for recreational purposes.

No area within the five-mile radius presently devoted to recreation will be affected by plant construction or operation.

4.1.3 Air Quality

Effects on air quality from construction activities fall into three general categories:

A. Dust will be generated, particularly during the site preparation and grading operations, by vehicular and equipment traffic operating over temporary roads or unpaved areas. Gulf will mitigate the adverse effects of these operations by minimizing clearing and grading limits to those essential to maintain construction sequence and schedule, grassing disturbed areas as promptly as possible, and sprinkling operations in support of grassing operations to keep down dust generated by vehicular traffic on unsurfaced roadways or areas.

B. Exhaust emissions from the vehicles of commuting workmen and from gasoline and diesel engine powered vehicles and equipment during the period of construction are unavoidable; however, these sources will decline abruptly and become negligible as construction completion approaches.

C. Gulf will dispose of combustible solid wastes and the displaced vegetation resulting from land clearing activities by controlled burning which will produce some smoke. This burning activity will be done in accordance with existing ordinances and laws. This is not a continuous operation requirement, however, and burning will be scheduled when conditions are optimal.

4.1.4 Solid Waste Generation and Disposal

4.1.4.1 Solid Waste - The initial and largest solid-waste disposal requirement will be unmarketable timber incidental to land clearing operations. As discussed in subsection 4.1.3 C. above, Gulf will accomplish this disposal by controlled burning under applicable Florida Department of Pollution Control regulations. During subsequent phases of work there will be a continuous generation of combustible and non-combustible wastes as a by-product of work in progress. This would include scrap metal, scrap lumber from carpentry work and the dunnage and crating resulting from equipment deliveries, and cardboard and paper from material packaging and field-office waste baskets. There will be litter barrels

See FAC

about the site containing disposable sanitary drinking cups, lunch wrappings, and the like which will be cleaned up to prevent vermin from being attracted to them.

During periodic cleanups of the work areas, Gulf will segregate and stockpile scrap ~~metal~~ for potential ~~salvage~~ reuse during the course of construction and ultimate disposal by sale as scrap at the conclusion of the project. ~~Combustible~~ materials resulting from work-area cleanups and the periodic pickups and emptying of litter barrels and trash cans will be hauled to a designated ~~solid-waste disposal area~~. Inconsequential quantities of ~~garbage~~ will be generated, primarily stemming from construction workers' lunch leavings, and will be readily collectable and disposed of with the other ~~combustible~~ materials. Although burning is preferable, an alternate would be to establish a land-fill operation at a carefully selected site location whose topography would preclude adverse affects on ground water.

Disposal by burning or landfill

Location - Gulf or private

4.1.4.2 Sanitary Waste - Gulf will handle sanitary waste disposal by portable chemical toilets which contractors will be required to provide for their workers on a one to twenty ratio. (Refer to section 3.6, "Sanitary and Other Wastes' Systems.") Open-pit latrines or privies will not be allowed under any circumstances.

Disposal.

4.1.4.3 Petroleum and Chemical Wastes - Gulf will collect in drums and periodically dispose of used motor oil in conjunction with the disposal of other combustible materials in accordance with all applicable local and State ordinances and regulations. Other chemical wastes will be collected either in drums or, should large volumes be involved, in lined ponds for neutralization and removal by tank trucks. Subsequent disposal will be in accordance with current regulatory standards and recommendations.

4.1.5 Ambient Noise Levels

Ambient noise levels generated by the work are those background noises normally associated with heavy construction. Included are internal combustion engines, the whine of power-driven handsaws and tools, hammering and nailing, the use of impact wrenches for bolting up structural steel, and pile-driving operations. These two latter operations will not persist but for a relatively brief portion of the overall project duration, and while some overlapping of all the noises noted will occur, it is not a continuous overlap. Furthermore, the construction schedule is based on ~~a single-shift, 40-hour work week~~. Accordingly, the noises discussed below could persist only for eight hours a day, five days a week, and would not exist continuously during and eight-hour work day. This factor in combination with the remoteness of the work site relative to populated areas makes it most unlikely that noise will constitute an adverse impact on the human environment.

Nearest residence

3000'± from plant island to property line ie nearest residence

2500 ft from Unit No. 2 to nearest point on property line.

4.1.5.1 Proximity of Humans to Noise - Table 4.1-1 and figure 4.1-1 indicate the proximity of human populations and identify the impacts on the environment arising from noise.

4.1.5.2 Construction Noise - Gulf makes the following seven observations, A through G, based on sound level studies made at other plant sites during their construction stages (1, 2, 3).

A. Individual machines used in construction work may produce sound levels which are quite high; e.g., compressors may produce 100 dBA (decibels on "A" scale) at five feet and cranes may produce 90 dBA at five feet.

B. Figure 4.1-2 illustrates typical data aquired at distances of approximately 200 feet and 400 feet from the central construction area of a plant (1). At 200 feet, the sound levels were concentrated in the range of 72 to 80 dBA with L_{10} = 78 dBA, L_{50} = 73 dBA, and L_{90} = 68 dBA. At 400 feet, the sound levels were concentrated in the range of 67 to 75 dBA with L_{10} = 76 dBA, L_{50} = 71 dBA, and L_{90} = 64 dBA.

C. At approximately 3,600 feet from the same construction site (1), the sound level had dropped to the 45 to 55 dBA range with L_{10} = 54 dBA, L_{50} = 47 dBA, and L_{90} = 45 dBA. These levels are only slightly above the expected summer ambient sound levels at the proposed Caryville plant site.

D. A Bechtel Corporation study (3) reported the following results for two monitoring stations around a plant construction site.

	Sound Levels, dBA	
	Ambient	During Construction
Station 1	L_{10} = 42 L_{50} = 36 L_{90} = 33	L_{10} = 64 L_{50} = 58 L_{90} = 51
Station 2	L_{10} = 41 L_{50} = 33 L_{90} = 31	L_{10} = 65 L_{50} = 57 L_{90} = 50

According to the Bechtel study, construction occured within 100 to 200 yards of Station 1 and "very close" to Station 2. The construction phases reported were the site preparation and excavation only.

E. Some construction activities, such as site preparation and excavation, and construction of the water intake system, may have a significant effect on the community since such construction efforts cover a large

area of the proposed site. A conclusion of the Bechtel study (3), was that "construction activities have had a significant effect on the surrounding noise environment. Overall outdoor noise levels have increased approximately 20 dBA." However, based on observation C above, this impact should be reduced considerably when the construction is concentrated around the central area near Gulf's proposed Caryville Units No. 1 and 2.

F. Increased traffic along some of the secondary roads leading to the plant site will also contribute to an increased sound level during construction. This increased traffic will normally be concentrated at shift changes. The average daily traffic on Florida Highway No. 179 in 1973 was 415 vehicles (4). If 1,000 construction workers were employed, it is estimated that the traffic would at least double.

G. Automobiles and trucks traveling U. S. No. 90 will remain as the predominant noise sources along the south property line.

4.1.6 Estimated Work Force Schedule

Table 4.1-2 and figures 4.1-3, -4, and -5 show Gulf's estimated work force schedule for preparation and construction of the proposed power plant.

Table 4.1-2 which relates to figure 4.1-5, identifies the key time periods of plant construction, and enumerates expected employment levels and construction phases. The greatest construction benefits will occur in 1979, when the maximum construction employment level is reached.

4.1.7 Human Impact

4.1.7.1 Human Movement - Table 4.1-3 gives the proximity of human populations and impacts on the environment arising from human movement. Figure 4.1-6 shows expected land-use changes from the movement of construction workers within and beyond a five-mile radius area, respectively. Figure 4.1-7 shows the potential major and secondary traffic flows within and beyond a five-mile radius area. The regional citizenry is insufficient in number for adequate work force manning levels of employment at the construction site. In addition, adequate housing is not available in the locale of the construction site for work relocation. Consequently, Gulf anticipates that construction workers will commute from distances on the order of 75 to 100 miles. While adequate on-site parking facilities are planned, the influx of traffic at the beginning of the work day and its egress at the end of the work day will impact traffic control in the local community. Gulf expects the cooperation and assistance of cognizant enforcement agencies to alleviate this impact at peak periods.

Commuting 50 miles

See FSU grant rec'd, # 4 p 11

No satellite industry is expected in the region as a consequence of construction, and due to the foregoing discussion regarding the nonavailability of an adequate local work force or housing for extensive worker relocation,

Disagree

There will be significant socio-economic impact

no significant long range economic impacts are anticipated on the region that may be related to the construction.

4.1.7.2 Material and Machine Movement - Table 4.1-4 indicates the proximity of human populations and identifies the impacts on the environment arising from the movement of material and machines. Figure 4.1-8 shows the anticipated truck movement within and beyond a five-mile radius area of the plant site.

A portion of the rail spur into the site is programmed for completion within the first year of the construction to facilitate equipment and material deliveries by rail versus motor freight. This spur line will further ameliorate traffic flow during construction. On completion of construction, Gulf expects any adverse traffic impacts to cease altogether.

4.1.7.3 Housing Provisions - Table 4.1-5 indicates the proximity of human populations and identifies the impact on the environment arising from activities associated with the provisioning of housing. Figure 4.1-9 indicates land-use impacts from construction worker housing within and beyond a five-mile radius area of the plant site.

✓4.1-3

4.1.7.4 Transportation - Table 4.1-6 indicates the proximity of human populations and identifies the impact of the environment arising from the provisioning of transportation.

4.1.7.5 Educational Facilities - Table 4.1-7 indicates the proximity of human populations and identifies the impact on the environment arising from the provisioning of educational facilities for workers and their families.

4.1.7.6 Relocating Family Dwellings - Relocation of family dwellings will be minor as the majority of the land is agricultural. Neither site preparation nor construction activities should have adverse effects on ground water or surface water usage.

water use

4.1.8 Beneficial Consequences of Site Preparation and Plant Construction

Few business establishments are located along the highway routes which will most likely be traveled by plant construction workers majority of which will come from outside Washington and Holmes counties. Some of these workers may relocate to the local area. Most, however, will probably commute daily from their home areas.

The economic benefit accruing from the construction workers who commute daily will be from local sales in gasoline and other automobile related goods and services, eating and drinking establishments, and food stores. As indicated in table 4.1-8, approximately twelve such business establishments are found in the local area most likely to be traveled by construction workers.

What is possible construction work population of Dothan, Ala. Marianna, etc.

Those workers who decide to relocate in the area during plant construction could live in available housing near the plant site or in the nearby cities of Bonifay, Chipley, Marianna, or DeFuniak Springs. Local entrepreneurs could set up mobile home camps either near the plant site itself or in the nearby cities mentioned above. Figure 4.1-9, previously referred to, identifies potential construction mobile homes sites within the five-mile radius area.

Relocated construction workers could purchase a wider variety of goods and services than the commuting workers. Table 4.1-9 identifies the types of business which could be benefited by the relocated construction workers.

Few local purchases of major equipment are anticipated. However, construction material purchases will be substantial, and the nearby metropolitan areas where these purchases could be made will be greatly benefited. Local — lumber

Employment and income could also be benefited by plant construction workers. Table 4.1-10 indicates the estimated employment and income of the business establishments most likely to benefit from purchases from commuting construction workers. Relocated construction worker purchases could be larger and have more variety. The employment and income accruing from the business establishments identified in table 4.1-9 could then be increased.

State, local, and federal taxes could also be benefited by plant construction activities. Table 4.1-11 indicates the types of taxes which could be affected. The potential exists for increased ad valorem taxes due to new commercial development or intensification of existing uses. Sales and use taxes could increase from construction worker purchases; income taxes could increase from increased wages in commercial business; gasoline taxes could increase from construction worker purchases of gasoline; and finally, mobile home licenses could increase if new mobile home camps for relocated construction workers are developed.

Advalorum taxes on power plant.

4.1.9 References

(1) Hickman, C. E. Sound Level Monitoring Study, Joseph M. Farley Nuclear Plant, Alabama Power Company, Internal Southern Services, Inc., Document, 1973.

(2) Hickman, C. E. Sound Level Monitoring Study, Edwin I. Hatch Nuclear Plant, Georgia Power Company, Internal Southern Services, Inc., Document 1974.

(3) Colman, R., et. al. Long-Term Noise Monitoring At A Nuclear Generating Station Construction Site, Inter-Noise 74 Conference, Bechtel Corporation Study, September 30 to October 2, 1974

(4) 1973 Average Daily Traffic for Holmes and Washington Counties, Florida Department of Transportation, Division of Planning and Programming, Bureau of Planning, 1974.

TABLE 4.1-1

PROXIMITY OF HUMAN POPULATIONS AND IMPACTS ON THE ENVIRONMENT ARISING FROM NOISE

IMPACTED RESOURCE	NATURE OF IMPACT	I*	A**	AMELIORATIVE MEASURES	AMELIORATIVE RESPONSIBILITY
Human Population	Five-Mile Radius Area				
	Explosives or other, extraordinary, noise-producing construction activities are not anticipated. However, some pile-driving activity is expected approximately mid-year 1976 to the first part of 1977, and boiler "blowdown" is expected in December, 1979. No other noise influence is expected. Contractor's equipment will comply with U.S. Occupational Safety and Health Act (OSHA) safety standards.		X	Since the noise is expected to be of limited duration and to be attenuated away from the site, no other ameliorative measures are anticipated	-
	Beyond Five-Mile Radius Area				
	→ "Blowdown" noise from boiler start-up may affect some population living outside the five-mile radius area.		X	Noise to be intermittent, of short duration, and occur only during first three days of Unit start-up.	-
Land Use	Five-Mile Radius Area				
	No adverse impact on land use is expected from construction noise.				
	Beyond Five-Mile Radius Area				
	No adverse impact on land use is expected from construction noise.				

* - Impact is irreversible.
** - Impact is subject to amelioration.

TABLE 4.1-2

TIMETABLE OF PLANT CONSTRUCTION EMPLOYMENT, BY UNIT

Time Period Month/Year	Construction Phase	Average Daily Employment Unit 1	Unit 2	Subtotal	Total
1/76 to 6/67	Preliminary Clearing Grading	100	-	100	100
7/76 to 12/76	Preliminary	100	-	100	250
	Structural	150	-	150	
1/77 to 6/77	Preliminary	50	100	150	425
	Structural	275	-	275	
7/77 to 12/77	Preliminary	-	100	100	850
	Structural	350	75	425	
	Mechanical	275	-	275	
	Electrical	50	-	50	
1/78 to 6/78	Preliminary	-	50	50	1,225
	Structural	350	250	600	
	Mechanical	450	25	475	
	Electrical	100	-	100	
7/78 to 12/78	Structural	350	350	700	1,625
	Mechanical	450	275	725	
	Electrical	100	100	200	
1/79 to 6/79	Structural	350	350	700	1,800
	Mechanical	450	450	900	
	Electrical	100	100	200	
7/79 to 12/79	Structural	275	350	625	1,775
	Mechanical	400	450	950	
	Electrical	100	100	200	
1/80 to 6/80	Structural	150	350	500	1,450
	Mechanical	300	450	750	
	Electrical	100	100	200	
7/80 to 12/80	Structural	50	275	325	950
	Mechanical	75	400	475	
	Electrical	50	100	150	
1/81 to 6/81	Structural	-	150	150	550
	Mechanical	-	300	300	
	Electrical	-	100	100	
7/81 to 12/81	Structural	-	50	50	175
	Mechanical	-	75	75	
	Electrical	-	50	50	

Figure shows max of 900+800 or 1600 for 1 Quarter

TABLE 4.1-3

PROXIMITY OF HUMAN POPULATIONS AND IMPACTS ON THE ENVIRONMENT ARISING FROM MOVEMENT OF MEN

IMPACTED RESOURCE	NATURE OF IMPACT	I*	A**	AMELIORATIVE MEASURES	AMELIORATIVE RESPONSIBLITY
Human Population	Five-Mile Radius Area				
	Gulf expects traffic congestion resulting from construction worker's automobile movements into and out of the plant site to be minimal. When plant construction begins in 1976, Interstate No. 10 will be open to Cottondale. By that time, most of the U.S. No. 90 traffic (estimated at approximately 6,020 units in 1973***) will be diverted to I-10, leaving little remaining traffic on U.S. 90.			Since the impact is not adverse, no ameliorative measures are specified.	-
	Workers will enter and leave the plant site via Florida No. 179. Most construction worker traffic will also utilize U.S. No. 90, Florida No. 279, and No. I-10. Turning movements at Florida No. 179 and U.S. Florida No. 90 and at Florida No. 279 and U.S. No. 90 could be relatively congestion free due to the diversion of U.S. No. 90 traffic to No. I-10.			-	-

* - Impact is irreversible.
** - Impact is subject to amelioration.
*** - 1973 Average Daily Traffic, Washington County, Florida, Florida Department of Transportation.

TABLE 4.1-3 (Continued)

IMPACTED RESOURCE	NATURE OF IMPACT	I*	A**	AMELIORATIVE MEASURES	AMELIORATIVE RESPONSIBILITY
Land Use (Continued)	Beyond Five-Mile Radius Area				
	Commercial establishments catering to construction workers could develop. These could include eating, drinking, or entertainment establishments. This land use impact is not necessarily adverse because automobile-through movements by construction workers will not be occurring in these areas.		X	Since the impact is not adverse, no ameliorative measures are specified.	-

* - Impact is irreversible.
** - Impact is subject to amelioration.

TABLE 4.1-3 (Continued)

IMPACTED RESOURCE	NATURE OF IMPACT	I*	A**	AMELIORATIVE MEASURES	AMELIORATIVE RESPONSIBLITY
Human Population (Continued)	Beyond Five-Mile Radius Area Traffic congestion could occur during morning and afternon peak hours in Bonifay, Chipley, Mariana, and DeFuniak Springs if construction workers temproarily relocate to these areas during plant construction.		X	Local uniformed police could direct traffic in these cities during the peak hours to relieve congestion.	Washington/Holmes/Jackson/Walton County Sheriff departments.
Land Use	Five-Mile Radius Area				
1230	Land use changes, or in some cases an intensification of present uses, could occur. With the potential of over 1,300*** automobiles coming to and going from the construction site, new automobile oriented businesses such as gasoline service stations and repair shops, as well as new food and drink retail activity, could develop along U.S. No. 90 and Florida Nos. 179 and 279. Existing comercial establishments could expand. These land use changes could cause traffic congestion or could be incompatible with existing development.		X	New commercial development or expansions of present commercial development for the construction worker market could be subject to parking and locational regulations which could make them more compatible with existing development.	Washington and Holmes counties, or the cities of Caryville and Westville.

* - Impact is irreversible.
** - Impact is subject to amelioration.
*** - A high of approximately ~~1,800~~ workers is expected in 1979. The 1,300 figure is based on 1.3 persons per automobile. 1600

CSP-ER-4

TABLE 4.1-4

PROXIMITY OF HUMAN POPULATIONS AND IMPACTS ON THE ENVIRONMENT ARISING FROM MOVEMENT OF MATERIAL AND MACHINES

IMPACTED RESOURCE	NATURE OF IMPACT	I*	A**	AMELIORATIVE MEASURES	AMELIORATIVE RESPONSIBILITY
Human Population	Five-Mile Radius Area				
	Most of the construction material will be brought to the site by rail facilities. However, trucks will deliver certain materials to and from the site. These trucks could carry oversize or over-weight loads. This truck movement will use U.S. No. I-10 and Florida Nos. 279 and 179. Movement of earth off of the site is not anticipated.		X	Coordinate movement of trucks and materials to avoid concentrations of truck traffic.	Gulf/Contractor
	Beyond Five-Mile Radius Area				
	No adverse impact is anticipated due to the expected use of No. I-10 by all truck traffic.			Since the impact is not adverse, no ameliorative measures are specified.	
Land Use	Five-Mile Radius Area				
	No adverse land use changes are expected.			-	-
	Beyond Five Mile Radius Area				
	No adverse land use changes are expected.				

* - Impact is irreversible.
** - Impact is subject to amelioration.

TABLE 4.1-5

PROXIMITY OF HUMAN POPULATIONS AND IMPACTS ON THE ENVIRONMENT ARISING FROM ACTIVITIES ASSOCIATED WITH ANY PROVISION OF HOUSING

IMPACTED RESOURCE	NATURE OF IMPACT	I*	A**	AMELIORATIVE MEASURES	AMELIORATIVE RESPONSIBILITY
Human Population	Five-Mile Radius Area				
	The vast majority of construction workers are expected to come from such areas as Panama City and Pensacola, Florida and Mobile and Dothan, Alabama. Because of the completion of No. I-10 in the area, many of these workers are expected to commute to their homes daily. However, some workers may choose to temporarily relocate in the Caryville area in either rental apartments, houses, or mobile homes. Since rental housing is limited in the area, local entrepreneurs may set up mobile home camps for construction workers. These mobile home camps may be unsanitary and may not provide other facilities such as potable water and sanitary waste treatment, or adequate parking facilities.		x	Areas in convenient locations to the plant construction site could be set aside for the orderly placement of mobile houses, through zoning, including provisions for potable water, sanitary waste treatment, and adequate parking and turnaround areas. All provisions should be followed as set out in Chapter 10D-26. Trailer Park Rules as administered by the Division of Health, Florida Department of Health and Rehabilitative Services.	Cities of Caryville and Westville, Washington and Holmes counties, and owners of mobile home camps.

*Impact is irreversible.
**Impact is subject to amelioration.

TABLE 4.1-5 (Continued)

IMPACTED RESOURCE	NATURE OF IMPACT	I*	A**	AMELIORATIVE MEASURES	AMELIORATIVE RESPONSIBILITY
Human Population (Continued)	Beyond Five-Mile Radius Area				
	No adverse impact is expected from the approximately 12 Gulf employees engaged in construction oriented activities at the site. These employees with their families are expected to relocate in the general site area, or in Bonifay or Chipley.		X	-	-
Land Use	Five-Mile Radius Area				
	No adverse land use impact is expected.			-	-
	Beyond Five-Mile Radius				
	No adverse land use impact is expected.			-	-

*Impact is irreversible
**Impact is subject to amelioration

TABLE 4.1-6

PROXIMITY OF HUMAN POPULATIONS AND IMPACTS ON THE ENVIRONMENT ARISING FROM PROVISION OF TRANSPORTATION

IMPACTED RESOURCE	NATURE OF IMPACT	I*	A**	AMELIORATIVE MEASURES	AMELIORATIVE RESPONSIBILITY
Human Population	Five-Mile Radius Area				
	Transportation will not be provided to construction employees or Gulf employees at the construction site. However, railroad transportation will be provided on the site for heavy plant and construction equipment. The rail facilities on the site will not conflict with circulation of employment automobile traffic.			Since the impact is not adverse, no ameliorative measures are specified.	-
	Beyond Five-Mile Radius				
	No adverse impact is expected.			Since the impact is not adverse, no ameliorative measures are specified.	-
Land Use	Five-Mile Radius Area				
	Since the rail facilities associated with the construction activities lie within the site area, they will not be in conflict with the plant site land use. Land usage adjacent to where the rail facilities will be located is generally agricultural.			-	-
	Beyond Five-Mile Radius Area				
	No adverse impact is expected.			Since the impact is not adverse, no ameliorative measures are specified.	-

*Impact is irreversible.
**Impact is subject to amelioration.

TABLE 4.1-7

PROXIMITY OF HUMAN POPULATIONS AND IMPACT ON THE ENVIRONMENT ARISING FROM PROVISION OF EDUCATIONAL FACILITIES FOR WORKERS AND THEIR FAMILIES

IMPACTED RESOURCE	NATURE OF IMPACT	I*	A**	AMELIORATIVE MEASURES	AMELIORATIVE RESPONSIBILITY
Human Population	Five-Mile Radius Area				
	Some construction workers may relocate within the five-mile area and bring their families. If these families have school-age children, local schools could become overcrowded. The impact would depend on the number of children added to the area and local school capacities at the time of relocation.	x		Local school officials should make appropriate arrangements to distribute and balance the additional pupil load in the district.	Local school officials should determine from statistics the anticipated increase in attendants.
	Beyond Five-Mile Radius Area				
	Some construction workers may relocate in the local area beyond the five-mile radius area and bring their families. If these families have school-age children, local schools could become overcrowded. The extent of the impact would depend on the number of children added to the area and local school capacities at the time of relocation.	x		Local school officials should be notified as soon as possible as to how many school age children will likely relocate into their school districts. School officials should then make appropriate arrangements to distribute and balance the additional pupil load in the district.	Local school officials.
Land Use	Five-Mile Radius Area				
	No adverse impact is expected.				
	Beyond Five Mile Radius Area				
	No adverse impact is expected.				

*Impact is irreversible.
**Impact is subject to amelioration.

Can not Gulf help!

Bonifay Chipley Vernon

CSP-ER-4

TABLE 4.1-8

COMMERCIAL BUSINESSES MOST LIKELY TO BE FREQUENTED BY COMMUTING CONSTRUCTION WORKERS

Type of Business	Estimated Establishments
MOST LIKELY TO BENEFIT	
Auto Services	7
Eating and Drinking Places	1
SUBSTANTIAL BENEFIT POTENTIAL	
Food Stores	4
Total	12

TABLE 4.1-9

COMMERCIAL BUSINESSES BENEFITED BY RELOCATED CONSTRUCTION WORKERS

MOST BENEFITED

Gasoline Service Stations
Eating and Drinking Places
Drug Stores and Proprietary Stores
Hotels, Motels, Tourist Courts, Camps
Auto Repair, Auto Services, Garages

SUBSTANTIALLY BENEFITED

General Merchandise Group Stores
Food Stores
Apparel and Accessory Stores
Miscellaneous Retail Stores
Motion Pictures
Other Amusement and Recreation Services
Building Materials, Hardware, and Farm Equipment
Finance, Insurance, and Real Estate
Personal Services

LEAST BENEFITED

Automotive Dealers
Furniture, Home Furnishings, and Equipment Stores
Non-store Retailers (General Merchandise)
Miscellaneous Repair Services
Miscellaneous Business Services

Basis for figuring

TABLE 4.1-11

ESTIMATED STATE AND LOCAL TAXES POTENTIALLY INCREASED BY CONSTRUCTION ACTIVITIES

Type of Tax	Washington County ($000)	Holmes County ($000)	Total ($000)
Ad Valorem	$ 867	$ 452	$1,319
Sales and Use	391	428	819
Income	NA*	NA*	NA*
Gasoline	510	522	1,032
Mobile Home License	NA*	NA*	NA*
Racing Tax	464	-	464
TOTAL	$2,232	$1,402	$3,634

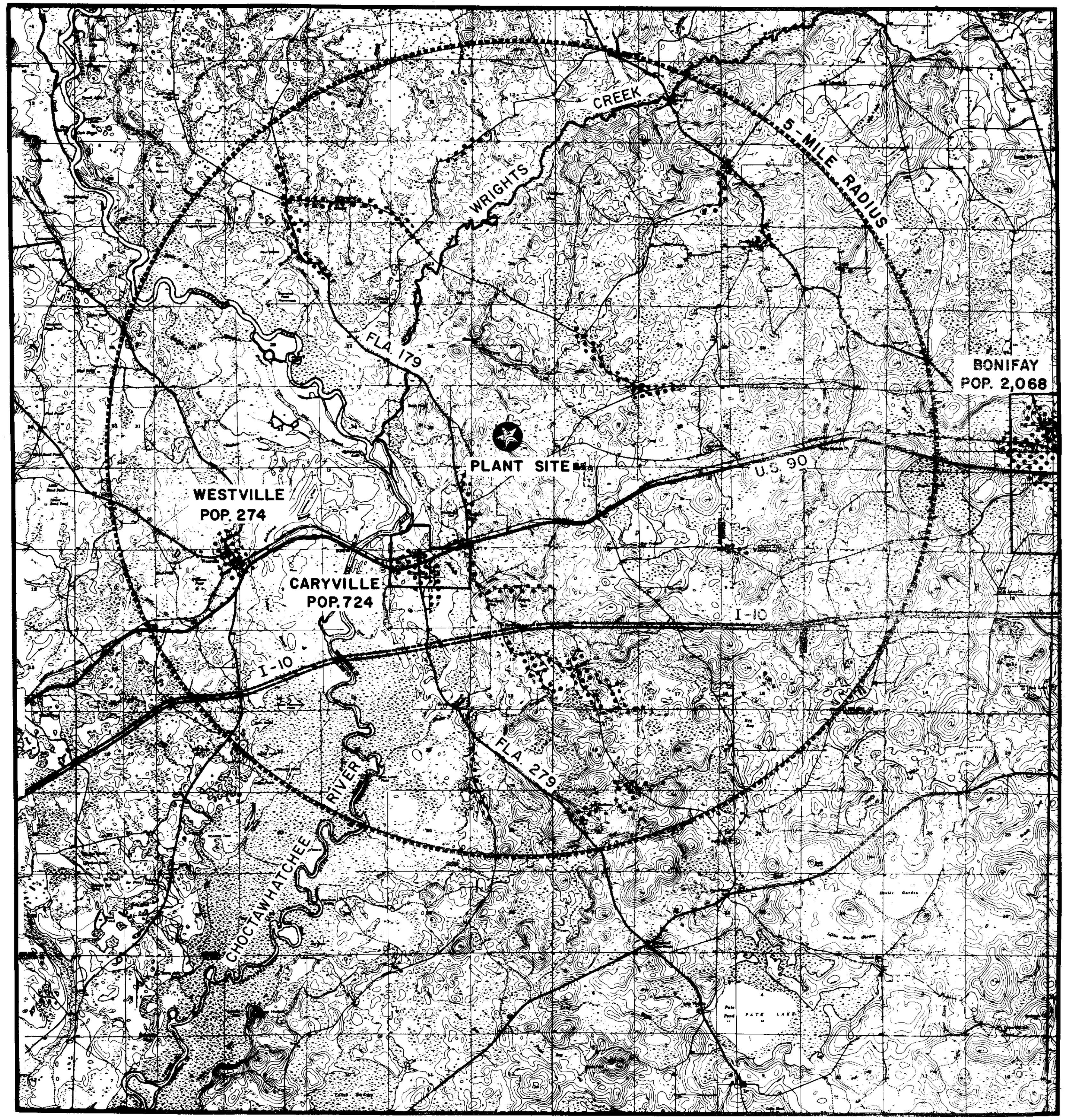
Data Source: Florida Statistical Abstract, 1973.
NA* = Data Not Available
Gulf Plant Site taxes excluded

TABLE 4.1-10

ESTIMATED EMPLOYMENT AND INCOME TO BE REALIZED BY COMMUTING CONSTRUCTION WORKERS

	Number of Present Employees	1972* Income ($000)
Most Likely to Increase	21	$49.8
Substantial Potential to Increase	5	$ 1.3
Total	26	$51.1

* The low income figure would indicate that most of the employees are part-time.



NORTH

SCALE 1" = 8000'

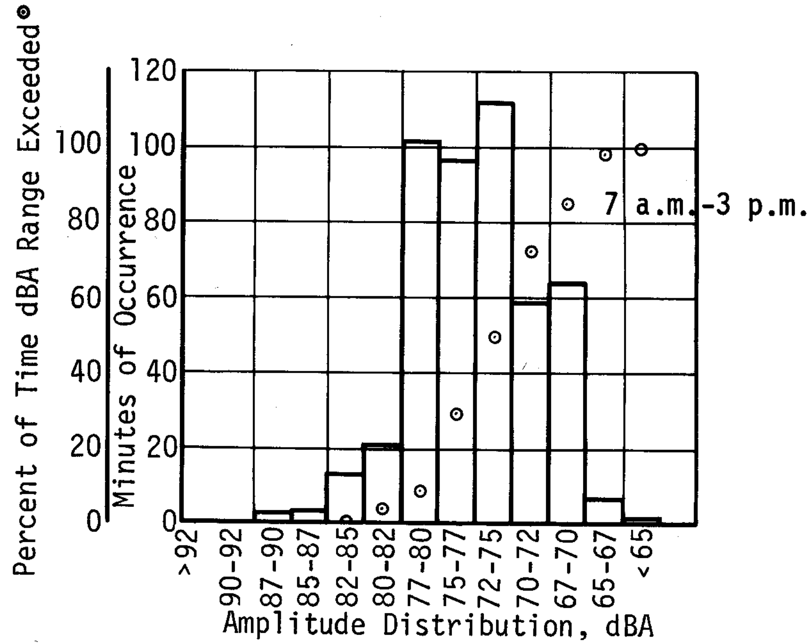
CONCENTRATIONS OF POPULATION

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

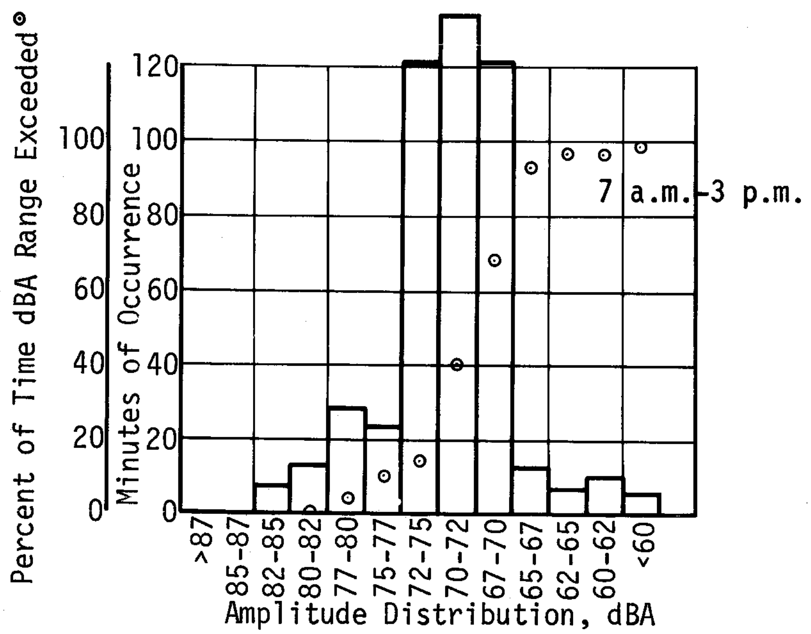
GULF POWER CO.
CARYVILLE STEAM PLANT

PROXIMITY OF HUMAN POPULATION

FIGURE 4.1-1

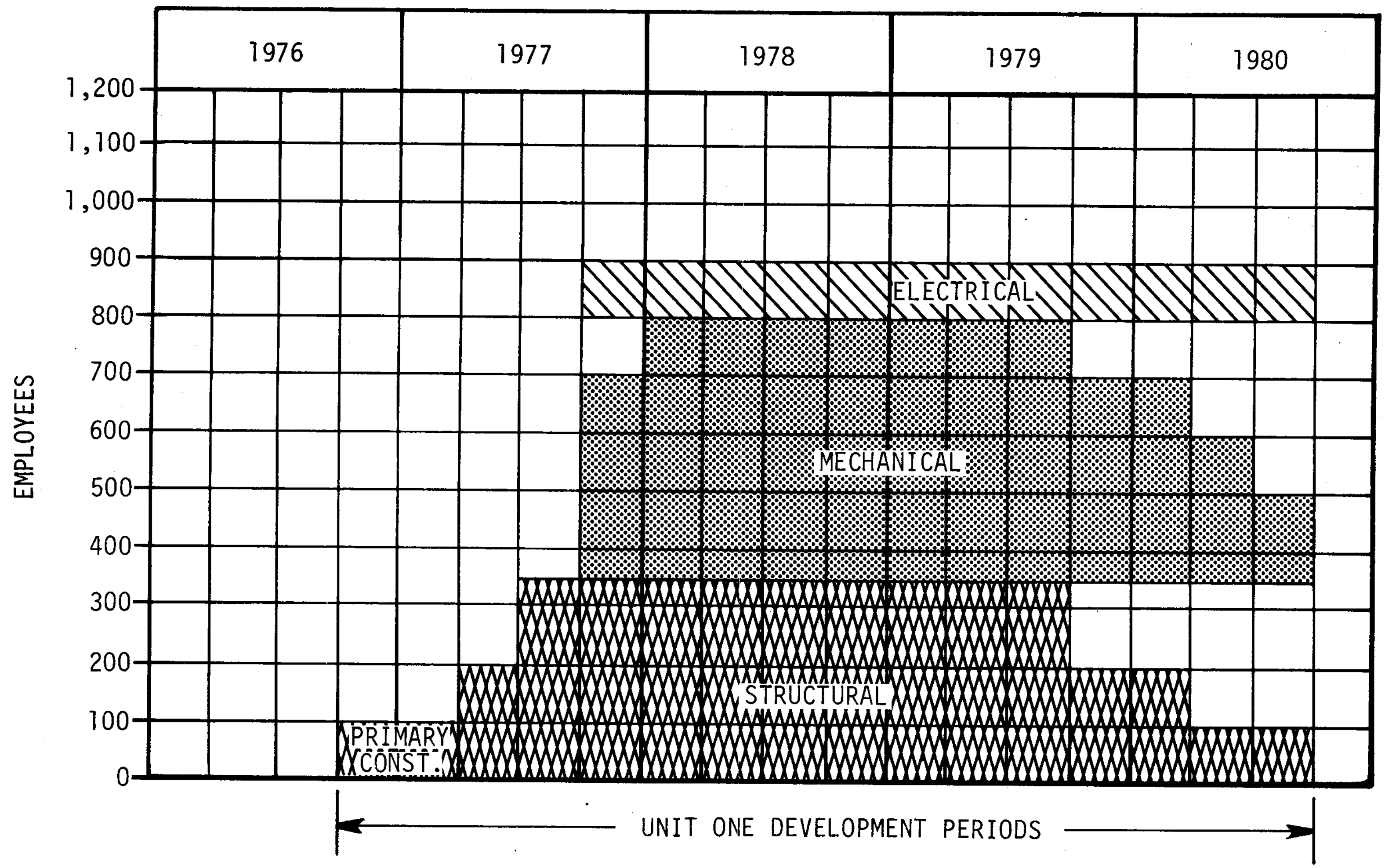


a. Sound Levels at 200 Feet



b. Sound Levels at 400 Feet

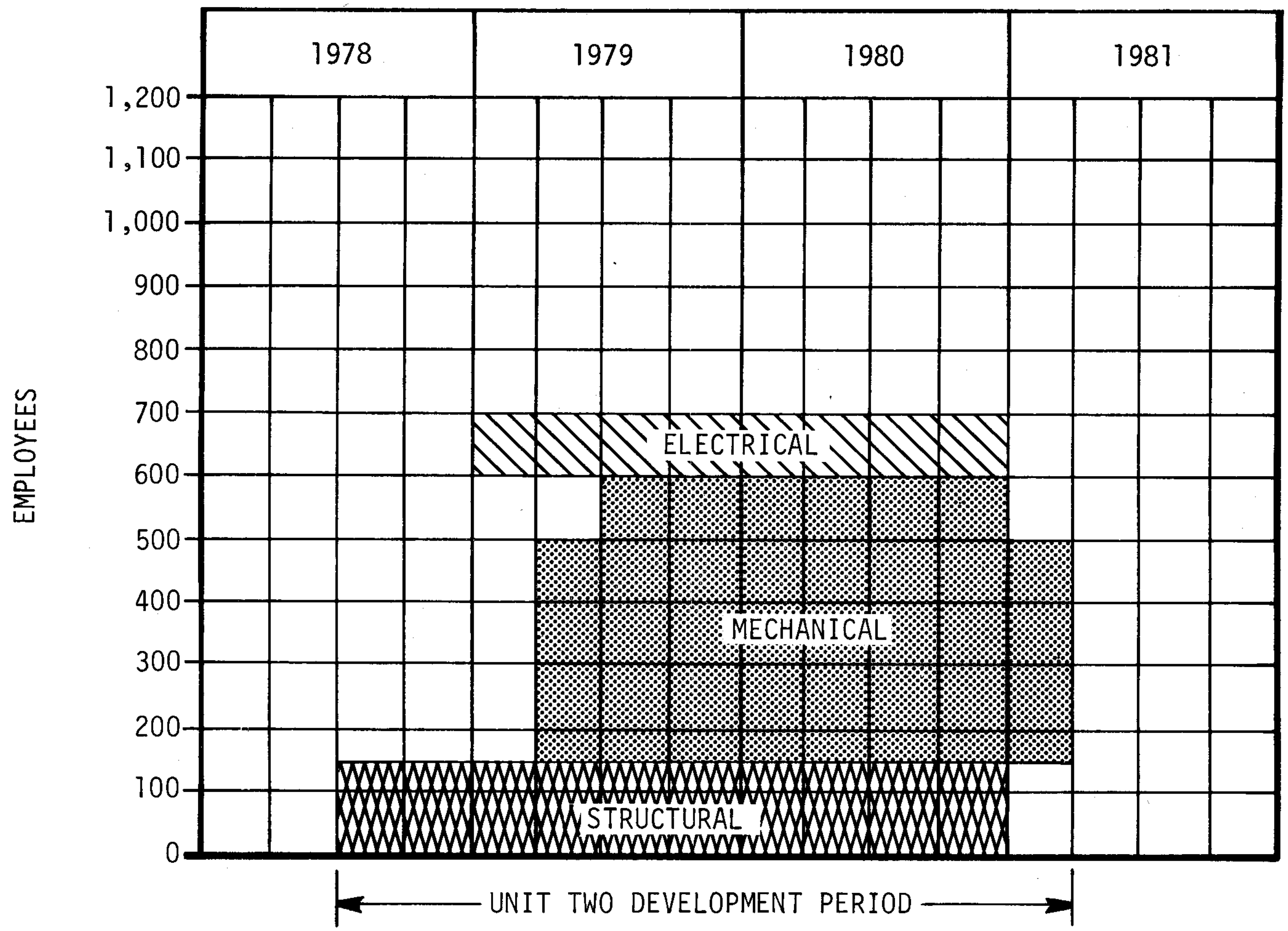
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	HISTOGRAMS OF dBA SOUND LEVELS MEASURED AT 200 FEET AND 400 FEET FROM A MAJOR CONSTRUCTION AREA
		FIGURE 4.1-2



GULF POWER CO.
CARYVILLE STEAM PLANT

SCHEDULE OF ESTIMATED WORK FORCE IN SITE PREPARATION AND PLANT CONSTRUCTION FOR UNIT ONE

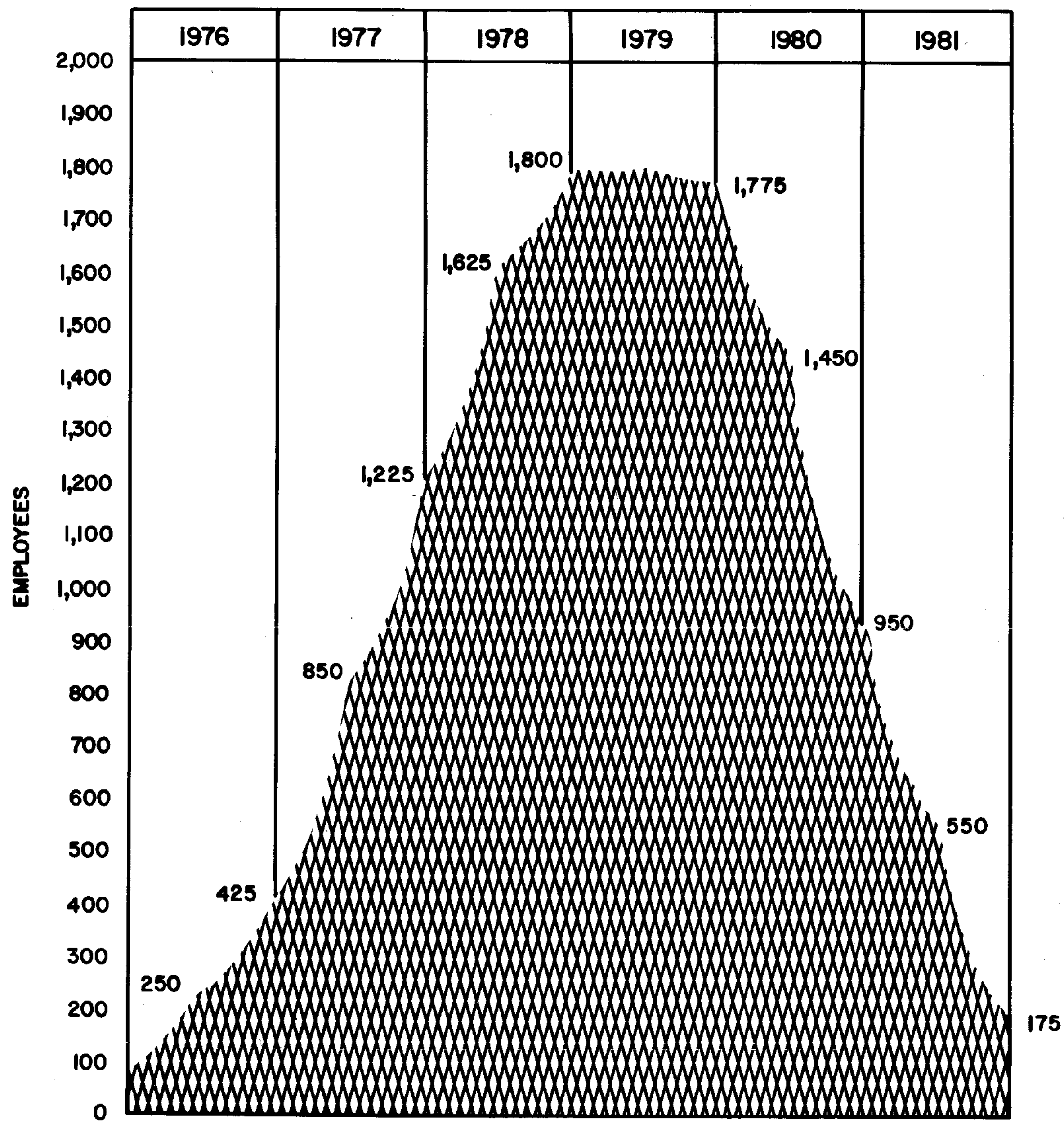
FIGURE 4.1-3



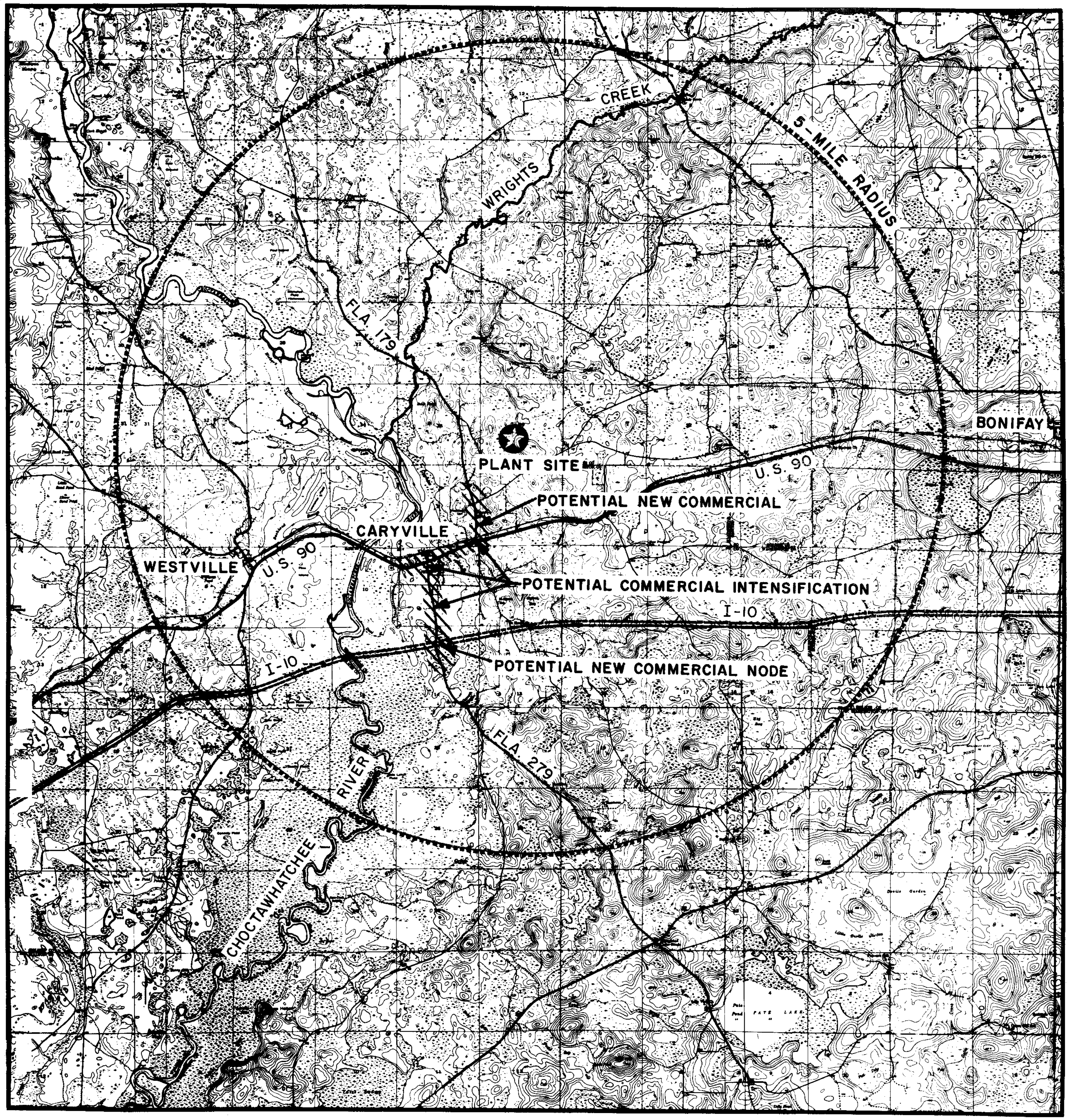
GULF POWER CO.
CARYVILLE STEAM PLANT

SCHEDULE OF ESTIMATED WORK FORCE IN SITE PREPARATION AND PLANT CONSTRUCTION FOR UNIT TWO

FIGURE 4.1-4



GULF POWER CO. CARYVILLE STEAM PLANT	SCHEDULE OF ESTIMATED WORK FORCE IN SITE PREPARATION AND PLANT CONSTRUCTION
	FIGURE 4.1-5



NORTH
SCALE 1" = 8000'

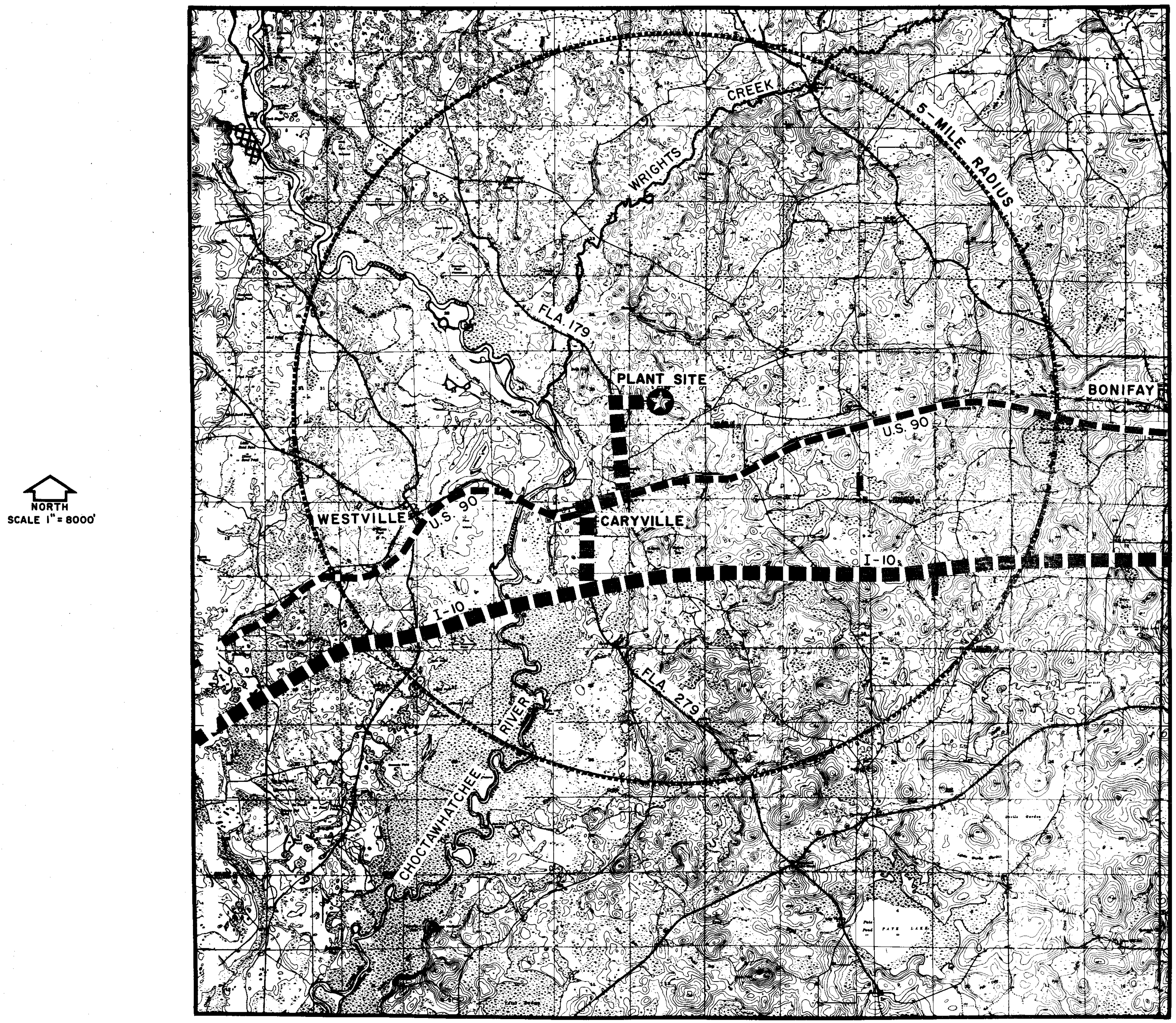
POTENTIAL AREAS OF COMMERCIAL ACTIVITY

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

POTENTIAL LAND USE CHANGES GENERATED BY CONSTRUCTION TRAFFIC

FIGURE 4.1-6



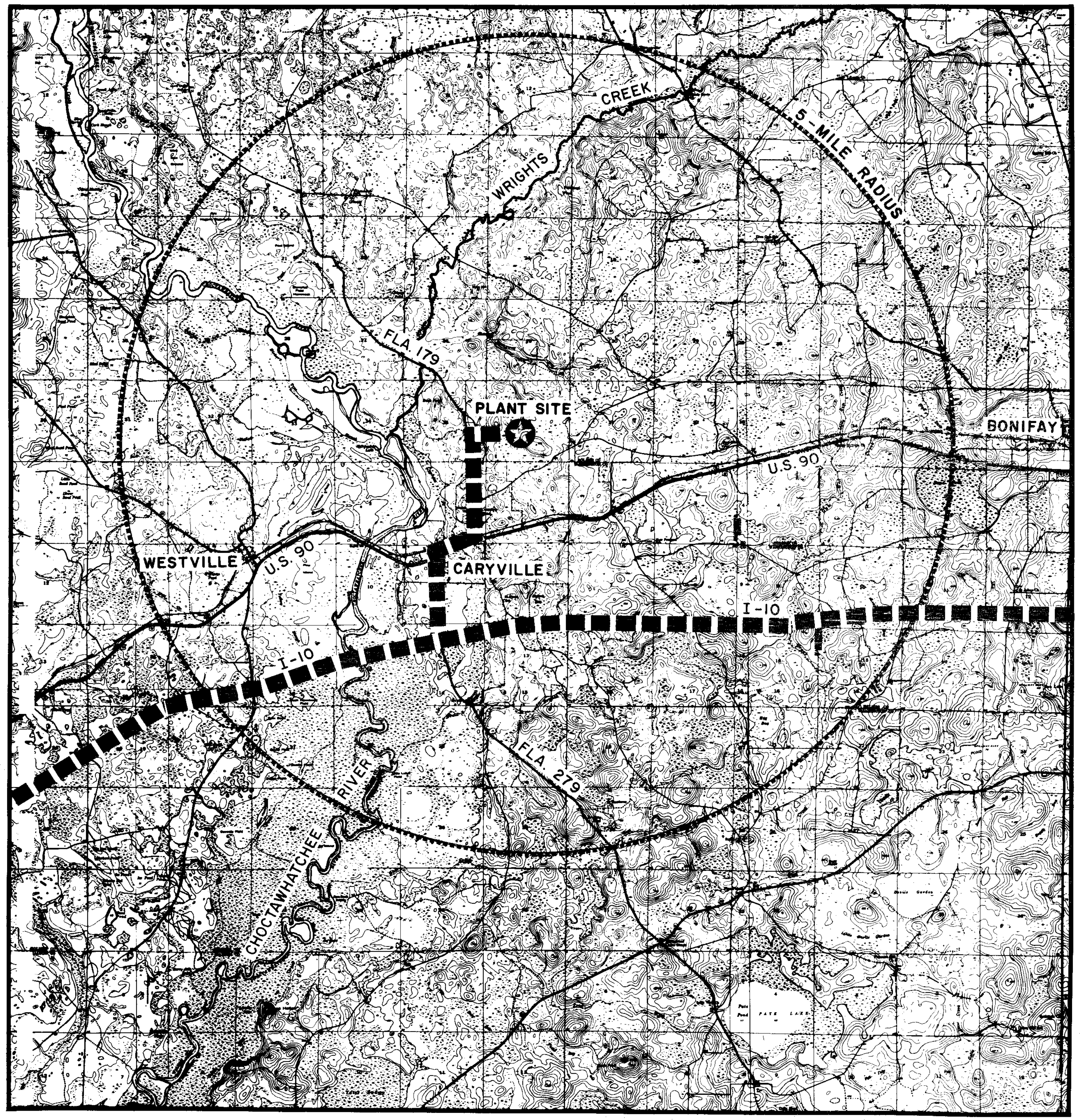
POTENTIAL MAJOR TRAFFIC FLOW
POTENTIAL SECONDARY TRAFFIC FLOW

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

PONTENTIAL TRAFFIC FLOW

FIGURE 4.1-7



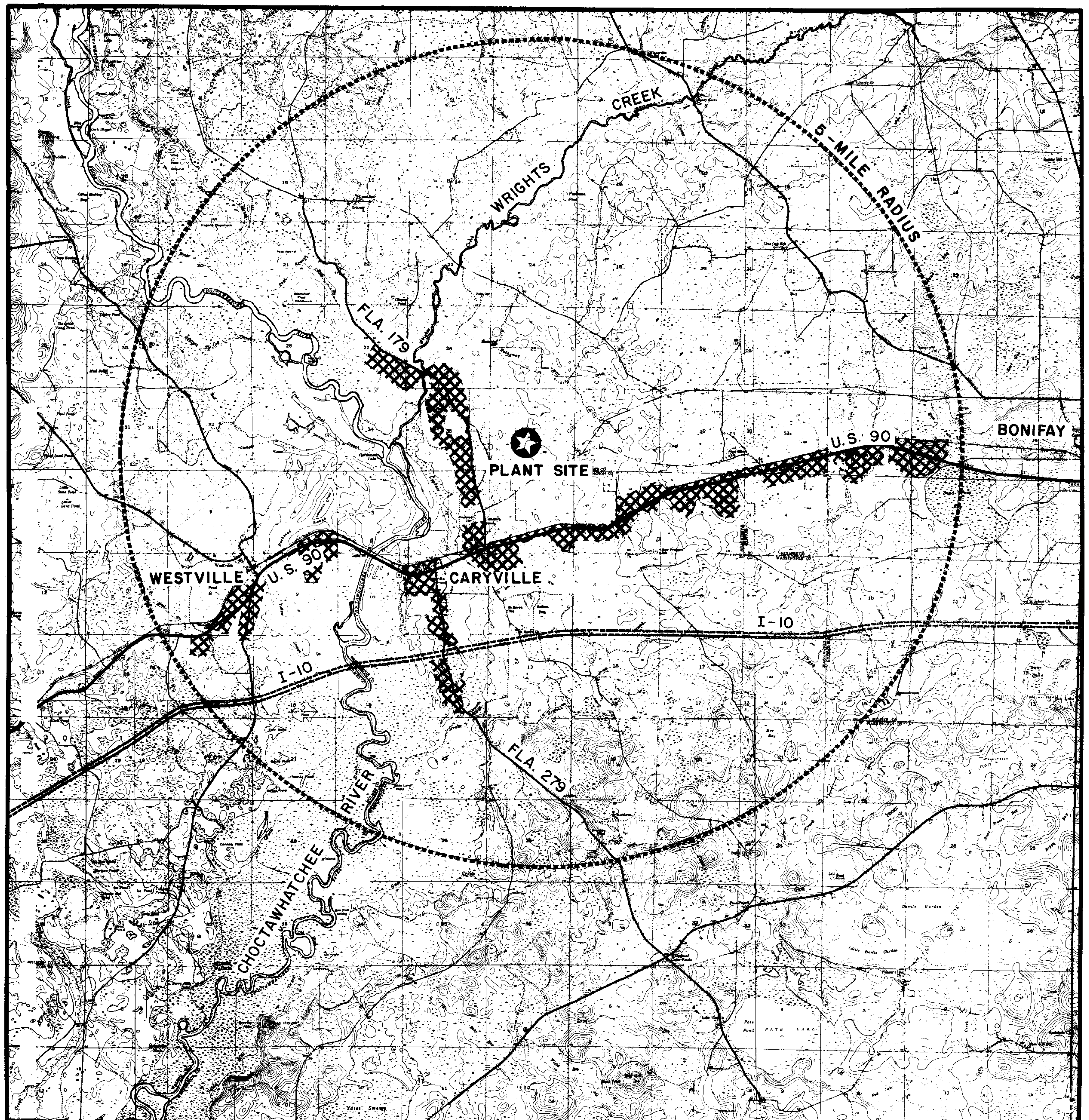
NORTH
SCALE 1"=8000'

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

PONTENTIAL TRUCK MOVEMENT

FIGURE 4.1-8



NORTH
SCALE 1" = 8000'

POTENTIAL AREAS FOR MOBILE HOME SITES

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

POTENTIAL CONSTRUCTION WORKER MOBILE HOME SITES

FIGURE 4.1-9

4.2

4.2 Special Features

4.2.1 Boiler Blowdown Noise

A special feature in the nature of an environmental effect is noise resulting from "blowing down" major steam-piping system. (Steam-piping system "blowing down" is not to be confused with the "blowdown" operation associated with cooling towers. Refer to the first paragraph following subsection 5.6.5 D, "Sound Levels During Plant Operation.") This operation is performed by systematically blowing steam through major steam-piping systems to thoroughly cleanse their interiors immediately prior to final tie-in of the boiler to the turbine. This blowdown is necessary to remove any debris or scale or tools left in the boiler or piping that would damage the turbine. "Blowdown", a prestart-up operation occuring late in the construction cycle, is usually accomplished within a span of several days. The noise produced, the sound and level of which can best be likened to that of a jet aircraft engine, is not continuous over the entire blowdown time span. Rather, a series of blows with durations measured in seconds and possibly minutes are involved with 45- to 90-minute intervals in-between for resupplying boiler feedwater and the build-up of the boiler pressure for the next "blow". This operation is normally conducted during daylight hours only.

4.2.2 Other Effects

Other than fertilizer, which will be used for reseeding and grassing activities, there will be no deleterious chemicals, growth retardants, biocides, etc., used either during or after the site clearing and grading phases of construction.

4.3

4.3 Associated Transmission Facilities Construction

4.3.1 Introduction

Construction of transmission facilities will be performed in such a manner as to minimize environmental changes through careful planning and implementation of rights-of-way selection and by using existing corridors to the maximum extent. The following are the changes expected to occur due to construction of transmission facilities:

A. The loss of approximately 0.63 acres of land from vegetative production. The transmission line rights-of-way can be used for growing of crops and other agricultural uses so that only land actually occupied by structures will be affected.

B. Approximately 1,927 acres of land being maintained in a subclimatic condition. Periodic removal of vegetation greater than six inches in height will enhance the development of grasses, other herbaceous plants, and woody shrubs. Such removal will produce a subclimatic condition similar to an "old field" successional status (1).

C. Some changes in wildlife populations, especially small animals, as a result of habitat alteration. Populations of small game animals are expected to increase due to increased availability of new habitat within the corridor rights-of-way. 2

4.3.2 Environmental Guidelines

Ecological concerns played a major part in Gulf's establishing environmental guidelines in its corridor study and selection process. Certain aspects of these guidelines are applicable to and will be followed during construction phases, while other aspects consider operation and maintenance phases. Additionally, potential problems during construction and maintenance phases have been anticipated. These are defined in both general and site-specific terms where activity within or near important natural systems will occur.

4.3.2.1 Guidelines for Corridor Selection - The following three guidelines were used to select Gulf's proposed transmission line corridors:

A. Rights-of-way selection has been made with the objective of preserving important systems and minimizing conflict with current and future regional land-use planning.

B. Existing rights-of-way will be used or expanded where feasible to minimize impact of new corridors on natural systems.

C. Sensitive areas (as defined in 4.3.3 below) have been avoided wherever possible.

4.3.2.2 Guidelines for Corridor Construction - Guidelines for the following subject areas are presented below: construction wastes, debris, and facilities; clearing; stream crossings; erosion and discharge; dust control; waste disposal; and encounters of endangered or protected species.

A. Construction Wastes, Debris, and Facilities - Construction camps, storage areas, and temporary buildings required in the performance of construction activities will be located to minimize disturbance of the natural community. Work areas will be furnished with sanitary facilities as needed. Work areas will be kept in a neat, clean, and sanitary condition at all times.

B. Clearing

1. Initial clearing will be conducted using mowing and brush-cutting tractors and/or by hand cutting as necessary. Larger vegetation will be clear cut to a minimum six inches height. Grass cover will be left intact.

2. The width of a given corridor segment to be cleared will vary, but in each case, a minimum area will be cleared consistent with construction requirements.

C. Stream Crossings 2

1. Transmission line corridor rights-of-way will cross streams at right angles where feasible.

2. When siting transmission line support structures, maximum use will be made of higher ground bordering streams and low areas.

3. Soil will not be pushed into stream channels.

D. Erosion and Discharge

1. Erosion directly traceable to construction activities could occur as a result of one or a combination of the following factors:

   a. Clearing of vegetation from unstable soils.

   b. Changes in surface water drainage patterns.

   c. Movement of construction vehicles resulting in the natural soil surface being broken and unconsolidated soils being exposed.

Three control measures will be employed as required by site specific conditions to provide effective control. These are (a) control of

runoff, (b) use of sediment traps, if necessary, and (c) alert construction personnel of the potential for erosion in areas where the transmission line corridor crosses erodible soil series (2). (See figures 4.3-1, -2, -3, and -4.)

Gulf will make every effort to prevent erosion during initial construction. Upon completion of construction, damaged areas will be filled, terraced, and/or planted to control existing and eliminate future erosion.

2. Streams likely to be affected by construction-induced erosion and sedimentation will be anticipated and protected if necessary by appropriate sediment trapping procedures. Proximity of construction to a stream, weather, and physical conditions such as susceptibility of the soil to erosion and slope will dictate those mitigative measures to be employed at a given locality.

E. Dust Control

1. Dust control measures will be applied whenever a dust nuisance occurs due to rights-of-way construction activities.

2. A proposed method of dust control is water sprinkling. 2

F. Waste Disposal

1. Proper arrangements will be made for the collection and disposal of domestic wastes.

2. Spillage of cement and concrete will be minimized by care in handling.

3. Precautions will be taken to prevent construction debris from entering streams. Such materials as wood, litter, steel cuttings, wire, oil, and grease will be stockpiled or stored in predesignated areas and periodically transported to proper disposal sites.

4. Unmarketable timber and other vegetative growth will be windrowed, or chipped and used as a mulch, for erosion control purposes on the rights-of-way. This practice is considered economically and ecologically sound for maximizing resource use. Some environmental benefits which would accrue include (a) an increase in the number of nesting and foraging sites for small animals, (b) retardation of soil erosion, (c) return of chemically bound nutrients to the soil, and (d) building and binding of topsoil as organics decompose slowly in place.

G. Encounters of Endangered or Protected Animals - Gulf will inform the Florida State Game and Freshwater Fish Commission of the presence of any endangered or protected animals encountered during

construction of the transmission line corridor (3, 4). Animals most likely to be encountered are the American alligator (Alligator mississippiensis), and the Gopher tortosie, (Gopherus polyphemus).

4.3.3 Potentially Sensitive Areas

Sections of the new lines may have to be routed through or near lands visually sensitive to the presence of transmission lines and associated structures. Visually sensitive lands as described by the guidelines include natural shoreline, marshland, wildlife refuges, parks, national and state monuments, scenic areas, recreation areas, historic areas, national forests and/or heavily timbered areas, shelter belts, steep slopes, and wilderness areas.

Visually sensitive lands applicable to the proposed project include (a) rivers and lowlands and (b) state forests. A detailed discussion of these two land types is presented below in subsections 4.3.3.1 and 4.3.3.2, respectively. The total length of new lines through various categories of visually sensitive land is as follows:

Category	Length of New Lines
Parks	None
National and State Monuments	None
Scenic Areas	None
Recreation Areas	None
Historic Areas	None
Marshland	Approximately 5 Miles
Shoreline	Approximately 1 Mile
State Forest (outside of but adjacent to)	Approximately 0.5 Mile

2

Gulf personnel will, thorugh on-site inspections and briefings, alert its clearing and grading contractors to problems associated with working in these areas.

4.3.3.1 Rivers and Lowlands - Rivers, streams, and their associated floodplains; swampy areas; and bayheads were categorized as rivers and lowlands. Potential effects of the proposed transmission line corridor can be associated with the construction and maintenance of corridors crossing or paralleling these sensitive areas. Ten such potentially sensitive areas were identified within the study region. They represent approximately 276 acres (14 percent) out of the total 1,927 acres to be committed.

4.3.3.1.1 Choctawhatchee River

A. General Description - The proposed transmission line corridor will cross the Choctawhatchee River approximately 1.0 mile west of the proposed Caryville plant site. The 0.5 mile wide zone discussed in

subsection 6.3.3.1, "Corridor Zone Studied," crosses the river and its bordering floodplain for a distance of approximately two miles. The area is presently crossed by a 46,000-volt (46-kilovolt (kV)) transmission line corridor which will require widening to accommodate three additional 230-kV lines. Approximately 36 acres may be affected. (See figures 3.8-1, sheet 7, and 4.3-1.)

B. Mitigative Action - Gulf will construct transmission line towers on elevated areas (apparent former levees noted in aerial photographic study of this area), and avoid the vulnerable wetlands by spanning these lower areas. Additionally, where feasible, Gulf will route the transmission corridor perpendicular across the floodplain to reduce the area affected.

4.3.3.1.2 Sandy Creek

A. General Description - Sandy Creek is a meandering stream which originates north-northeast of DeFuniak Springs and terminates in the Choctawhatchee River south of Ponce de Leon. After crossing this stream, the 0.5 mile zone parallels the stream and its floodplain for approximately 2.3 miles. Land in this section of the proposed corridor route is relatively flat and in agricultural use. The area selected is presently crossed by a 46-kV transmission line corridor. The existing corridor will be widened at the Sandy Creek crossing to accommodate three additional 230-kV lines. After 2
crossing Sandy Creek, two 230-kV lines will be constructed to the east-southeast while one new 230-kV line will continue to parallel the existing 46-kV line. Approximately 21 acres may be affected. (See figures 3.8-1, sheet 6, and 4.3-1.)

B. Mitigative Action - Mitigative action planned by Gulf will include:

1. Crossing the creek at right angles as discussed in the guidelines.

2. Widening the existing 46-kV corridor on the southern side rather than the northern side. This alignment would take advantage of natural vegetation barriers within the existing corridor to serve in an erosion control function.

4.3.3.1.3 Shoal River

A. General Description - The proposed transmission corridor will cross the Shoal River approximately 2.5 miles east of the Shoal River substation. The 0.5 mile zone crosses the river and its associated lowlands for a distance of approximately 1.0 mile. A 230-kV transmission line currently crosses the river at this point, and one additional 230-kV line is proposed. Interpretation of aerial photographs indicates that of the 1.0 mile affected, 0.5 mile is river and wetlands while the other 0.5 mile is mixed mesophytic

hardwoods. Approximately 10 acres may be affected. (See figures 3.8-1, sheet 2, and 4.3-2.)

B. Mitigative Action - Shoal River will be crossed incorporating topographically higher ground for structure location to mitigate potential effects on the wetlands and wildlife habitat.

4.3.3.1.4 Long Round Bay

A. General Description - Long Round Bay is located 5.0 miles northeast of the proposed Caryville plant site. The 0.5 mile zone crosses this bayhead area for a distance of 1.5 miles. A transmission line does not presently exist in the area; a single 230-kV line is proposed. Approximately 27 acres may be affected. (See figures 3.8-1, sheet 8, and 4.3-1.)

B. Mitigative Action - Ridges of topographically higher, dry land extend out into this low area, as determined by study of topographic maps and aerial photos. These areas will be used in siting of permanent structures.

4.3.3.1.5 Bayhead

A. General Description - A small bayhead, approximately 0.2 mile in diameter, will be bisected by the proposed transmission corridor. 2
This area is located 2.8 miles north of Whitehead Crossroads. No transmission lines exist in this area presently; a single 230-kV line is proposed. The 0.5 mile zone crosses this low area for a length of 0.2 mile. Approximately four acres of land may be affected. (See figures 3.8-1, sheet 10, and 4.3-3.)

B. Mitigative Action - Mitigative action by Gulf will be to span the area and locate permanent structures on topographically higher ground, if possible, or to circumvent the area. Particular attention will be given to minimizing any activity which would affect the quality of this system.

4.3.3.1.6 Holmes Creek

A. General Description - This small stream, which originates in northern Holmes County, will be crossed by the proposed transmission line corridor 2.0 miles north of New Hope. Holmes Creek enters the Choctawhatchee River approximately 7.0 miles south-southeast of the proposed transmission line crossing. The 0.5 mile zone comes in contact with the creek and its associated lowlands for a distance of approximately 0.3 mile. At present, no transmission lines exist in the area; one 230-kV line is proposed. Approximately five acres of land may be affected. (See figures 3.8-1, sheet 11, and 4.3-3.)

B. Mitigative Action - The proposed corridor will cross the creek at nearly right angles. The bordering high ridges of Holmes Creek and its associated floodplain will be employed in construction of the transmission towers. In so doing, particular attention will be given to erosion and runoff control.

4.3.3.1.7 Choctawhatchee River Lowlands

A. General Description - Approximately 0.7 mile west-northwest of Ebro, the Choctawhatchee River will be paralleled by the proposed transmission line corridor. The 0.5 mile zone comes in contact with the floodplain of the river for approximately five miles. A 115-kV transmission line already exists in this area; one additional 230-kV line is proposed. Approximately 73 acres of land may be affected. (See figures 3.8-1, sheets 12 and 13, and 4.3-3.)

B. Mitigative Action - Routing and construction in this area will be performed on the east side of the existing 115-kV line, if possible. This will take advantage of the topographically higher, drier land and thus eliminate the need for further encroachment on the floodplain. This may also reduce the need for herbicide usage that would be required in vegetation control and preserve any important wildlife habitat located in this segment of the floodplain.

4.3.3.1.8 Pine Log Creek 2

A. General Description - The proposed transmission line corridor will cross the Pine Log Creek 2.5 miles south-southwest of Ebro. Pine Log Creek originates four miles south of Vernon and enters the East River three miles west of an existing transmission line crossing. The 0.5 mile zone crosses the creek and its lowlands for a distance of 0.2 mile. At present, a 115-kV transmission line corridor exists; a single additional 230-kV line is proposed. Approximately three acres of land may be affected. (See figures 3.8-1, sheets 13 and 14, and 4.3-3.)

B. Mitigative Action - Pine Log Creek will be crossed at a point which represents a narrow segment of the watershed. The transmission corridor is expected to cross the stream at a right angle. Topographically higher ground will be employed for siting of permanent structures. During permanent structure siting and construction, Gulf will follow responsible construction methods to reduce potential erosion.

4.3.3.1.9 Lowland Near Laguna Beach

A. General Description - The proposed transmission lines will cross a lowland area between the Intercoastal Waterway and the Laguna Beach substation. In this area, the 0.5 mile zone comes in contact with the lowlands for approximately 3.5 miles. A 115-kV

transmission line presently crosses this area; one 230-kV line is proposed. Approximately 51 acres of land may be affected. (See figures 3.8-1, sheet 15, and 4.3-5.)

B. Mitigative Action - The corridor route has been planned to make maximum use of higher ground in structure siting. This, in turn, will minimize other potential adverse effects considered during planning of the corridor route.

4.3.3.1.10 Valleys in the Vicinity of the Intersection of Proposed Caryville Laguna Beach and Existing Shoal River - Smith Transmission Line Corridors

A. General Description - A series of relatively steep valleys occur near reference point "L" approximately one mile south-southeast of New Hope. The 0.5 mile zone crosses several of these valleys in a 2.5 mile reach of the corridor. No transmission lines exist in this area presently. A single 230-kV line is proposed. Approximately 45 acres of land may be affected. (See figures 3.8-1, sheet 12, and 4.3-3.)

B. Mitigative Action - Maximum use will be made of the higher, drier ridges between these valleys. The crossing will be aligned at angles to minimize impact on valleys. A minimum of clearing area. In addition, Gulf will ensure that adequate erosion control 2
measures are applied during construction in this segment of the corridor.

4.3.3.2 State Forests

A. General Description - The proposed transmission lines will parallel the western boundary of Pine Log State Forest. The 0.5 mile zone comes in contact with the state forest for approximately 3.0 miles. This area is planted with pine trees, and appeared relatively well drained during aerial photo study. Natural drainage from the state forest is from the east and toward the corridor. This would preclude the possibility of any construction-induced, water-quality problems affecting the forests. Approximately 44 acres of land may be affected. (See figures 3.8-1, sheets 13 and 14, and 4.3-3.)

B. Mitigative Action - Gulf is aware that the most likely impact on this sensitive area would be visual in character. Therefore, Gulf will direct the attention and the required effort necessary to preserve the aesthetics of this area.

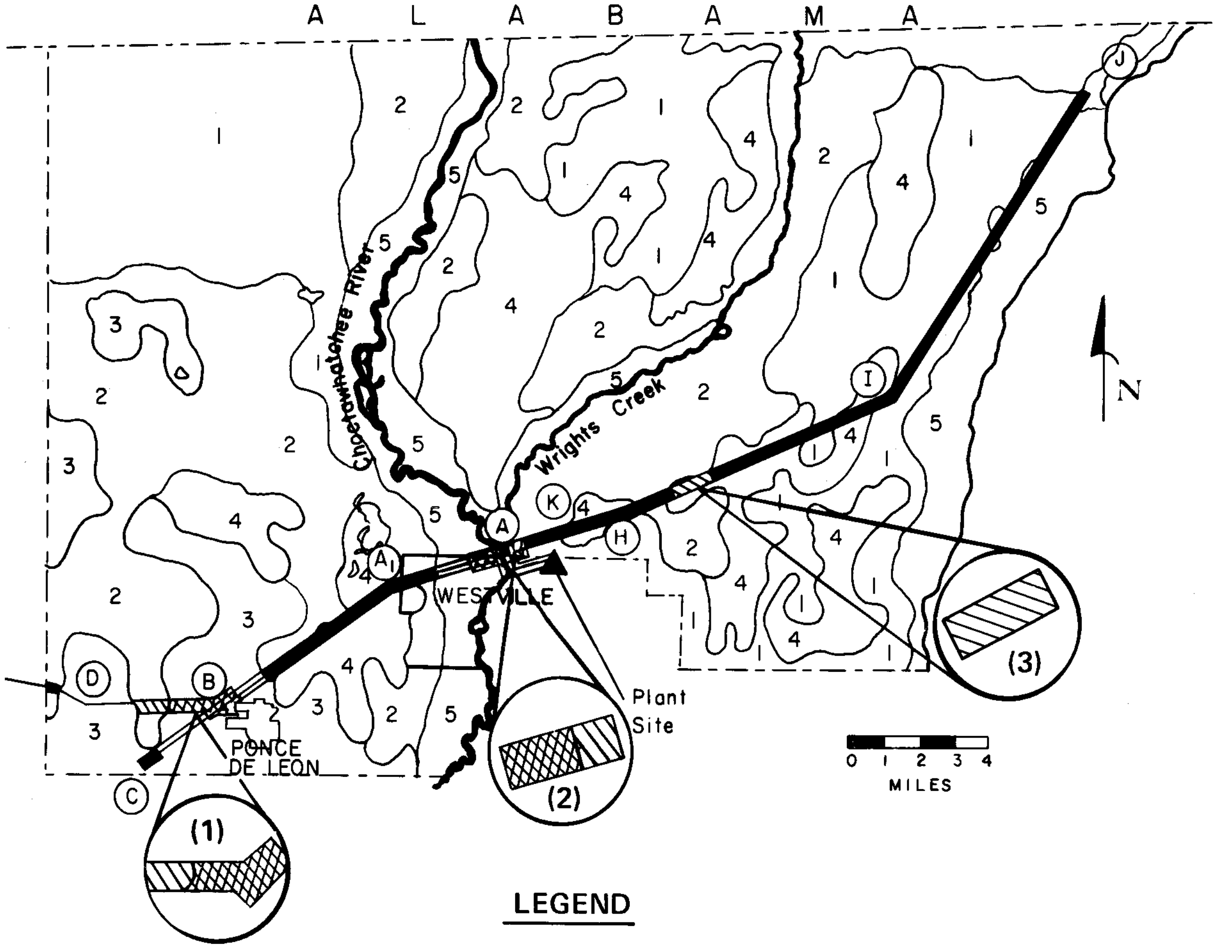
4.3.4 References

(1) Odum, E.P. Fundamentals of Ecology, Second Ed., W. B. Saunders Co., Philadelphia, p. 546, 1959.

(2) The Florida General Soils Atlas with Interpretations for Regional Planning Districts I & II, Florida Dept. of Administration, Division of State Planning, Bureau of Comprehensive Planning, Tallahassee, p. 36, 1974. 2

(3) United States List of Endangered Fauna, U. S. Dept of the Interior, Fish and Wildlife Service, Washington, p. 22, 1974.

(4) Frye, O.E., Jr. "Threatened Species of Florida Wildlife." Florida Wildlife, 27:(12) 15-18, 1974.



LEGEND

- Soil Associations Susceptible to Erosion Crossed by Proposed Transmission Corridor (A)
- River and Lowland Areas Crossed by Proposed Transmission Corridor (B)
- Overlap of Areas (A) & (B)
- Transmission Line Corridor
- State Boundary Line
- County Boundary Line
- Reference Point

Potentially Sensitive Areas

(1) Sandy Creek
(2) Choctawhatchee River
(3) Long Round Bay

Amendment 2 8/75

Gulf Power Company	GULF POWER CO CARYVILLE STEAM PLANT	POTENTIALLY SENSITIVE AREAS CROSSED BY TRANSMISSION LINES IN HOLMES COUNTY
		FIGURE 4.3-1 (Sheet 1 of 2)

SOIL RATINGS AND LIMITATIONS AND FEATURES AFFECTING SELECTED USES BY SOIL ASSOCIATIONS 1/

Degree and Kind of Limitations for

Map Symbol	Name of Association with Component Soils 2/	Percent of Association 3/	Sanitary Facilities: Septic Tank Absorption Fields	Sanitary Facilities: Sewage Lagoons	Sanitary Facilities: Sanitary Landfill (Trench Type)	Community Development: Shallow Excavations	Community Development: Dwellings	Community Development: Light Industry	Community Development: Local Roads and Streets	Water Management: Embankments Dikes and Levees	Water Management: Excavated Ponds (Aquifer Fed)	Recreation: Camp and Picnic Areas	Recreation: Playgrounds	Recreation: Paths and Trails
1	Dothan - Ardilla (32%) Dothan Ardilla Others	 65 20 15	SEVERE Severe PS Severe WT,PS -	MODERATE Moderate HS Severe WT -	SLIGHT Slight - Severe WT -	SLIGHT Slight - Slight - -	SLIGHT Slight - Severe WT -	SLIGHT Slight - Severe WT -	SLIGHT Slight - Moderate WT -	SLIGHT Slight - Moderate PG,CP,LS -	SEVERE Severe DTW Moderate DTW -	SLIGHT Slight - Moderate WT -	MODERATE Moderate PS Moderate WT -	SLIGHT Slight - Moderate WT -
2	Fuqua - Dothan (32%) Fuqua Dothan Others	 40 30 30	MODERATE Moderate PWT Severe PS -	SLIGHT Slight - Moderate HS -	SLIGHT Slight - Slight - -	MODERATE Moderate LS Slight - -	SLIGHT Slight - Slight - -	SLIGHT Slight - Slight - -	SLIGHT Slight - Slight - -	MODERATE Moderate PG Slight - -	SEVERE Severe DTW Severe DTW -	MODERATE Moderate TS Slight - -	MODERATE Moderate TS Moderate PS -	MODERATE Moderate TS Slight - -
3	Troup - Fuqua (9%) Troup Fuqua Others	 40 30 30	SLIGHT Slight - Moderate PWT -	SEVERE Severe PR Slight - -	SEVERE Severe PR,TS Slight - -	SEVERE Severe CC Moderate CC -	SLIGHT Slight - Slight - -	SLIGHT Slight - Slight - -	SLIGHT Slight - Slight - -	SEVERE Severe PR,PG Moderate PG -	SEVERE Severe DTW Severe DTW -	SEVERE Severe TS Moderate TS -	SEVERE Severe TS Moderate TS -	SEVERE Severe TS Moderate TS -
4	Pantego - Stilson (15%) Pantego Stilson Others	 30 20 50	SEVERE Severe WT Moderate WT -	SEVERE Severe PR,WT Moderate PR,HS -	SEVERE Severe PR,WT Severe WT,PR -	SLIGHT Slight - Moderate CC -	SEVERE Severe WT Slight - -	SEVERE Severe WT Slight - -	SEVERE Severe WT Slight - -	MODERATE Moderate PR,PG,EE Moderate PR,PG,EE -	SLIGHT Slight - Severe DTW -	SEVERE Severe WT Moderate TS,WT -	SEVERE Severe WT Moderate TS,WT -	SEVERE Severe WT Moderate TS,WT -
5	Bibb (12%) Bibb Others	 80 20	SEVERE Severe FL,WT -	SEVERE Severe FL,WT -	SEVERE Severe FL,WT -	SEVERE Severe FL,WT -	SEVERE Severe FL,WT -	Severe Severe FL,WT -	Severe Severe FL,WT -	NR NR - -	SLIGHT Slight - -	SEVERE Severe FL,WT -	SEVERE Severe FL,WT -	SEVERE Severe FL,WT -

Map Symbol	Name of Association with Component Soils 2/	Percent of Association 3/	Soil Features Affecting Water Management: Pond Reservoir Areas	Soil Features Affecting Water Management: Drainage	Soil Features Affecting Water Management: Irrigation	Suitability as a Source of: Topsoil	Suitability as a Source of: Sand	Suitability as a Source of: Roadfill	Soil Potential for Agriculture: Capability Unit	Soil Potential for Agriculture: Pine Woodland	Soil Potential for Agriculture: Cropland	Soil Potential for Agriculture: Improved Pasture	Suitability as a Habitat for Wildlife: Openland Wildlife	Suitability as a Habitat for Wildlife: Woodland Wildlife	Suitability as a Habitat for Wildlife: Wetland Wildlife
1	Dothan - Ardilla (32%) Dothan Ardilla Others	 65 20 15	PR PR - PR - -	NN NN - WT,PS - -	FAV FAV - WT - -	FAIR Fair TL Fair TL -	POOR Poor - Poor - -	GOOD Good - Fair WT -	- IIe-10 - IIe-17 - -	HIGH High - High - -	HIGH High - High - -	HIGH High - High - -	GOOD Good - Good - -	GOOD Good - Good - -	V. POOR V. Poor - Fair - -
2	Fuqua - Dothan (32%) Fuqua Dothan Others	 40 30 30	FAV FAV - PR - -	NN NN - NN - -	FAV FAV - FAV - -	POOR Poor TS Fair TL -	POOR Poor - Poor - -	GOOD Good - Good - -	- IIs-8 - IIe-10 - -	MODERATE Moderate - High - -	HIGH High - High - -	HIGH High - High - -	GOOD Good - Good - -	FAIR Fair - Good - -	V. POOR V. Poor - V. Poor - -
3	Troup - Fuqua (9%) Troup Fuqua Others	 40 30 30	PR PR - FAV - -	NN NN - NN - -	PR,DTY PR,DTY - FAV - -	POOR Poor TS Poor TS -	FAIR Fair - Poor - -	GOOD Good - Good - -	- IIIs-6 - IIs-8 - -	MODERATE Moderate - Moderate - -	MODERATE Moderate DTY,PR High - -	MODERATE Moderate DTY,PR High - -	POOR Poor - Good - -	FAIR Fair - Fair - -	V. POOR V. Poor - V. Poor - -
4	Pantego - Stilson (15%) Pantego Stilson Others	 30 20 50	PR PR - PR - -	WT WT - NN - -	WT WT - PR - -	POOR Poor WT Poor TS -	POOR Poor - Poor - -	POOR Poor WT Good - -	- IIIw-25 - IIe-15 - -	HIGH High - Moderate - -	MODERATE Moderate PO,DTC High - -	MODERATE Moderate PO,DTC High - -	POOR Poor - Fair - -	POOR Poor - Fair - -	FAIR Fair - Poor - -
5	Bibb (12%) Bibb Others	 80 20	SL SL - -	FL,WT FL,WT - -	FL,WT FL,WT - -	POOR Poor WT -	NR NR - -	NR NR - -	- - - -	HIGH High 5/ - -	V. LOW V. Low FL,DTC -	V. LOW V. Low FL,DTC -	V. POOR V. Poor - -	GOOD Good - -	FAIR Fair - -

1/ The overall rating for the association is based on the rating for the dominant soil (soil that makes up the greatest percentage of the association) or soils if more than one soil has the same rating.

2/ "Others" represents minor soils in the association. No one of the individual minor soils makes up as large a percentage of the association as the major soil with the lowest percentage. The percentage in parentheses following each of the soil associations represents the percentage of the county covered by that association.

3/ The percentage are estimates and are not based on measured acreage.

4/ High-level management is assumed which includes water management.

5/ Rating is for hardwood trees.

ABBREVIATIONS

AR - Area Reclamation
CC - Cutbanks Cave
CP - Compressible
CR - Corrosive
CS - Clayey Surface
CT - Clayey Texture
DTC - Difficult to Clear
DTR - Depth to Rock
DTW - Deep to Water
DTY - Droughty
EE - Erodes Easily
EH - Excess Humus
ES - Excess Salt
FAV - Soil Characteristics Favorable
FI - Fast Intake
FL - Floods
HS - Lateral Seepage
LS - Low Strength
NN - Not Needed
NR - Not Rated
PDY - Productivity
PG - Piping
PO - Poor Outlets
PR - Percolates Rapidly
PS - Percolates Slowly
PWT - Perched Water Table
RD - Rooting Depth
SB - Soil Blowing
SL - Slope
SS - Shrink - Swell
TF - Tidal Flooding
TL - Thin Layer
TS - Too Sandy
UF - Unstable Fill
WT - Wet

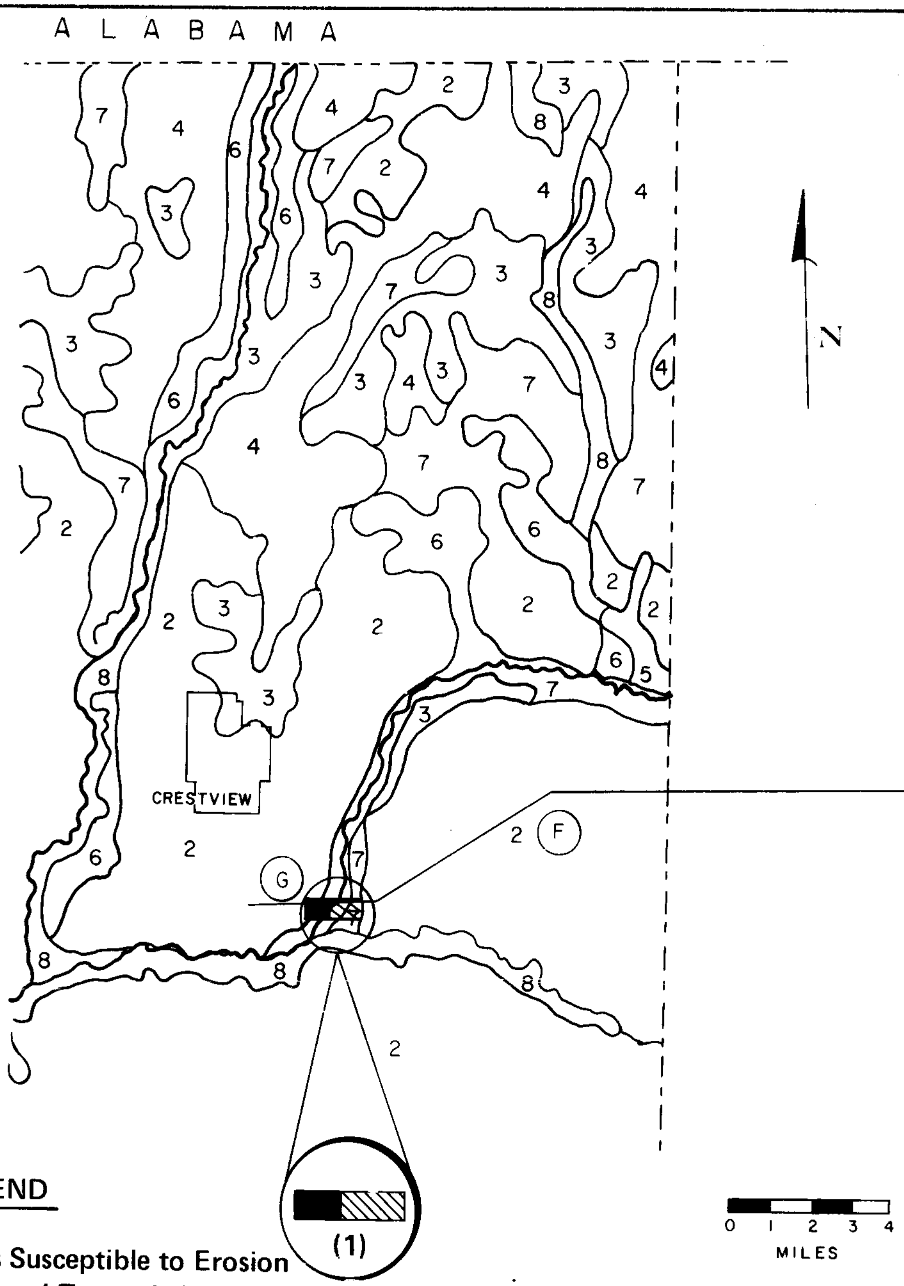
Amendment 2 8/75

Gulf Power Company

GULF POWER CO.
CARYVILLE STEAM PLANT

POTENTIALLY SENSITIVE AREAS CROSSED BY TRANSMISSION LINES IN HOLMES COUNTY

FIGURE 4.3-1 (Sheet 2 of 2)



LEGEND

- Soil Associations Susceptible to Erosion Crossed by Proposed Transmission Corridor (A)
- River and Lowland Crossed by Proposed Transmission Corridor (B)
- Overlap of Areas (A) & (B)
- Transmission Line Corridor
- State Boundary Line
- County Boundary Line
- Reference Point

Potentially Sensitive Areas

(1) Shoal River

Amendment 2 8/75

Gulf Power Company	GULF POWER CO CARYVILLE STEAM PLANT	POTENTIALLY SENSITIVE AREAS CROSSED BY TRANSMISSION LINES IN OKALOOSA COUNTY FIGURE 4.3-2 (Sheet 1 of 2)

SOIL RATINGS AND LIMITATIONS AND FEATURES AFFECTING SELECTED USES BY SOIL ASSOCIATIONS[1]

Degree and Kind of Limitations for

			Sanitary Facilities			Community Development				Water Management		Recreation		
Map Symbol	Name of Association with Component Soils[2]	Percent of Association[3]	Septic Tank Absorption Fields	Sewage Lagoons	Sanitary Landfill (Trench Type)	Shallow Excavations	Dwellings	Light Industry	Local Roads and Streets	Embankments Dikes and Levees	Excavated Ponds (Aquifer Fed)	Camp and Picnic Areas	Playgrounds	Paths and Trails
1	Kureb - St. Lucie - Rimini (2%)		SLIGHT	SEVERE	SEVERE	SEVERE	SLIGHT	SLIGHT	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE
	Kureb	40	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS
	St. Lucie	20	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS
	Rimini	15	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS
	Others	25	-	-	-	-	-	-	-	-	-	-	-	-
2	Lakeland - Troup (6%)		SLIGHT	SEVERE	SEVERE	SEVERE	SLIGHT	SLIGHT	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE
	Lakeland	75	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS
	Troup	10	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS
	Others	15	-	-	-	-	-	-	-	-	-	-	-	-
3	Fuqua - Lucy - Troup (6%)		MODERATE	SLIGHT	SLIGHT	MODERATE	SLIGHT	SLIGHT	SLIGHT	MODERATE	SEVERE	MODERATE	MODERATE	MODERATE
	Fuqua	40	Moderate PWT	Slight -	Slight -	Moderate CC	Slight -	Slight -	Slight -	Moderate PG	Severe DTW	Moderate TS	Moderate TS	Moderate TS
	Lucy	25	Slight -	Severe PR	Slight -	Slight -	Slight -	Slight -	Slight -	Moderate PG	Severe DTW	Moderate TS	Moderate TS	Moderate TS
	Troup	20	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS
	Others	15	-	-	-	-	-	-	-	-	-	-	-	-
4	Dothan - Orangeburg - Tifton (9%)		SEVERE	MODERATE	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SEVERE	SLIGHT	MODERATE	SLIGHT
	Dothan	35	Severe PS	Moderate HS	Slight -	Slight -	Slight -	Slight -	Slight -	Slight -	Severe DTW	Slight -	Moderate PS	Slight -
	Orangeburg	30	Slight -	Moderate PR	Slight -	Slight -	Slight -	Slight -	Slight -	Slight -	Severe DTW	Slight -	Slight -	Slight -
	Tifton	15	Moderate PS	Moderate PR	Slight -	Slight -	Slight -	Slight -	Slight -	Slight -	Severe DTW	Slight -	Slight -	Slight -
	Others	20	-	-	-	-	-	-	-	-	-	-	-	-
5	Lakeland - Faceville (3%)		SLIGHT	SEVERE	SEVERE	SEVERE	SLIGHT	SLIGHT	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE
	Lakeland	40	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS
	Faceville	35	Slight -	Moderate PR	Slight -	Slight -	Slight -	Slight -	Moderate LS	Slight -	Severe DTW	Slight -	Slight -	Slight -
	Others	25	-	-	-	-	-	-	-	-	-	-	-	-
6	Chipley - Albany - Leon (4%)		MODERATE	SEVERE	SEVERE	SEVERE	MODERATE	MODERATE	MODERATE	MODERATE	SEVERE	MODERATE	MODERATE	MODERATE
	Chipley	50	Moderate WT	Severe PR	Severe TS,PR,WT	Severe CC	Moderate WT	Moderate WT	Moderate WT	Moderate PR,PG	Severe DTW	Moderate TS,WT	Moderate TS,WT	Moderate TS,WT
	Albany	25	Severe WT	Severe PR	Severe WT,PR	Severe CC	Moderate WT	Moderate WT	Moderate WT	Moderate PG,EE	Moderate DTW	Moderate WT	Moderate WT	Moderate WT
	Leon	10	Severe WT	Severe PR	Severe TS,PR,WT	Severe CC	Severe WT	Severe WT	Severe WT	Severe PR	Slight -	Severe WT	Severe WT	Severe WT
	Others	15	-	-	-	-	-	-	-	-	-	-	-	-
7	Adrilla - Leefield - Stilson (7%)		SEVERE	SEVERE	SEVERE	SLIGHT	SEVERE	SEVERE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
	Adrilla	40	Severe WT,PS	Severe WT	Severe WT	Slight -	Severe WT	Severe WT	Moderate WT	Moderate PG,CP,LS	Moderate DTW	Moderate WT	Moderate WT	Moderate WT
	Leefield	25	Severe WT	Moderate HS	Severe WT	Moderate CC	Moderate WT	Moderate WT	Moderate WT	Moderate PG,EE	Moderate DTW	Moderate WT	Moderate WT	moderate WT
	Stilson	10	Moderate WT	Moderate PR,HS	Severe WT,PR	Moderate CC	Slight -	Slight -	Slight -	Moderate PG,EE	Severe DTW	Moderate TS,WT	Moderate TS,WT	Moderate TS,WT
	Others	25	-	-	-	-	-	-	-	-	-	-	-	-
8	Plummer - Rutlege (7%)		SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SLIGHT	SEVERE	SEVERE	SEVERE
	Plummer	60	Severe WT,FL	Severe PR,WT,FL	Severe WT,FL	Severe CC,WT	Severe WT,FL	Severe WT,FL	Severe WT,FL	Severe PR,PC	Slight -	Severe WT,FL	Severe WT,FL	Severe WT,FL
	Rutlege	25	Severe WT,FL	Severe PR,WT,FL	Severe WT,FL	Severe CC,WT	Severe WT,FL	Severe WT,FL	Severe WT,FL	Severe PR,PG	Slight -	Severe WT,FL	Severe WT,FL	Severe WT,FL
	Others	15	-	-	-	-	-	-	-	-	-	-	-	-
9	Alluvial Land (1%)		SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	NR	SLIGHT	SEVERE	SEVERE	SEVERE
	Alluvial Land	80	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	NR	Slight -	Severe FL,WT	Severe FL,WT	Severe FL,WT
	Others	20	-	-	-	-	-	-	-	-	-	-	-	-
10	Dorovan - Pamlico (1%)		V. SEVERE	V. SEVERE	V. SEVERE	V. SEVERE	V. SEVERE	V. SEVERE	V. SEVERE	V. SEVERE	SLIGHT	V. SEVERE	V. SEVERE	V. SEVERE
	Dorovan	35	V. Severe WT,FL	V. Severe WT,FL,EH, PR	V. Severe WT,FL,EH, PR	V. Severe WT,FL,EH	V. Severe WT,FL,EH, LS	V. Severe WT,FL,EH, LS	V. Severe WT,FL,EH, LS	V. Severe PR,PG,CP,UF	Slight -	V. Severe WT,FL	V. Severe WT,FL	V. Severe WT,FL
	Pamlico	30	V. Severe WT,FL	V. Severe WT,FL,EH, PR	V. Severe WT,FL,EH PR	V. Severe WT,FL,EH	V. Severe WT,FL,EH, LS	V. Severe WT,FL,EH LS	V. Severe WT,FL,EH,LS	V. Severe PR,PG,CP,UF	Slight -	V. Severe WT,FL	V. Severe WT,FL	V. Severe WT,FL
	Others	35	-	-	-	-	-	-	-	-	-	-	-	-

		Soil Features Affecting Water Management			Suitability as a Source of			Soil Potential for Agriculture[4]				Suitability as a Habitat for Wildlife		
Map Symbol	Name of Association with Component Soils[2]	Pond Reservoir Areas	Drainage	Irrigation	Topsoil	Sand	Roadfill	Capability Unit	Pine Woodland	Cropland	Improved Pasture	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
1	Kureb - St. Lucie - Rimini (2%)	PR	NN	PR,DTY,PDY	POOR	GOOD	GOOD	-	V. LOW	V. LOW	V. LOW	POOR	POOR	V. POOR
	Kureb	PR	NN	PR,DTY,PDY	Poor TS	Good	Good	VIIs-1	V. Low	V. Low DTY,PR,PDY	V. Low DTY,PR,PDY	Poor	Poor	V. Poor
	St. Lucie	PR	NN	PR,DTY,PDY	Poor TS	Good	Good	VIIs-1	V. Low	V. Low DTY,PR,PDY	V. Low DTY,PR,PDY	Poor	Poor	V. Poor
	Rimini	PR	NN	PR,DTY, PDY	Poor TS	Good	Good	VIs-4	V. Low	V. Low DTY,PR,PDY	V. Low DTY,PR,PDY	Poor	Poor	V. Poor
	Others	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Lakeland - Troup (6%)	PR	NN	PR,DTY	POOR	GOOD	GOOD	-	MODERATE	MODERATE	MODERATE	POOR	FAIR	V. POOR
	Lakeland	PR	NN	PR,DTY	Poor TS	Good	Good	IIIs-6	Moderate	Moderate DTY,PR	Moderate DTY,PR	Poor	Fair	V. Poor
	Troup	PR	NN	PR,DTY	Poor TS	Fair	Good	IIIs-6	Moderate	Moderate DTY,PR	Moderate DTY,PR	Poor	Fair	V. Poor
	Others	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Fuqua - Lucy - Troup (6%)	FAV	NN	FAV	POOR	POOR	GOOD	-	MODERATE	HIGH	HIGH	GOOD	FAIR	V. POOR
	Fuqua	FAV	NN	FAV	Poor TS	Poor	Good	IIs-8	Moderate	High	High	Good	Fair	V. Poor
	Lucy	PR	NN	FAV	Poor	Fair	Fair	IIs-3	Moderate	High	High	Good	Good	V. Poor
	Troup	PR	NN	PR,DTY	Poor	Fair	Good	IIIs-6	Moderate	Moderate DTY,PR	Moderate DTY,PR	Poor	Fair	V. Poor
	Others	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Dothan - Orangeburg - Tifton (9%)	PR	NN	FAV	FAIR	POOR	GOOD	-	HIGH	HIGH	HIGH	GOOD	GOOD	V. POOR
	Dothan	PR	NN	FAV	Fair TL	Poor	Good	IIe-10	High	High	High	Good	Good	V. Poor
	Orangeburg	PR	NN	FAV	Fair PDY	Poor	Good	IIe-1	Moderate	High	High	Good	Good	V. Poor
	Tifton	PR	NN	FAV	Good	Poor	Good	IIe-1	Moderate	High	High	Good	Good	V. Poor
	Others	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Lakeland - Faceville (3%)	PR	NN	PR,DTY	POOR	GOOD	GOOD	-	MODERATE	MODERATE	MODERATE	POOR	FAIR	V. POOR
	Lakeland	PR	NN	PR,DTY	Poor TS	Good	Good	IIIs-6	Moderate	Moderate DTY,PR	Moderate DTY,PR	Poor	Fair	V. Poor
	Faceville	PR	NN	FAV	Good	Poor	Fair SS	IIe-1	Moderate	High	High	Good	Fair	V. Poor
	Others	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Chipley - Albany - Leon (4%)	PR	NN	PR,DTY	POOR	FAIR	GOOD	-	HIGH	MODERATE	MODERATE	FAIR	FAIR	V. POOR
	Chipley	PR	NN	PR,DTY	Poor TS	Fair	Good	IIIs-11	High	Moderate PR,DTY	Moderate PR,DTY	Fair	Fair	V. Poor
	Albany	PR	WT,CC	PR,WT	Poor TS	Poor	Fair[5]	IIIw-4	Moderate	Moderate PR,PDY	Moderate PR,PDY	Fair	Fair	Poor
	Leon	PR	WT,CC	PR,WT	Poor TS	Fair[5]	Good[5]	IVw-14	Low to Moderate	Moderate PR,PDY,DTY	Moderate PR,PDY,DTY	Poor	Poor	Poor
	Others	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Adrilla - Leefield - Stilson (7%)	PR	WT,PS	WT	FAIR	POOR	FAIR	-	HIGH	HIGH	HIGH	GOOD	GOOD	FAIR
	Adrilla	PR	WT,PS	WT	Fair TL	Poor	Fair WT	IIe-17	High	High	High	Good	Good	Fair
	Leefield	HS	WT,PS	WT	Poor PDY	Fair	Fair WT	IIe-18	Moderate	High	High	Fair	Fair	Poor
	Stilson	PR	NN	PH	Poor TS	Poor	Good	IIe-15	Moderate	High	High	Fair	Fair	Poor
	Others	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Plummer - Rutlege (7%)	PR	WT,FL,PO	WT,PR	POOR	POOR	POOR	-	HIGH	LOW	MODERATE	POOR	POOR	FAIR
	Plummer	PR	WT,FL,PO	WT,PR	Poor TS,WT	Poor	Poor WT	IVw-10	High	Low FL,PO,PDY	Moderate PDY,FL	Poor	Poor	Fair
	Rutlege	PR	WT,FL,PO	WT,PR	Fair[5] TS,WT	Fair	Good[5]	IIIw-34	Moderate	Low FL,PO,PDY	Moderate FL	Poor	Poor	Good
	Others	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Alluvial Land (1%)	SL	FL,WT	FL,WT	POOR	NR	NR		HIGH	V. LOW	V. LOW	V. POOR	GOOD	FAIR
	Alluvial Land	SL	FL,WT	FL,WT	Poor TS,WT	NR	NR	VIIw-2	High[6]	V. Low FL,DTC	V. Low FL,DTC	V. Poor	Good	Fair
	Others	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Dorovan - Pamlico (1%)	SL	WT,PO,EH	WT,PR	POOR	POOR	POOR	-	V. LOW	V. LOW	V. LOW	V. POOR	GOOD	GOOD
	Dorovan	SL	WT,PO,EH	WT,PR	Poor EH	Poor	Poor	VIIw-2	V. Low	V. Low WT,FL,PO	V. Low WT,FL,PO	V. Poor	Good	Good
	Pamlico	SL	WT,PO,EH	WT,PR	Poor EH	Poor	Poor EH	IVw-17	V. Low	V. Low WT,FL,PO	V. Low WT,FL,PO	V. Poor	Good	Good
	Others	-	-	-	-	-	-	-	-	-	-	-	-	-

1/ The overall rating for the association is based on the rating for the dominant soil (soil that makes up the greatest percentage of the association) or soils if more than one soil has the same rating.

2/ "Others" represents minor soils in the association. No one of the individual minor soils makes up as large a percentage of the association as the major soil with the lowest percentage. The percentage in parentheses following each of the soil associations represents the percentage of the county covered by that association.

3/ The percentage are estimates and are not based on measured acreage.

4/ High-level management is assumed which includes water management.

5/ The material itself is considered to be FAIR of GOOD for the intended use, but wetness may be a limitation in obtaining it.

6/ Rating is for hardwood trees.

7/ Rating is for Choctawhatchee sand pine.

ABBREVIATIONS

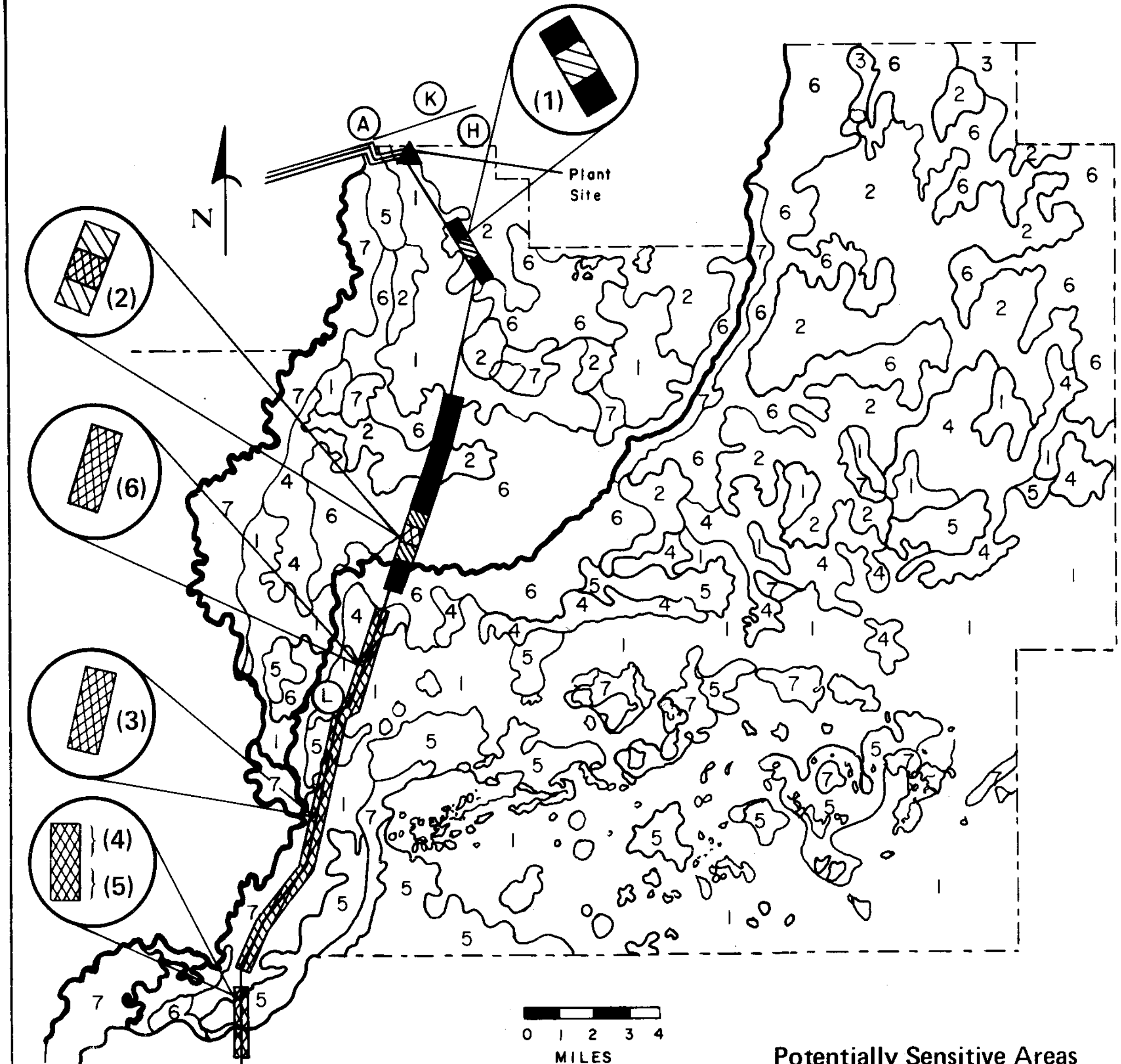
AR - Area Reclamation
CC - Cutbanks Cave
CP - Compressible
CR - Corrosive
CS - Clayey Surface
CT - Clayey Texture
DTC - Difficult to Clear
DTR - Depth to Rock
DTW - Deep to Water
DTY - Droughty
EE - Erodes Easily
EH - Excess Humus
ES - Excess Salt
FAV - Soil Characteristics Favorable
FI - Fast Intake
FL - Floods
HS - Lateral Seepage
LS - Low Strength
NN - Not Needed
NR - Not Rated
PDY - Productivity
PG - Piping
PO - Poor Outlets
PR - Percolates Rapidly
PS - Percolates Slowly
PWT - Perched Water Table
RD - Rooting Depth
SB - Soil Blowing
SL - Slope
SS - Shrink - Swell
TF - Tidal Flooding
TL - Thin Layer
TS - Too Sandy
UF - Unstable Fill
WT - Wet

Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

POTENTIALLY SENSITIVE AREAS CROSSED BY TRANSMISSION LINES IN OKALOOSA COUNTY

FIGURE 4.3-2 (Sheet 2 of 2)



LEGEND

- Soil Associations Susceptible to Erosion Crossed by Proposed Transmission Corridor (A)
- River and Lowlands or State Forest Adjacent to Proposed Transmission Corridor (B)
- Overlap of Areas (A) & (B)
- Transmission Line Corridor
- County Boundary Line
- Reference Point

Potentially Sensitive Areas

(1) Bayhead

(2) Holmes Creek

(3) Choctawhatchee River Lowlands

(4) Pine Log Creek

(5) Pine Log State Forest

(6) Valleys Near Intersection

Amendment 2 8/75

Gulf Power Company	GULF POWER CO. CARYVILLE STEAM PLANT	POTENTIALLY SENSITIVE AREAS CROSSED BY TRANSMISSION LINES IN WASHINGTON COUNTY FIGURE 4.3-3 (Sheet 1 of 2)

SOIL RATINGS AND LIMITATIONS AND FEATURES AFFECTING SELECTED USES BY SOIL ASSOCIATIONS1/

			Degree and Kind of Limitations for												Soil Features Affecting Water Management			Suitability as a Source of			Soil Potential for Agriculture4/				Suitability as a Habitat for Wildlife		
			Sanitary Facilities			Community Development				Water Management		Recreation															
Map Symbol	Name of Association with Component Soils2/	Percent of Association3/	Septic Tank Absorption Fields	Sewage Lagoons	Sanitary Landfill (Trench Type)	Shallow Excavations	Dwellings	Light Industry	Local Roads and Streets	Embankments Dikes and Levees	Excavated Ponds (Aquifer Fed)	Camp and Picnic Areas	Play-grounds	Paths and Trails	Pond Reservoir Areas	Drainage	Irrigation	Topsoil	Sand	Roadfill	Capability Unit	Pine Woodland	Cropland	Improved Pasture	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
1	Lakeland - Eustia (42.0%) Lakeland Eustia Others	 45 25 30	SLIGHT Slight - Slight	SEVERE Severe PR Severe PR	SEVERE Severe PR,TS Severe PR,TS	SEVERE Severe CC Severe CC	SLIGHT Slight - Slight	SLIGHT Slight - Slight	SLIGHT Slight - Slight	SEVERE Severe PR,PG Severe PR,PG	SEVERE Severe DTW Severe DTW	SEVERE Severe TS Severe TS	SEVERE Severe TS Severe TS	SEVERE Severe TS Severe TS	PR PR - PR	NN NN - NN	PR,DTY PR,DTY - PR,DTY	POOR Poor TS Poor TS	GOOD Good - Good	GOOD Good - Good	- IIIs-6 - IIIs-1	MODERATE Moderate - Moderate	MODERATE Moderate DTY,PR Moderate DTY,PR	MODERATE Moderate DTY,PR Moderate DTY,PR	POOR Poor - Poor	FAIR Fair - Fair	V. POOR V. Poor - V. Poor
2	Norfolk - Ruston - Goldsboro (16%) NorfolkA/ Ruston GoldsboroB/ Others	 30 25 10 35	SEVERE Severe PS Slight - Severe PS,WT	MODERATE Moderate HS Severe PR Severe WT	SLIGHT Slight - Slight - Severe WT	SLIGHT Slight - Slight - Slight	SLIGHT Slight - Slight - Severe WT	SLIGHT Slight - Moderate LS Severe WT	SLIGHT Slight - Slight - Moderate WT	SLIGHT Slight - Slight - Moderate PG,CP,LS	SEVERE Slight DTW Severe DTW Moderate DTW	SLIGHT Slight - Moderate TS Moderate WT	MODERATE Moderate PS Moderate TS Moderate PS,WT	SLIGHT Slight - Moderate TS Moderate WT	PR PR - PR - PR	NN NN - NN - WT,PS	FAV FAV - FAV - WT	FAIR Fair TL Fair TL Fair	POOR Poor - Poor - Poor	GOOD Good - Fair - Fair6/	- IIe-10 IIs-3 IIe-17	HIGH High - High - High	HIGH High - High - High	HIGH High - High - High	GOOD Good - Fair - Good	GOOD Good - Fair - Good	V. POOR V. Poor - V. Poor - Fair
3	Tifton - Faceville - Marlboro (1.0%) TiftonC/ Faceville Marlboro Others	 35 30 10 25	SLIGHT Slight - Slight - Moderate PS	MODERATE Moderate PR Moderate PR Moderate PR	SLIGHT Slight - Slight - Slight	SLIGHT Slight - Slight - Slight	MODERATE Moderate LS Slight - Slight	MODERATE Moderate LS Slight - Slight	MODERATE Moderate LS Moderate LS Slight	MODERATE Moderate CP Slight - Slight	SEVERE Severe DTW Severe DTW Severe DTW	SLIGHT Slight - Slight - Slight	SLIGHT Slight - Slight - Slight	SLIGHT Slight - Slight - Slight	PR PR - PR - PR	NN NN - NN - NN	FAV FAV - FAV - FAV	FAIR Fair - Good - Good	POOR Poor - Poor - Poor	FAIR Fair SS Fair SS Good	- IIe-2 - IIe-1 - IIe-1	MODERATE Moderate - Moderate - Moderate	HIGH High - High - High	HIGH High - High - High	GOOD Good - Good - Good	GOOD Good - Fair - Good	V. POOR V. Poor - V. Poor - V. Poor
4	Lakeland - Cuthbert - Shubuta5/ (7.0%) Lakeland - Cuthbert Shubuta Others	 85.0 15.0	SEVERE - Severe SL	SEVERE - Severe SL,PR	MODERATE - Moderate SL,TS	SEVERE - Severe EE,SL	SEVERE - Severe SL	SEVERE - Severe SL	SEVERE - Severe SL,EE	SEVERE - Severe PR,PG,SL	SEVERE - Severe DTW,SL	SEVERE - Severe SL,TS	SEVERE - Severe SL,TS	SEVERE - Severe SL,TS	PR PR	NN NN	PR,SL - PR,SL	POOR - Poor TS	FAIR - Fair	GOOD - Good	- - NR	MODERATE - Moderate	V. LOW - V. Low SL,EE	LOW - Low SL,EE	POOR - Poor	FAIR - Fair	V. POOR - V. Poor
5	Blanton - Kiej Plummer (8.0%) Blanton Kiej Plummer Others	 45 25 15 15	MODERATE Moderate WT Moderate WT Severe WT	SEVERE Severe PR SEvere PR Severe PR,WT	SEVERE Severe TS,PR,WT Severe TS,PR,WT Severe TS,PR,WT	SEVERE Severe CC Severe CC Severe CC,WT	MODERATE Moderate WT Moderate WT Severe WT	MODERATE Moderate WT Moderate WT Severe WT	MODERATE Moderate WT Moderate WT Severe WT	MODERATE Moderate PR,PS Moderate PR,PG Severe PR,PG,EE	SEVERE Severe DTW Severe DTW Slight	MODERATE Moderate TS,WT Moderate TS,WT Severe WT	MODERATE Moderate TS,WT Moderate TS,WT Severe WT	MODERATE Moderate TS,WT Moderate TS,WT Severe WT	PR PR - PR - PR	NN NN - NN - WT	PR,DTY PR,DTY - PR,DTY - PR,WT	POOR Poor TS Poor TS Poor TS	FAIR Fair - Fair - Fair	GOOD Good - Good - Good6/	- IIIs-11 - IIIs-11 - IVw-10	HIGH High - High - Low	MODERATE Moderate PR,DTY Moderate PR,DTY Moderate PDY	MODERATE Moderate PR,DTY Moderate PR,DTY Moderate PDY	FAIR Fair - Fair - Poor	FAIR Fair - Fair - Fair	V. POOR V. Poor - V. Poor - Fair
6	Goldsboro - Lynchburg - Rains (18.0%) GoldsboroB/ Lynchburg Rains Others	 35 25 15 25	SEVERE Severe WT,PS Severe WT,PS Severe WT	SEVERE Severe WT Severe WT Severe WT	SEVERE Severe WT Severe WT Severe WT	SLIGHT Slight - Slight - Slight	SEVERE Severe WT Severe WT Severe WT	SEVERE Severe WT Severe WT Severe WT	MODERATE Moderate WT Moderate WT Severe WT	MODERATE Moderate PS,CP,LS Moderate PG,CP,LS Slight	MODERATE Moderate DTW Moderate DTW Severe DTW	MODERATE Moderate WT Moderate WT Severe WT	MODERATE Moderate WT Moderate WT Severe WT	MODERATE Moderate WT Moderate WT Severe WT	PR PR - PR - PR	WT,PS WT,PS - WT - WT	WT WT - WT - WT	FAIR Fair TL Fair TL Fair WT	POOR Poor - Poor - Poor	FAIR Fair6/ WT Fair6/ WT Poor WT	- IIe-17 - IIe-17 - IIIw-1	HIGH High - High - High	HIGH High - High - High	HIGH High - High - Moderate PDY	GOOD Good - Good - Poor	GOOD Good - Good - Fair	FAIR Fair - Fair - Good
7	Alluvial Land - Swamp (8.0%) Alluvial Land Swamp Others	 78.0 15.0 7.0	SEVERE Severe FL,WT V. Severe FL,WT	SEVERE Severe FL,WT V. Severe FL,WT	SEVERE Severe FL,WT V. Severe FL,WT	SEVERE Severe FL,WT V. Severe FL,WT	SEVERE Severe FL,WT V. Severe FL,WT	SEVERE Severe FL,WT V. Severe FL,WT	SEVERE Severe FL,WT V. Severe FL,WT	NR NR - NR	SLIGHT Slight - Slight	SEVERE Severe FL,WT V. Severe FL,WT	SEVERE Severe FL,WT V. Severe FL,WT	SEVERE Severe FL,WT V. Severe FL,WT	SL SL - SL	FL,WT FL,WT - FL,WT	FL,WT FL,WT - FL,WT	POOR Poor TS,WT Poor WT	NR NR - NR	NR NR - NR	- VIIw-2 - VIIw-2	'IGH 'igh7/ - ighn7/	V. LOW V. Low FL,DTC V. Low FL,DTC,PO	V. LOW V. Low FL,DTC V. Low FL,DTC,PO	V. POOR V. Poor - V. Poor	GOOD Good - Good	FAIR Fair - Good

1/ The overall rating for the association is based on the rating for the dominant soil (soil that makes up the greatest percentage of the association) or soils if more than one soil has the same rating.

2/ "Others" represents minor soils in the association. No one of the individual minor soils makes up as large a percentage of the association as the major soil with the lowest percentage. The percentage in parentheses following each of the soil associations represents the percentage of the county covered by that association.

3/ The percentages are estimates and are not based on measured acreage.

4/ High-level management is assumed which includes water management.

5/ Soils in this association occur in intricate patterns and are not mapped separately. About 75 percent of the soils occur on slopes of 5 to 12 percent; 25 percent of the soils occur on slopes of 12 to 45 percent and are severely eroded.

6/ The material itself is considered to be FAIR or GOOD for the intended use, but wetness may be a limitation in obtaining it.

7/ Rating is for hardwood trees.

8/ Rating is for Choctawhatchee sand pine.

A/ Norfolk soils as mapped in Washington County are very similar to Dothan soils

B/ Goldsboro soils as mapped in Washington County are very similar to Adrilla soils.

C/ Tifton soils as mapped in Washington County are very similar to Greenville soils.

ABBREVIATIONS

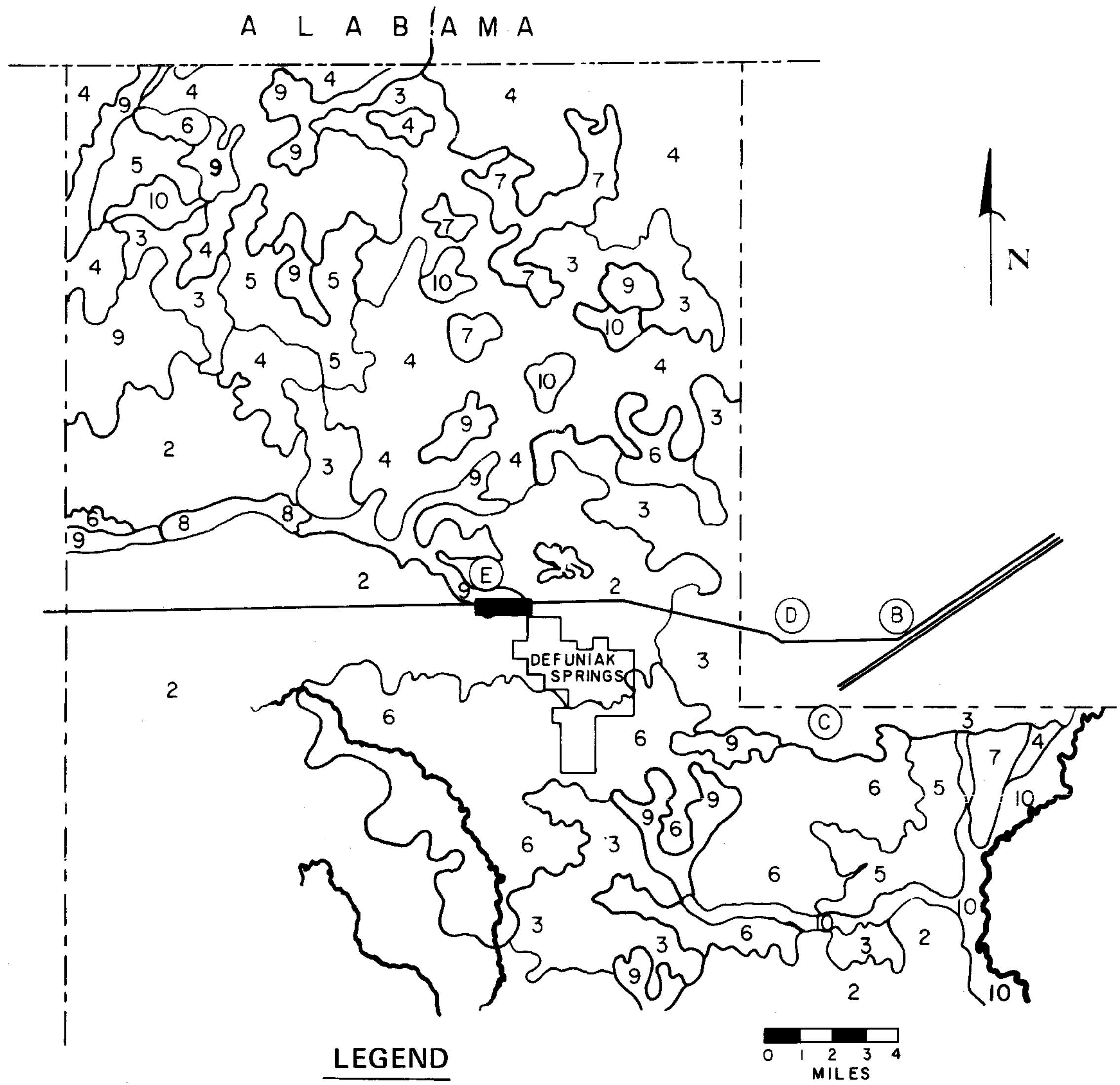
AR	- Area Reclamation	ES	- Excess Salt	PS	- Percolates Slowly
CC	- Cutbanks Cave	FAV	- Soil Characteristics Favorable	PWT	- Perched Water Table
CP	- Compressible	FI	- Fast Intake	RD	- Rooting Depth
CR	- Corrosive	FL	- Floods	SB	- Soil Blowing
CS	- Clayey Surface	HS	- Lateral Seepage	SL	- Slope
CT	- Clayey Texture	LS	- Low Strength	SS	- Shrink - Swell
DTC	- Difficult to Clear	NN	- Not Needed	TF	- Tidal Flooding
DTR	- Depth to Rock	NR	- Not Rated	TL	- Thin Layer
DTW	- Deep to Water	PDY	- Productivity	TS	- Too Sandy
DTY	- Droughty	PG	- Piping	UF	- Unstable Fill
EE	- Erodes Easily	PO	- Poor Outlets	WT	- Wet
EH	- Excess Humus	PR	- Percolates Rapidly		

Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

POTENTIALLY SENSITIVE AREAS
CROSSED BY TRANSMISSION LINES
IN WASHINGTON COUNTY

FIGURE 4.3-3 (Sheet 2 of 2)



LEGEND

Soil Associations Susceptible to Erosion Crossed by Proposed Transmission Corridor

Transmission Line Corridor

State Boundary Line

County Boundary Line

Reference Point

Potentially Sensitive Areas

None

Amendment 2 8/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	POTENTIALLY SENSITIVE AREAS CROSSED BY TRANSMISSION LINES IN WALTON COUNTY
		FIGURE 4.3-4 (Sheet 1 of 2)

SOIL RATINGS AND LIMITATIONS AND FEATURES AFFECTING SELECTED USES BY SOIL ASSOCIATIONS[1]

Map Symbol	Name of Association with Component Soils[2]	Percent of Association[3]	Degree and Kind of Limitations for: Sanitary Facilities: Septic Tank Absorption Fields	Sanitary Facilities: Sewage Lagoons	Sanitary Facilities: Sanitary Landfill (Trench Type)	Community Development: Shallow Excavations	Community Development: Dwellings	Community Development: Light Industry	Community Development: Local Roads and Streets	Water Management: Embankments Dikes and Levees	Water Management: Excavated Ponds (Aquifer Fed)	Recreation: Camp and Picnic Areas	Recreation: Playgrounds	Recreation: Paths and Trails	Soil Features Affecting Water Management: Pond Reservoir Areas	Soil Features Affecting Water Management: Drainage	Soil Features Affecting Water Management: Irrigation	Suitability as a Source of: Topsoil	Suitability as a Source of: Sand	Suitability as a Source of: Roadfill	Soil Potential for Agriculture[4]: Capability Unit	Soil Potential for Agriculture: Pine Woodland	Soil Potential for Agriculture: Cropland	Soil Potential for Agriculture: Improved Pasture	Suitability as a Habitat for Wildlife: Openland Wildlife	Suitability as a Habitat for Wildlife: Woodland Wildlife	Suitability as a Habitat for Wildlife: Wetland Wildlife
1	Kureb - St. Lucie - Rimini (3%)		SLIGHT	SEVERE	SEVERE	SEVERE	SLIGHT	SLIGHT	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	PR	NN	PR,DTY,PDY	POOR	GOOD	GOOD	-	V. LOW	V. LOW	V. LOW	POOR	POOR	V. POOR
	Kureb	30	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR -	NN -	PR,DTY,PDY -	Poor TS	Good -	Good -	VIIs-1 -	V. Low -	V. Low DTY,PR,PDY	V. Low DTY,PR,PDY	Poor -	Poor -	V. Poor -
	St. Lucie	20	Slight -	Severe PR,TS	Severe CC	Severe -	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR -	NN -	PR,DTY,FDY -	Poor TS	Good -	Good -	VIIs-1 -	V. Low -	V. Low DTY,PR,PDY	V. Low DTY,PR,PDY	Poor -	Poor -	V. Poor -
	Rimini	10	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR -	NN -	PR,DTY,PDY -	Poor TS	Good -	Good -	VIs-4 -	V. Low -	V. Low DTY,PR,PDY	V. Low DTY,PR,PDY	Poor -	Poor -	V. Poor -
	Others	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Lakeland - Troup (39%)		SLIGHT	SEVERE	SEVERE	SEVERE	SLIGHT	SLIGHT	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	PR	NN	PR,DTY	POOR	GOOD	GOOD	-	MODERATE	MODERATE	MODERATE	POOR	FAIR	V. POOR
	Lakeland	75	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR -	NN -	PR,DTY -	Poor TS	Fair -	Good -	IIIs-6 -	Moderate DTY,PR	Moderate DTY,PR	Moderate DTY,PR	Poor -	Fair -	V. Poor -
	Troup	15	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR -	NN -	PR,DTY -	Poor TS	Good -	Good -	IIIs-6 -	Moderate DTY,PR	Moderate DTY,PR	Moderate DTY,PR	Poor -	Fair -	V. Poor -
	Others	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Troup - Fuqua - Lucy (10%)		SLIGHT	SEVERE	SEVERE	SEVERE	SLIGHT	SLIGHT	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	PR	NN	PR,DTY	POOR	FAIR	GOOD	-	MODERATE	MODERATE	MODERATE	POOR	FAIR	V. POOR
	Troup	33	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR -	NN -	PR,DTY -	Poor TS	Fair -	Good -	IIIs-6 -	Moderate -	Moderate DTY,PR	Moderate DTY,PR	Poor -	Fair -	V. Poor -
	Fuqua	32	Moderate PWT	Slight -	Slight -	Moderate CC	Slight -	Slight -	Slight -	Moderate PG	Severe DTW	Moderate TS	Moderate TS	Moderate TS	FAV -	NN -	FAV -	Poor TS	Poor -	Good -	IIs-8 -	Moderate -	High -	High -	Good -	Fair -	V. Poor -
	Lucy	20	Slight -	Severe PR	Slight -	Slight -	Slight -	Slight -	Slight -	Moderate PG	Severe DTW	Moderate TS	Moderate TS	Moderate TS	PR -	NN -	FAV -	Poor TS	Fair -	Fair -	IIs-3 -	Moderate -	High -	High -	Good -	Good -	V. Poor -
	Others	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Dothan - Orangeburg (8%)		SEVERE	MODERATE	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SEVERE	SLIGHT	MODERATE	SLIGHT	PR	NN	FAV	FAIR	POOR	GOOD	-	HIGH	HIGH	HIGH	GOOD	GOOD	V. POOR
	Dothan	40	Severe PS	Moderate HS	Slight -	Slight -	Slight -	Slight -	Slight -	Slight -	Severe DTW	Slight -	Moderate PS	Slight -	PR -	NN -	FAV -	Fair TL	Poor -	Good -	IIe-10 -	High -	High -	High -	Good -	Good -	V. Poor -
	Orangeburg	30	Slight -	Moderate PR	Slight -	Slight -	Slight -	Slight -	Slight -	Slight -	Severe DTW	Slight -	Slight -	Slight -	PR -	NN -	FAV -	Fair PDY	Poor -	Good -	IIe-1 -	Moderate -	High -	High -	Good -	Good -	V. Poor -
	Others	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Tifton - Faceville - Greenville (4%)		MODERATE	MODERATE	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SEVERE	SLIGHT	SLIGHT	SLIGHT	PR	NN	FAV	GOOD	POOR	GOOD	-	MODERATE	HIGH	HIGH	GOOD	GOOD	V. POOR
	Tifton	30	Moderate PS	Moderate PR	Slight -	Slight -	Slight -	Slight -	Slight -	Slight -	Severe DTW	Slight -	Slight -	Slight -	PR -	NN -	FAV -	Good -	Poor -	Good -	IIe-1 -	Moderate -	High -	High -	Good -	Good -	V. Poor -
	Faceville	25	Slight -	Moderate PR	Slight -	Slight -	Slight -	Slight -	Moderate LS	Slight -	Severe DTW	Slight -	Slight -	Slight -	PR -	NN -	FAV -	Good -	Poor -	Fair SS	IIe-1 -	Moderate -	High -	High -	Good -	Fair -	V. Poor -
	Greenville	15	Slight -	Moderate PR	Slight -	Slight -	Moderate LS	Moderate LS	Moderate LS	Moderate CP	Severe DTW	Slight -	Slight -	Slight -	PR -	NN -	FAV -	Fair -	Poor -	Fair SS	IIe-2 -	Moderate -	High -	High -	Good -	Good -	V. Poor -
	Others	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Lakeland - Faceville (8%)		SLIGHT	SEVERE	SEVERE	SEVERE	SLIGHT	SLIGHT	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	PR	NN	PR,DTY	POOR	GOOD	GOOD	-	MODERATE	MODERATE	MODERATE	POOR	FAIR	V. POOR
	Lakeland	40	Slight -	Severe PR	Severe PR,TS	Severe CC	Slight -	Slight -	Slight -	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR -	NN -	PR,DTY -	Poor TS	Good -	Good -	IIIs-6 -	Moderate -	Moderate DTY,PR	Moderate DTY,PR	Poor -	Fair -	V. Poor -
	Faceville	25	Slight -	Moderate PR	Slight -	Slight -	Slight -	Slight -	Moderate LS	Slight -	Severe DTW	Slight -	Slight -	Slight -	PR -	NN -	FAV -	Good -	Poor -	Fair -	IIe-1 -	Moderate -	High -	High -	Good -	Fair -	V. Poor -
	Others	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Chipley - Albany (5%)		MODERATE	SEVERE	SEVERE	SEVERE	MODERATE	MODERATE	MODERATE	MODERATE	SEVERE	MODERATE	MODERATE	MODERATE	PR	NN	PR,DTY	POOR	FAIR	GOOD	-	HIGH	MODERATE	MODERATE	FAIR	FAIR	V. POOR
	Chipley	50	Moderate WT	Severe PR	Severe TS,PR,WT	Severe CC	Moderate WT	Moderate WT	Moderate WT	Moderate PR,PG	Severe DTW	Moderate TS,WT	Moderate TS,WT	Moderate TS,WT	PR -	NN -	PR,DTY -	Poor TS	Fair -	Good -	IIIs-11 -	High -	Moderate PR,DTY	Moderate PR,DTY	Fair -	Fair -	V. Poor -
	Albany	35	Severe WT	Severe PR	Severe WT,PR	Severe CC	Moderate WT	Moderate WT	Moderate WT	Moderate PG,EE	Moderate DTW	Moderate WT	Moderate WT	Moderate WT	PR -	WT,CC -	PR,WT -	Poor TS	Poor -	Fair[5] -	IIIw-4 -	Moderate -	Moderate PR,DTY	Moderate PR,DTY	Fair -	Fair -	Poor -
	Others	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Leon - Chipley (11%)		SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SLIGHT	SEVERE	SEVERE	SEVERE	PR	WT,CC	PR,WT	POOR	FAIR	GOOD	-	MODERATE	MODERATE	MODERATE	POOR	POOR	POOR
	Leon	45	Severe WT	Severe PR	Severe TS,PR,WT	Severe CC	Severe WT	Severe WT	Severe WT	Severe PR	Slight -	Severe WT	Severe WT	Severe WT	PR -	WT,CC -	PR,WT -	Poor TS	Fair[5] -	Good[5] -	IVw-14 -	Moderate -	Moderate PRPDYDTY	Moderate PRPDYDTY	Poor -	Poor -	Poor -
	Chipley	25	Moderate WT	Severe PR	Severe TS,PR,WT	Severe CC	Moderate WT	Moderate WT	Moderate WT	Moderate PR,PG	Severe DTW	Moderate TS,WT	Moderate TS,WT	Moderate TS,WT	PR -	NN -	PR,DTY -	Poor TS	Fair -	Good -	IIIs-11 -	High -	Moderate PR,DTY	Moderate PR,DTY	Fair -	Fair -	V. Poor -
	Others	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Ardilla - Stilson - Leefield (7%)		SEVERE	SEVERE	SEVERE	SLIGHT	SEVERE	SEVERE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	PR	WT,PS	WT	FAIR	POOR	FAIR	-	HIGH	HIGH	HIGH	GOOD	GOOD	FAIR
	Ardilla	35	Severe WT,PS	Severe WT	Severe WT	Slight -	Severe WT	Severe WT	Moderate WT	Moderate PG,CP,LS	Moderate DTW	Moderate WT	Moderate WT	Moderate WT	PR -	WT,PS -	WT -	Fair TL	Poor -	Fair WT	IIe-17 -	High -	High -	High -	Good -	Good -	Good -
	Stilson	25	Moderate TS	Moderate PR,HS	Severe WT,PR	Moderate CC	Slight -	Slight -	Slight PG,EE	Moderate DTW	Severe TS,WT	Moderate TS,WT	Moderate TS,WT	Moderate TS,WT	PR -	NN -	PR -	Poor TS	Poor -	Good -	IIe-15 -	Moderate -	High -	High -	Fair -	Fair -	Poor -
	Leefield	20	Severe WT	Moderate HS	Severe WT	Moderate CC	MOderate WT	Moderate WT	Moderate WT	Moderate PG,EE	Moderate DTW	Moderate WT	Moderate WT	Moderate WT	HS -	WT,PS -	WT -	Poor PDY	Fair -	Fair WT	IIe-18 -	Moderate -	High -	High -	Fair -	Fair -	Poor -
	Others	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Alluvial Land - Swamp (6%)		SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	NR	SLIGHT	SEVERE	SEVERE	SEVERE	SL	FL,WT	FL,WT	POOR	NR	NR	-	HIGH	V. LOW	V. LOW	V. POOR	GOOD	FAIR
	Alluvial Land	40	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	NR -	Slight -	Severe FL,WT	Severe FL,WT	Severe FL,WT	SL -	FL,WT -	FL,WT -	Poor TS,WT	NR -	NR -	VIIw-2 -	High[6] -	V. Low FL,DTC	V. Low FL,DTC	V. Poor -	Good -	Fair -
	Swamp	35	V. Severe FL,WT	V. Severe FL,WT	V. Severe FL,WT	V. Severe FL,WT	V. Severe FL,WT	V. Severe FL,WT	V. Severe FL,WT	NR -	Slight -	V. Severe FL,WT	V. Severe FL,WT	V. Severe FL,WT	SL -	FL,WT -	FL,WT -	Poor WT	NR -	NR -	VIIw-2 -	High[6] -	V. Low FL,DTC,PO	V. Low FL,DTC,PO	V. Poor -	Good -	Good -
	Others	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1/ The overall rating for the association is based on the rating for the dominant soil (soil that makes up the greatest percentage of the association) or soils if more than one soil has the same rating.

2/ "Others" represents minor soils in the association. No one of the individual minor soils makes up as large a percentage of the association as the major soil with the lowest percentage. The percentage in parentheses following each of the soil associations represents the percentage of the county covered by that association.

3/ The percentages are estimates and are not based on measured acreage.

5/ The material itself is considered to be FAIR or GOOD for the intended use, but wetness may be a limitation in obtaining it.

6/ Rating is for hardwood trees.

7/ Rating is for Choctawhatchee sand pine.

ABBREVIATIONS

AR	- Area Reclamation	ES	- Excess Salt	PS	- Percolates Slowly
CC	- Cutbanks Cave	FAV	- Soil Characteristics Favorable	PWT	- Perched Water Table
CP	- Compressible	FI	- Fast Intake	RD	- Rooting Depth
CR	- Corrosive	FL	- Floods	SB	- Soil Blowing
CS	- Clayey Surface	HS	- Lateral Seepage	SL	- Slope
CT	- Clayey Texture	LS	- Low Strength	SS	- Shrink - Swell
DTC	- Difficult to Clear	NN	- Not Needed	TF	- Tidal Flooding
DTR	- Depth to Rock	NR	- Not Rated	TL	- Thin Layer
DTW	- Deep to Water	PDY	- Productivity	TS	- Too Sandy
DTY	- Droughty	PG	- Piping	UF	- Unstable Fill
EE	- Erodes Easily	PO	- Poor Outlets	WT	- Wet
EH	- Excess Humus	PR	- Percolates Rapidly		

Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

POTENTIALLY SENSITIVE AREAS CROSSED BY TRANSMISSION LINES IN WALTON COUNTY

FIGURE 4.3-4 (Sheet 2 of 2)

SOIL RATINGS AND LIMITATIONS AND FEATURES AFFECTING SELECTED USES BY SOIL ASSOCIATIONS[1/]

			Degree and Kind of Limitations for: Sanitary Facilities			Community Development				Water Management		Recreation			Soil Features Affecting Water Management			Suitability as a Source of			Soil Potential for Agriculture[4/]				Suitability as a Habitat for Wildlife		
Map Symbol	Name of Association with Component Soils[2/]	Percent of Association[3/]	Septic Tank Absorption Fields	Sewage Lagoons	Sanitary Landfill (Trench Type)	Shallow Excavations	Dwellings	Light Industry	Local Roads and Streets	Embankments Dikes and Levees	Excavated Ponds (Aquifer Fed)	Camp and Picnic Areas	Playgrounds	Paths and Trails	Pond Reservoir Areas	Drainage	Irrigation	Topsoil	Sand	Roadfill	Capability Unit	Pine Woodland	Cropland	Improved Pasture	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
1	Kureb - St. Lucie - Rimini (3%)		SLIGHT	SEVERE	SEVERE	SEVERE	SLIGHT	SLIGHT	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	PR	NN	PR,DTY,PDY	POOR	GOOD	GOOD	-	V. LOW	V. LOW	V. LOW	POOR	POOR	V. POOR
	Kureb	40	Slight	Severe PR	Severe PR,TS	Severe CC	Slight	Slight	Slight	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR	NN	PR,DTY,PDY	Poor TS	Good	Good	VIIs-1	V. Low	V. Low DTY,PR,PDY	V. Low DTY,PR,PDY	Poor	Poor	V. Poor
	St. Lucie	20	Slight	Severe PR	Severe PR,TS	Severe CC	Slight	Slight	Slight	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR	NN	PR,DTY,PDY	Poor TS	Good	Good	VIIe-1	V. Low	V. Low DTY,PR,PDY	V. Low DTY,PR,PDY	Poor	Poor	V. Poor
	Rimini	15	Slight	Severe PR	Severe PR,TS	Severe CC	Slight	Slight	Slight	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR	NN	PR,DTY,PDY	Poor TS	Good	Good	VIe-4	V. Low	V. Low DTY,PR,PDY	V. Low DTY,PR,PDY	Poor	Poor	V. Poor
	Others	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Lakeland - Troup (17%)		SLIGHT	SEVERE	SEVERE	SEVERE	SLIGHT	SLIGHT	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	PR	NN	PR,DTY	POOR	GOOD	GOOD	-	MODERATE	MODERATE	MODERATE	POOR	FAIR	V. POOR
	Lakeland	80	Slight	Severe PR	Severe PR,TS	Severe CC	Slight	Slight	Slight	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR	NN	PR, DTY	Poor TS	Good	Good	IIIs-6	Moderate	Moderate DTY,PR	Moderate DTY,PR	Poor	Fair	V. Poor
	Troup	10	Slight	Severe PR	Severe PR,TS	Severe CC	Slight	Slight	Slight	Severe PR,PG	Severe DTW	Severe TS	Severe TS	Severe TS	PR	NN	PR,DTY	Poor TS	Fair	Good	IIIs-6	Moderate	Moderate DTY,PR	Moderate DTY,PR	Poor	Fair	V. Poor
	Others	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Dothan - Tifton (1%)		SEVERE	MODERATE	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SLIGHT	SEVERE	SLIGHT	MODERATE	SLIGHT	PR	NN	FAV	FAIR	POOR	GOOD	-	HIGH	HIGH	HIGH	GOOD	GOOD	V. POOR
	Dothan	40	Severe PS	Moderate HS	Slight	Slight	Slight	Slight	Slight	Slight	Severe DTW	Slight	Moderate PS	Slight	PR	NN	FAV	Fair TL	Poor	Good	IIe-10	High	High	High	Good	Good	V. Poor
	Tifton	30	Moderate PS	Moderate PR	Slight	Slight	Slight	Slight	Slight	Slight	Severe DTW	Slight	Slight	Slight	PR	NN	FAV	Good	Poor	Good	IIe-1	Moderate	High	High	Good	Good	V. Poor
	Others	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Chipley - Albany (11%)		MODERATE	SEVERE	SEVERE	SEVERE	MODERATE	MODERATE	MODERATE	MODERATE	SEVERE	MODERATE	MODERATE	MODERATE	PR	NN	PR,DTY	POOR *	FAIR	GOOD	-	HIGH	MODERATE	MODERATE	FAIR	FAIR	V. POOR
	Chipley	45	Moderate WT	Severe PR	Severe TS,PR,WT	Severe CC	Moderate WT	Moderate WT	Moderate WT	Moderate PR,PG	Severe DTW	Moderate TS,WT	Moderate TS,WT	Moderate TS,WT	PR	NN	PR,DTY	Poor TS	Fair	Good	IIIs-11	High	Moderate PR,DTY	Moderate PR,DTY	Fair	Fair	V. Poor
	Albany	35	Severe WT	Severe PR	Severe WT,PR	Severe CC	Moderate WT	Moderate WT	Moderate WT	Moderate PG,EE	Moderate DTW	Moderate WT	Moderate WT	Moderate WT	PR	WT,CC	PR,WT	Poor TS	Poor	Fair[5/]	IIIw-4	Moderate	Moderate PR,PDY	Moderate PR,PDY	Fair	Fair	Poor
	Others	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Leon - Plummer (47%)		SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SLIGHT	SEVERE	SEVERE	SEVERE	PR	WT,CC	PR,WT	POOR	FAIR	GOOD	-	MODERATE	MODERATE	MODERATE	POOR	POOR	POOR
	Leon	55	Severe WT	Severe PR	Severe TS,PR,WT	Severe CC	Severe WT	Severe WT	Severe WT	Severe PR	Slight	Severe WT	Severe WT	Severe WT	PR	WT,CC	PR,WT	Poor TS	Fair[5/]	Good[5/]	IVw-14	Moderate	Moderate PR,PDY,DTY	Moderate PR,PDY,DTY	Poor	Poor	Poor
	Plummer	25	Severe WT	Severe PR,WT	Severe TS,PR,WT	Severe CC	Severe WT	Severe WT	Severe WT	Severe PR,PG,EE	Slight	Severe WT	Severe WT	Severe WT	PR	WT	PR,WT	Poor TS	Fair[5/]	Good[5/]	IVw-10	Low	Moderate PDY,PR,DTY	Moderate PR,PDY,DTY	Poor	Fair	Fair
	Others	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Ardilla - Stilson - Leefield (5%)		SEVERE	SEVERE	SEVERE	SLIGHT	SEVERE	SEVERE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	PR	WT,PS	WT	FAIR	POOR	FAIR	-	HIGH	HIGH	HIGH	GOOD	GOOD	FAIR
	Ardilla	40	Severe WT,PS	Severe WT	Severe WT	Slight	Severe WT	Severe WT	Moderate WT	Moderate PS,CP,LS	Moderate DTW	Moderate WT	Moderate WT	Moderate WT	PR	WT,PS	WT	Fair TL	Poor	Fair WT	IIe-17	High	High	High	Good	Good	Fair
	Stilson	20	Moderate WT	Moderate PR,HS	Severe WT,PR	Moderate CC	Slight	Slight	Slight	Moderate PG,EE	Severe DTW	Moderate TS,WT	Moderate TS,WT	Moderate TS,WT	PR	NN	PR	Poor TS	Poor	Good	IIe-15	Moderate	High	High	Fair	Fair	Poor
	Leefield	15	Severe WT	Moderate HS	Severe WT	Moderate CC	Moderate WT	Moderate WT	Moderate WT	Moderate PG,EE	Moderate DTW	Moderate WT	Moderate WT	Moderate WT	HS	WT,PS	WT	Poor PDY	Fair	Fair WT	IIe-18	Moderate	High	High	Fair	Fair	Poor
	Others	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Osier - Rutlege - Dorovan (14%)		SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	SEVERE	NR	SLIGHT	SEVERE	SEVERE	SEVERE	SL	FL,WT	FL,WT	POOR	NR	NR	-	HIGH	V. LOW	V. LOW	V. POOR	GOOD	FAIR
	Osier	45	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	Severe FL,WT	NR	Slight	Severe FL,WT	Severe FL,WT	Severe FL,WT	SL	FL,WT	FL,WT	Poor TS	NR	NR	VIIw-2	High[6/]	V. Low FL,DTC	V. Low FL,DTC	V. Poor	Good	Fair
	Rutlege	30	Severe WT,FL	Severe PR,WT,FL	Severe WT,FL	Severe CC,WT	Severe WT,FL	Severe WT,FL	Severe WT,FL	Severe PR,PG	Slight	Severe WT,FL	Severe WT,FL	Severe WT,FL	PR	WT,FL,PO	PR,WT	Fair[5/] TS,WT	Fair	Good[5/]	IIIw-34	Moderate	Low FL,PO,PDY	Moderate FL	Poor	Poor	Good
	Dorovan	10	V. Severe WT,FL	V. Severe WT,FL,EH,PR	V. Severe WT,FL,EH,PR	V. Severe WT,FL,EH	V. Severe WT,FL,EH,LS	V. Severe WT,FL,EH,LS	V. Severe WT,FL,EH,LS	V. Severe WT,FL,EH,PR,PG,CP,UF	Slight	V. Severe WT,FL	V. Severe WT,FL	V. Severe WT,FL	SL	WT,PO,EH	WT,PR	Poor EH	Poor	Poor EH,LS	IIIw-2	V. Low	Low WT,FL,PO	Low WT,FL,PO	V. Poor	Good	Good
	Others	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Saltwater Marsh (2%)		V. SEVERE	V. SEVERE	V. SEVERE	V. SEVERE	V. SEVERE	V. SEVERE	V. SEVERE	NR	V. SEVERE	V. SEVERE	V. SEVERE	V. SEVERE	PR,TF	PO,TF,ES,WT	TF,ES,WT	POOR	NR	NR	-	V. LOW	V. LOW	V. LOW	V. POOR	V. POOR	GOOD
	Saltwater Marsh	70	V. Severe WT,TF	V. Severe WT,TF	V. Severe WT, TF	V. Severe WT,TF	V. Severe WT,LS,TF	V. Severe WT,LS,TF,CR	V. Severe WT,LS,TF,CR	NR	V. Severe TF	V. Severe WT,TF	V. Severe WT,FT	V. Severe WT,TF	PR,TF	PO,TF,ES,WT	TF,ES,WT	Poor ES,TF,WT	NR	NR	VIIIw-1	V. Low	V. Low TF,PO,WT, ES	V. Low TF,PO,WT, ES	V. Poor	V. Poor	Good
	Others	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1/ The overall rating for the association is based on the rating for the dominant soil (soil that makes up the greatest percentage of the association) or soils if more than one soil has the same rating.

2/ "Others" represents minor soils in the association. No one of the individual minor soils makes up as large a percentage of the association as the major soil with the lowest percentage. The percentage in parentheses following each of the soil associations represents the percentage of the county covered by that association.

3/ The percentages are estimates and are not based on measured acreage.

4/ High-level management is assumed which includes water management.

5/ The material itself is considered to be FAIR of GOOD for the intended use, but wetness may be a limitation in obtaining it.

6/ Rating is for hardwood trees.

7/ Rating is for Choctawhatchee sand pine.

ABBREVIATIONS

AR	- Area Reclamation	ES	- Excess Salt	PS	- Percolates Slowly
CC	- Cutbanks Cave	FAV	- Soil Characteristics Favorable	PWT	- Perched Water Table
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CS	- Clayey Surface	HS	- Lateral Seepage	SL	- Slope
CT	- Clayey Texture	LS	- Low Strength	SS	- Shrink - Swell
DTC	- Difficult to Clear	NN	- Not Needed	TF	- Tidal Flooding
DTR	- Depth to Rock	NR	- Not Rated	TL	- Thin Layer
DTW	- Deep to Water	PDY	- Productivity	TS	- Too Sandy
DTY	- Droughty	PG	- Piping	UF	- Unstable Fill
EE	- Erodes Easily	PO	- Poor Outlets	WT	- Wet
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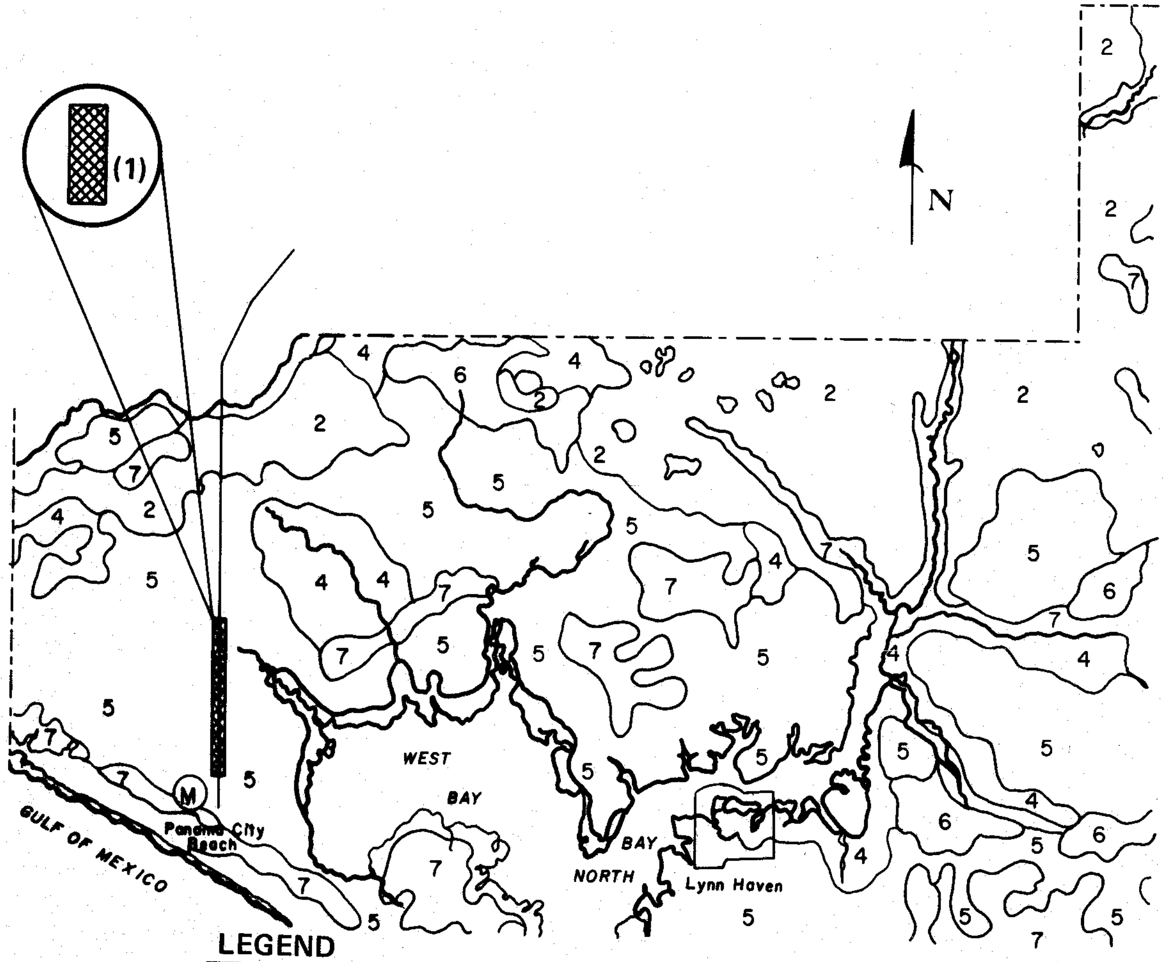
Amendment 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

POTENTIALLY SENSITIVE AREAS CROSSED BY TRANSMISSION LINES IN BAY COUNTY

FIGURE 4.3-5 (Sheet 2 of 2)



LEGEND

River and Lowland Area Crossed by Proposed Transmission Corridor

Transmission Line Corridor

County Boundary Line

Reference Point

0 1 2 3 4
MILES

Potentially Sensitive Areas

(1) Lowland Near Laguna Beach

Amendment 2 8/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	POTENTIALLY SENSITIVE AREAS CROSSED BY TRANSMISSION LINES IN BAY COUNTY
		FIGURE 4.3-5 (Sheet 1 of 2)

4.4

4.4 Resources Committed

Irreversible committments generally concern changes which begin with construction activities, and which at some later time cannot be altered to restore the present order of environmental resources. Irretrievable committments are generally brought about by the use or consumption of resources which are neither renewable nor recoverable for later use.

In general, resources that may be irreversibly committed during plant construction are (a) biological habitat disturbed or destroyed, (b) construction materials that cannot be recovered and recycled with present technology, or (c) land areas rendered unfit for other uses. Resources involved in irretrievable committments related to construction result primarily from the use of energy necessary to support construction activities.

4.4.1 Biological Resources

Construction activity of the Caryville plant will affect both the terrestrial and the aquatic habitat. This activity will result in disturbing some of the wildlife habitat in the plant's vicinity as well as in the loss of the wildlife habitat within the area of the plant proper.

For the total plant site proper, approximately 500 acres will be cleared and graded in increments as needed for each unit's expansion. Approximately 150 acres northeast of the plant proper will be cleared for coal storage. Two hundred acres will be cleared and excavated to create ash disposal area "A." This disposal area will be constructed for the initial site development of two 500 megawatt (MW) units. A second ash disposal area (ash disposal area "B") is planned to accommodate the additional MW capacity. This area will consist of 450 acres, which will require clearing and excavation at a later date, and will be cleared only when and to the extent needed to meet future generation needs.

In addition to the areas described above, a corridor will be cleared from the plant to the Choctawhatchee River to provide access for the intake and discharge piping systems, and for the intake and discharge 2
structures which will be built on the river. The corridor and the intake and discharge structures will be sized to service the ultimate 3,000 MW capacity.

The transmission line corridors associated with the plant will require 2
approximately 1,927 acres. These corridors have been selected to minimize clearing requirements through the use, where possible, of existing corridors.

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Construction activity on the land described above will require a committment of wildlife habitat. However, once the construction activity is completed, the only areas which will not be available for wildlife habitat will be those included in the plant site proper, the ash disposal areas, and that area of the Choctawhatchee River occupied by the intake structure. The habitat so committed could feasibly be restored at the end of the project life if the cost associated with the restoration is commensurate with the benefits to the gained.

4.4.2 Construction Materials

Many of the materials necessary to support the construction effort, such as materials for forming, construction offices, warehouses, etc., can be reclaimed and recycled following the construction periods. The feasibility of this process will be determined by the benefits associated with the reclaiming and/or recycling operation compared with costs.

The estimated quantity of construction materials for the 3,000 MW plant includes 500,000 cubic yards of concrete, 15,000 tons of reinforcing steel, and 70,000 tons of structural steel. The majority of the resources involved in these materials will not be recoverable, and thus constitute an irreversible committment. Some of these resources, i.e., structural steel, can be readily recycled by existing technology, however.

4.4.3 Land

Construction of the Caryville plant will require the conversion of land use from agricultural and timber production to the generation and transmission of electrical power. The economic productivity of the plant and its associated transmission lines will be much greater than the present economic productivity of the land from agricultural or other likely uses. At the end of the project life, the land dedicated to electric 2
power production and transmission could be restored for agricultural and timber production, assuming the cost associated with that restoration is commensurate with the benefits to be gained. Land involved in the transmission line rights-of-way will be available for use by the property owner throughout the life of the project. The land may be used in any manner that is consistent with the operation and maintenance of the transmission line. 2

4.4.4 Consumption of Energy

The estimated resource requirements to support the construction of 3,000 MW on this site are 10,000,000 gallons of diesel oil and other fuel oils and 160,000,000 kilowatt hours of electrical energy. This expenditure of energy will be necessary to operate the equipment and other support functions, and will represent an irretrievable committment of a resource 2
which is neither renewable nor recoverable for later use, and will occur over a large number of years.

5. PLANT OPERATION

5.0 Environmental Effects Of Plant Operation

5.0 ENVIRONMENTAL EFFECTS ON PLANT OPERATION

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5.0 ENVIRONMENTAL EFFECTS OF PLANT OPERATIONS

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LIST OF FIGURES (Continued)

5.0 ENVIRONMENTAL EFFECTS OF PLANT OPERATION

LIST OF FIGURES (Continued)

5.1

5.1 Effects Of The Operation Of The Heat Dissipation System

The proposed intake structure and the proposed discharge structure described in section 3.4, "Heat Dissipation System," are designed to withdraw and return water to the river at approximately the same depth. Therefore, no adverse effects are anticipated from withdrawal and return at different depths.

5.1.1 Temperature Effects of Tower Blowdown

Gulf will take blowdown from the cool side of the cooling tower, mix it with bleed-off from both the ash sluice systems and the effluent from the waste water basin, and then discharge it directly to the river. 3

In order to accurately predict the effluent temperature under various hydrometeorological conditions, Gulf performed a detailed thermal analysis. Included in the analysis were the following parameters: (a) heat gained in the ash sluice process, (b) net heat transfer from the ash disposal area surfaces, and (c) heat gained from tower blowdown. 3

The results of the analysis are presented in table 5.1-1.

5.1.2 Discussion of the Analytical Model

Several analytical models are available for predicting plume configurations (1, 2, 3, 4, 5). After studying the river bottom topography, river hydrology, and the discharge structure location, Gulf decided that the three-dimensional submerged discharge model (5) would give the most representative results.

The proposed discharge point is located on a concave bank where the river makes a sharp turn of approximately 90 degrees. Rather strong eddies and turbulence exist in the river due to the existence of a secondary flow (6) in the transverse direction across the river. These strong eddies tend to accelerate the mixing process for the effluent, but the effect of the eddies is neglected by the three-dimensional submerged discharge model. Therefore, the actual plume size will be smaller than predicted by this model, especially in the region where the jet velocity is close to the river velocity. Under low river flow conditions, the upper edge of the plume may reach the water surface some distance downstream of the discharge point, thereby restricting mixing somewhat. However, due to the existence of the secondary flow which tends to keep the plume submerged, this model is considered adequate. FSU agrees

5.1.3 Description of Cases Studied

Gulf's operation of the plant will result in varying discharge rates and temperatures. For the purpose of defining the mixing zone, it is only desirable to describe the largest probable thermal plume which can 3

occur during a hydrometeorological phenomenon governed by the three parameters of river flow rate, river water temperature, and ambient wet bulb temperature.

To determine the maximum probable plume size, it is necessary to postulate the simultaneous occurrence of (a) minimum river flow rate, thereby assuming the minimum amount of water available for mixing and dilution, and (b) minimum river water temperature. Furthermore, it is necessary to combine these two parameters with various discharge rates and temperatures to determine which combination will produce the largest thermal plume. 3

No computation of the minimum effluent discharge rate for the 500 MW case is possible because the three-dimensional submerged discharge model (5) does not give valid results when discharge velocities are nearly equal to the river velocity. The plume for the 500 MW minimum effluent case will be smaller than the 1,000 MW plume, because the quantity of water discharged is less and the river current velocity is higher than the discharge velocity. The river current tends to "pull" the discharged water from the outlet, resulting in much faster mixing with the river.

The effluent temperature is dependent upon the ambient wet bulb temperature since its source is the blowdown from an evaporative cooling device (wet cooling tower). The time frame of interest is the estimated life of the plant, or approximately 40 years. Since river flow is the only one of the three parameters for which 40 years of record exist, it is impossible to determine if the postulated worst case has occurred. From a statistical evaluation of the records available for ambient wet bulb temperatures (16 years of record) and river temperature (5 years of record), it is possible to estimate the probability of simultaneous occurrence of high wet bulb temperature, low river temperature, and low river flow. The probability of simultaneous occurrence of three independent parameters is the product of the probability of each event occurring independently. Expressed mathematically:

$$P = P_{lrf} \times P_{hwb} \times P_{lrt}$$

where

P_{lrf} = probability of occurrence of low river flow

P_{hwb} = probability of occurrence of high wet bulb temperature

P_{lrt} = probability of occurrence of low river temperature

for the general case

$$P = \frac{\text{Number of occurrences}}{\text{Total Number of readings}}$$

specifically

$$P_{lrf} = \frac{1}{90 \times 44}$$

$$P_{hwb} = \frac{43}{35549}$$

$$P_{lrt} = \frac{2}{450}$$

$$P = \frac{1}{90 \times 44} \times \frac{43}{35549} \times \frac{2}{450} = 1.36 \times 10^{-9}$$

It is therefore extremely unlikely that the phenomenon will occur during the life of the plant and, therefore, it is technically and economically undersirable to design the system for such stringent criteria.

A more logical approach is to arbitrarily use the minimum river temperature of record, the maximum wet bulb temperature of record, and the commonly accepted 7-day/10-year river flow of record to define the most severe cases. These record temperatures will produce the effluent temperatures presented in table 5.1-1.

The probability of the occurrence of the maximum temperature difference between the plant effluent and the river is independent of the river flow rate, and is dependent on the wet bulb and river temperatures and the plant effluent flow rate.

It is necessary to evaluate summer, autumn, and winter cases in conjunction with minimum, average, and maximum effluent flow rates in order to determine which case will actually result in the largest thermal plume. The commonly accepted value of 7-day/10-year low flow was arbitrarily selected for use in the prediction of adverse winter and summer conditions. From table 2.5-7, the 7-day/10-year low flow was taken as 870 cubic feet per second (CFS). For the adverse autumn case, the lowest monthly average flow of record (604 CFS) was selected for predictive purposes. At these flow rates, the discharge pipe centerline is estimated to be submerged 3
approximately three feet, while the full river depth is estimated to be approximately 10 feet.

Minimum, average, and maximum effluent flow rates per 500 MW generating capacity are estimated to be 1.84, 4.62, and 7.41 CFS respectively. Furthermore, minimum, average, and maximum flow rates were distributed on a 25 percent, 50 percent, and 25 percent occurrence basis, respectively.

Analyses of the plume under minimum effluent discharge rates and low river flows revealed that the portion of the plume with temperatures higher than $5^{o}F$ above ambient will not stay submerged for a very long distance from the point of discharge. This is due to the small momentum of a low velocity jet. The discharge pipe center line is therefore set at an angle

of 15^{o} below the horizontal to compensate for the buoyancy of the jet and to assure that the plume stays submerged throughout the reach of the $5^{o}F$ 3
isotherm.

5.1.4 Results of Analytical Modeling

The results of the plume analyses of Cases 1, 2, and 3 of table 5.1-1 were used to plot the decay curves of figure 5.1-1 in order to determine the hydrometeorological conditions (Case 1, 2, or 3) which will result in the largest thermal plume. From figure 5.1-1, it is apparent that Case 1 is the most severe.

The results of the plume analyses of Cases 1, 4, and 5 were used to plot the decay curves of figure 5.1-2 to determine whether the minimum or 3
maximum effluent creates the largest plume. It is seen from this figure that Case 1 (minimum effluent flow) will produce the largest affected area in the river and therefore the largest plume. The Case 1 plumes are shown in figures 5.1-3 and -4 for 3,000 MW and 1,000 MW, respectively. Plumes of more normal conditions are presented for comparative purposes only, in figures 5.1-5 through -7.

Figure 5.1-8 is a river cross section just downstream of the point of discharge under Case 1 conditions. The area affected by the thermal plume is 116 feet square, or about nine percent of the total cross sectional area of 1,329 feet square.

5.1.5 Whole River Temperature Rises

The "whole river temperature" increase caused by the plant effluent is small. (The "whole river temperature" is that calculated average temperature of the river along its length from the proposed plate site to Choctawhatchee Bay.) Calculated whole river temperature increases are presented in table 5.1-1.

5.1.6 Applicable Thermal Standards

Applicable state thermal standards are outlined in Chapter 17-3, as amended, of the Florida Administrative Code (7), and applicable Federal thermal standards are outlined in CFR (Code of Federal Requlations) Title 40, Part 423.15-1. Both standards permit discharge of heat from the cold side of the condenser.

The State of Florida may grant a zone mixing beyond the point of discharge to afford a reasonable opportunity for dilution and mixing of heated water with the river. Zones of mixing for cooling tower 3
blowdown discharges shall be established on the basis of the physical and biological characteristics of the river.

5.1.7 Environmental Effects of Cooling Towers

The wet natural draft cooling towers for the proposed Caryville plant will release water vapor to the atmosphere at a height greater than 550 feet above the ground elevation and a rate which will vary with plant load and site meteorological conditions. Maximum evaporation from the towers will be about 25,980 gallons per minute (GPM) per 3,000 MW on a hot summer day. The maximum drift rate will be about 90 GPM per 3,000 MW with an expected drift rate of about 45 GPM.

Potential environmental effects due to tower operation include possible increased frequency of fog formation and fog density, reduced visibility, icing on nearby objects, the deposition of materials contained in the drift, and the consumption of water. Each of these effects were considered during the selection of the cooling towers.

5.1.7.1 Local Fogging and Icing - The use of wet natural draft cooling towers with a height in excess of 550 feet will result in tower emissions reaching ground level far less frequently than emissions from shorter towers. Under most meteorological conditions, tower discharge will condense and form a visible water vapor plume until it is evaporated due to mixing with unsaturated air. The length of the visible plume depends on the temperature and the relative humidity of the surrounding 2
air. Much of the time, the visible plume will not extend beyond the site boundary, although, on cool humid mornings, longer plumes may occur. On such occasions, it may be difficult to distinguish such plumes from the overcast.

Gulf is working with other utility companies to develop a cooling tower plume dispersion model and has calibrated it against wet natural draft cooling tower plume observations. The physics of this particular model have been described (8). For relatively flat terrain similar to that at the plant site, the model's plume does not reach ground level at wind speeds up to and in excess of 40 miles per hour (MPH). Observations of cooling tower plumes by the American Electric Power Service Corporation (9) are that no visible plume reached ground level even with winds as strong as 44 MPH. The results of modeling studies and the finding of field observations lead to the conclusion that although natural draft towers have the potential to effect ground level fog, they seldom do. Studies of the environmental effects of cooling towers which support this statement are found in at least four current documents (9, 10, 11, 12).

The elevated cooling tower plume is not expected to contribute significant moisture to the atmosphere at ground level. Due to this low moisture contribution and the moderate climate with a low frequency of freezing conditions, Gulf does not expect increased icing on roads or other ground level surfaces.

5.1.7.2 Drift - The wet natural draft cooling towers selected for the Caryville plant will have state-of-the-art drift eliminators. The expected drift rate for these towers is 0.004 percent of the circulating water flow or approximately 7.5 GPM per 500 MW. The maximum guaranteed drift rate is 0.008 percent of the circulating water flow or approximately 15 GPM per 500 MW. The expected drift rate for the 3,000 MW site development will be approximately 45 GPM with a maximum rate of approximately 90 GPM.

Drift from the natural draft cooling towers will contain dissolved solids at the same concentration as tower blowdown. (See table 3.4-3.) These solids will be deposited over the land surface. At an expected rate of 45 GPM for 3,000 MW, drift will result in the deposition of approximately 31 tons of material per year. Assuming this material were deposited evenly over the 1,500 acre site, deposition would amount to approximately 0.02 tons per acre per year or 40 pounds per acre per year. This value may be compared with reported quantities of material leached from trees by rain. Depending on the type of forest, one inch of rain may leach from between 0.1 to 9.5 pounds per acre of constituents such as calcium, magnesium, potassium, phosphorus, and sodium from tree foliage (13).

The potential impact of icing conditions due to cooling tower drift is considered minimal. The climate in the vicinity of the proposed site is very moderate with a low frequency of freezing conditions.

5.1.7.3 Water Consumption - Evaporation and drift of water due to the operation of the wet natural draft cooling towers will constitute a consumptive use. The estimated consumptive rate for the initial 500 MW unit is 4,345 GPM. The consumptive rate will double to approximately 8,690 GPM for 1,000 MW and reach 26,070 GPM for the ultimate site development of 3,000 MW. Evaporation and drift constitute a consumptive use of surface water but the water is returned to the environment through the hydrologic cycle. (The hydrologic cycle is described in section 2.5, "Hydrology.")

The amount of water involved as consumptive use due to the operation of the natural draft cooling towers for the 3,000 MW site is approximately one percent of the average flow of the Choctawhatchee River at the site. The consumptive use is less than one percent of the average fresh water supply to the Choctawhatchee Bay. Therefore, the consumptive use of water at the proposed plant by natural draft cooling towers is expected to have minimal impact on the Choctawhatchee River and on Choctawhatchee Bay.

5.1.8 Effects on the Biota

For effects of the heat dissipation system on biota, refer to Section 2 of Appendix D. 3

Amendment 3 9/75
Amendment 2 8/75

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(2) Carter, H. H. "A Preliminary Report on the Characteristics of a Heated Jet Discharged Horizontally into the Transverse Current, Part I - Constant Depth." Technical Report 61, Chesapeake Bay Institute, The Johns Hopkins University, November, 1969.

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(4) Shirazi, M. A. and L. R. Davis. Workbook of Thermal Plume Prediction, Volume 2, Surface Discharge, EPA-R2-72-005b, National Environmental Research Center, U. S. EPA, Corvallis, Oregon, 97330, May, 1974.

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(6) Engelund, F. "Flow and Bed Topography in Channel Bends." J. of the Hydraulics Division, ASCE. Vol. 100, No. HY11, pp. 1631-1648, November, 1974.

(7) "Pollution of Waters." Rules of the Florida Department of Pollution Control, Chapter 17-3, May 7, 1974.

(8) Calabrese, R. V., J. H. Halitsky, and K. Woodard. "Prediction of Temperature and Moisture Distribution in Cooling Tower Plumes." Proc. American Meteorological Society and World Meteorological Organization Symposium on Atmospheric Diffusion and Air Pollution, Santa Barbara, Calif., 1974.

(9) Cooling Towers and the Environment, study published by American Electric Power Service Corp., 2 Broadway, N.Y., N.Y., October, 1974. 2

(10) Peterson, J. T. "Impact of Thermal Discharges on Air Quality." Effects and Methods of Control of Thermal Discharges, Report to the Congress by EPA in accordance with Section 104(t) of FWPCA, Amendments of 1972, Serial No. 93-14, November, 1973.

(11) Huff, F. A., et.al. "Preliminary Report, Effect of Cooling Tower Effluents on Atmospheric Conditions in Northeast Illinois." Illinois State Water Survey Circular 100, Urbana, Illinois, 1971.

(12) Hosler, C. L. "Wet Cooling Tower Plume Behavior." Cooling Towers, CEP Technical Manual Publication by AICHE, N.Y., N.Y., 1971.

(13) Final Impact Statement Related to the Construction of Joseph M. Farley Nuclear Plant, Units 1 and 2, U.S. Atomic Energy Commission, p. V-7, June, 1972. 2

TABLE 5.1-1

PLANT EFFLUENT TEMPERATURES AND WHOLE RIVER TEMPERATURE RISE

Hydrometeorological Conditions						Effluent Temperatures (°F)			Whole River Temperature Rise (°F)		
						Generating Capacity (MW)			Generating Capacity (MW)		
Case	Description	Probability of Occurrence	Wet Bulb Temperature (°F)	River Temperature (°F)	River Discharge Rate (cfs)	500	1,000	3,000	500	1,000	3,000
1	Minimum plant effluent under adverse winter conditions	$5x10^{-8}$	72	39	870	83.3	83.3	83.3	0.09	0.19	0.60
2	Minimum plant effluent under adverse summer conditions	$1.525x10^{-8}$	84	71	870	89.0	89.0	89.0	0.04	0.08	0.24
3	Minimum plant effluent under adverse autumn conditions	$2.425x10^{-8}$	82	68	604	89.4	89.4	89.4	0.07	0.13	0.43
4	Average plant effluent under adverse winter conditions	10^{-7}	72	39	870	70.5	69.7	70.8	0.17	0.33	1.08
5	Maximum plant effluent under adverse winter conditions	$5x10^{-8}$	72	39	870	67.1	66.7	67.3	0.24	0.48	1.55
6	Average plant effluent under average winter conditions	$6.25x10^{-2}$	48	52.1	6,413	68.1	68.6	67.3	0.01	0.02	0.07
7	Average plant effluent under average summer conditions	$6.25x10^{-2}$	74	79.6	3,805	88.9	89.3	88.0	0.01	0.02	0.06

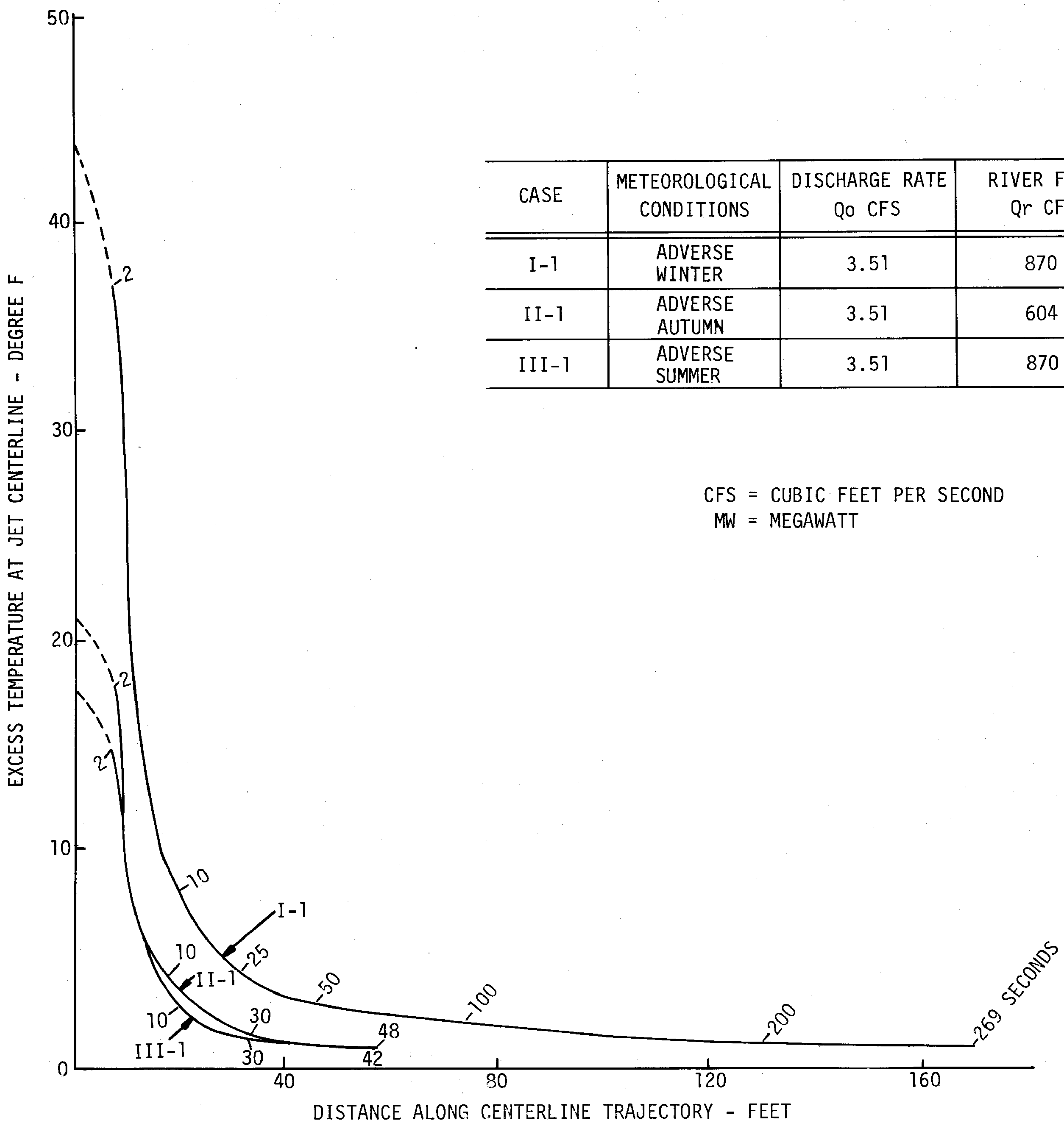
3

TABLE 5.1-2

WHOLE RIVER TEMPERATURE INCREASES DUE TO THE THERMAL EFFLUENT

Hydrometeorological Conditions					Whole River Temperature Rise		
					Generating Capacity (MW)		
Description	Probability of Occurrence	Web Bulb Temperature(^{o}F)	River Temperature(^{o}F)	River Discharge Rate (CFS)	500	1,000	3,000
Adverse Winter	$2x10^{-7}$	72	39	870	0.18	0.37	1.18
Adverse Summer	$6.1x10^{-8}$	84	71	870	0.11	0.23	0.74
Adverse Autumn	$9.7x10^{-8}$	82	68	604	0.17	0.35	1.08
Average Winter	0.125	48	52.05	6,413	0.01	0.02	0.08
Average Summer	0.125	74	79.6	3,805	0.01	0.02	0.07
Average Autumn	0.125	69.3	75.28	3,525	0.01	0.02	0.1

CFS = Cubic Feet Per Second
MW = Megawatts



CASE	METEOROLOGICAL CONDITIONS	DISCHARGE RATE Qo CFS	RIVER FLOW Qr CFS	DISCHARGE TEMP. To DEG.F	RIVER TEMP. Ta DEG.F
I-1	ADVERSE WINTER	3.51	870	83.3	39.0
II-1	ADVERSE AUTUMN	3.51	604	89.4	68.0
III-1	ADVERSE SUMMER	3.51	870	89.0	71.0

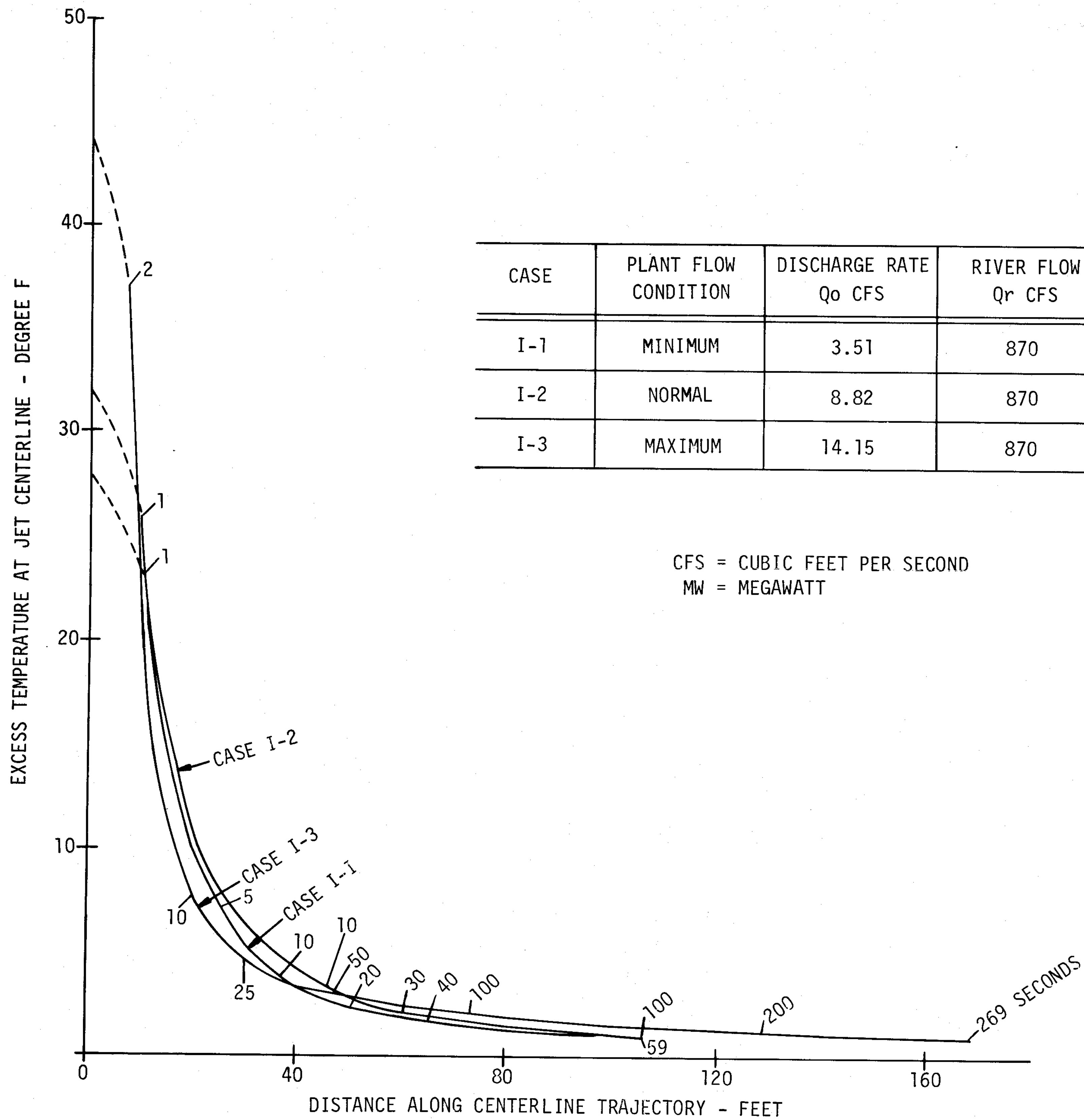
CFS = CUBIC FEET PER SECOND
MW = MEGAWATT

Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TEMPERATURE DECAY ALONG CENTERLINE TRAJECTORY, 3,000 MW AND MINIMUM PLANT FLOW CONDITIONS

FIGURE 5.1-1



CASE	PLANT FLOW CONDITION	DISCHARGE RATE Qo CFS	RIVER FLOW Qr CFS	DISCHARGE TEMP. To DEG. F	RIVER TEMP. Ta DEG. F
I-1	MINIMUM	3.51	870	83.3	39.0
I-2	NORMAL	8.82	870	70.8	39.0
I-3	MAXIMUM	14.15	870	67.3	39.0

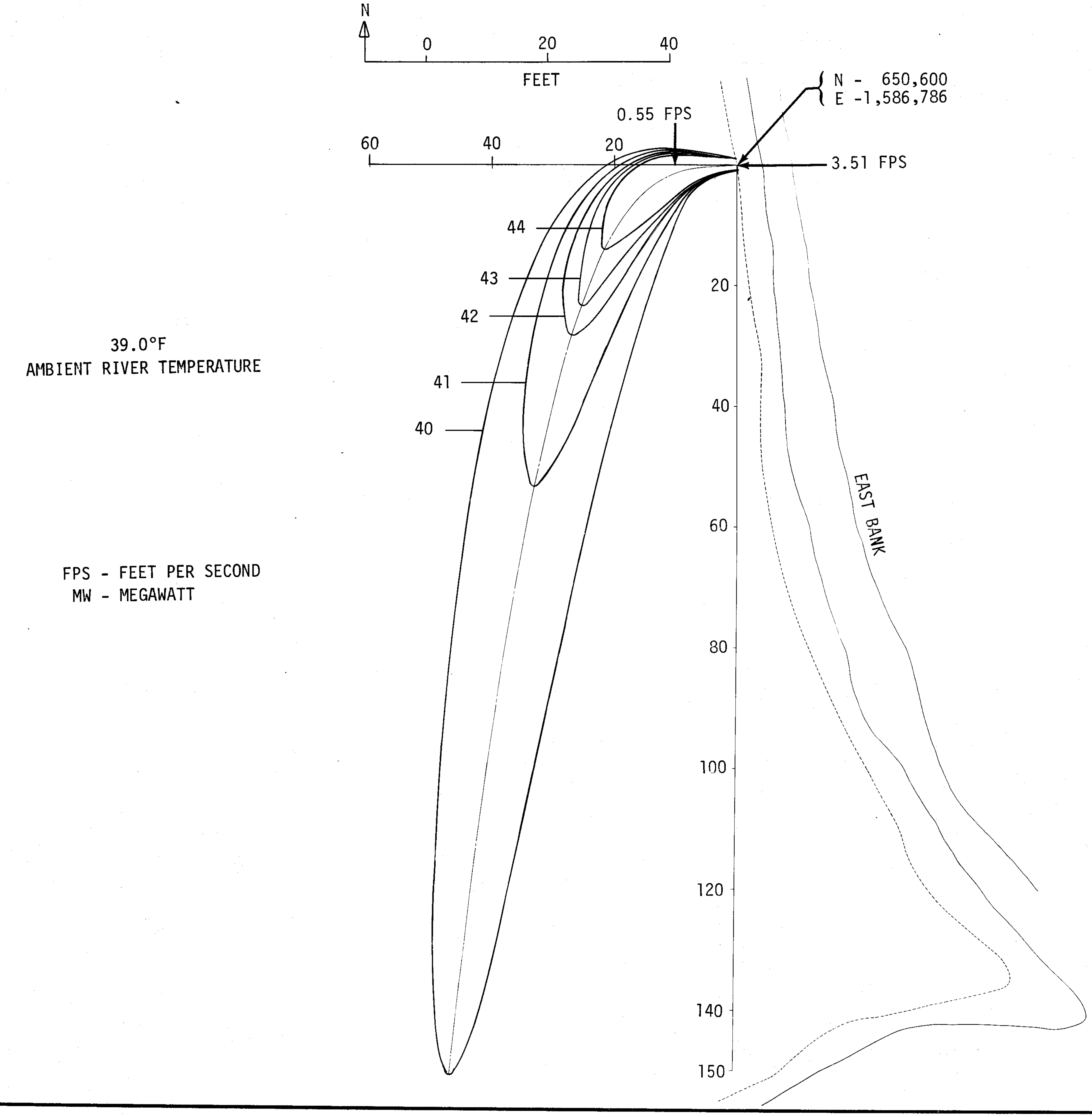
CFS = CUBIC FEET PER SECOND
MW = MEGAWATT

Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TEMPERATURE DECAY ALONG CENTERLINE TRAJECTORY 3,000 MW AND ADVERSE WINTER CONDITIONS

FIGURE 5.1-2



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GULF POWER CO.
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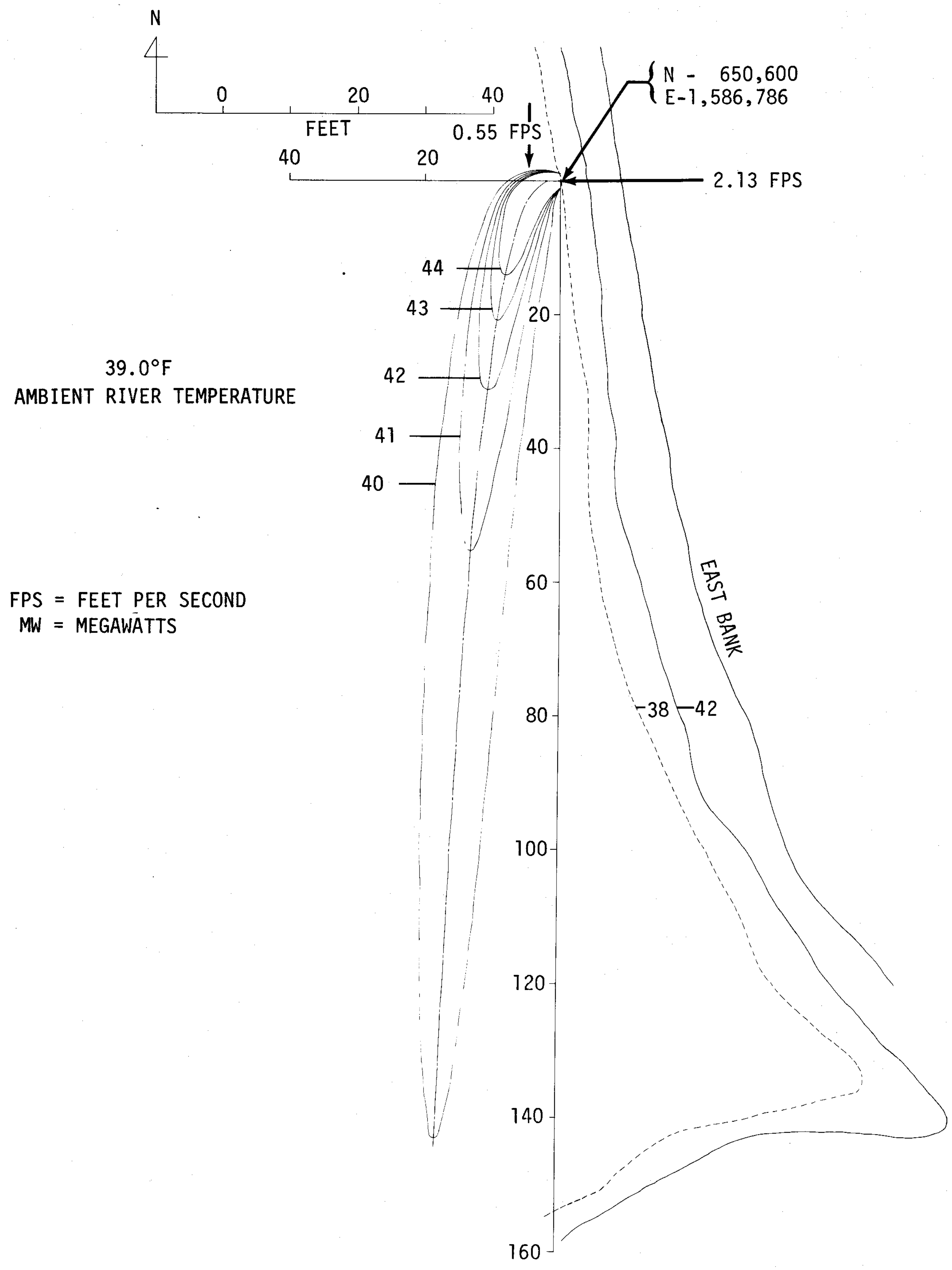
TEMPERATURE ISOTHERMS AT ULTIMATE 3,000 MW CAPACITY ADVERSE WINTER AND MINIMUM PLANT EFFLUENT RATE

FIGURE 5.1-3



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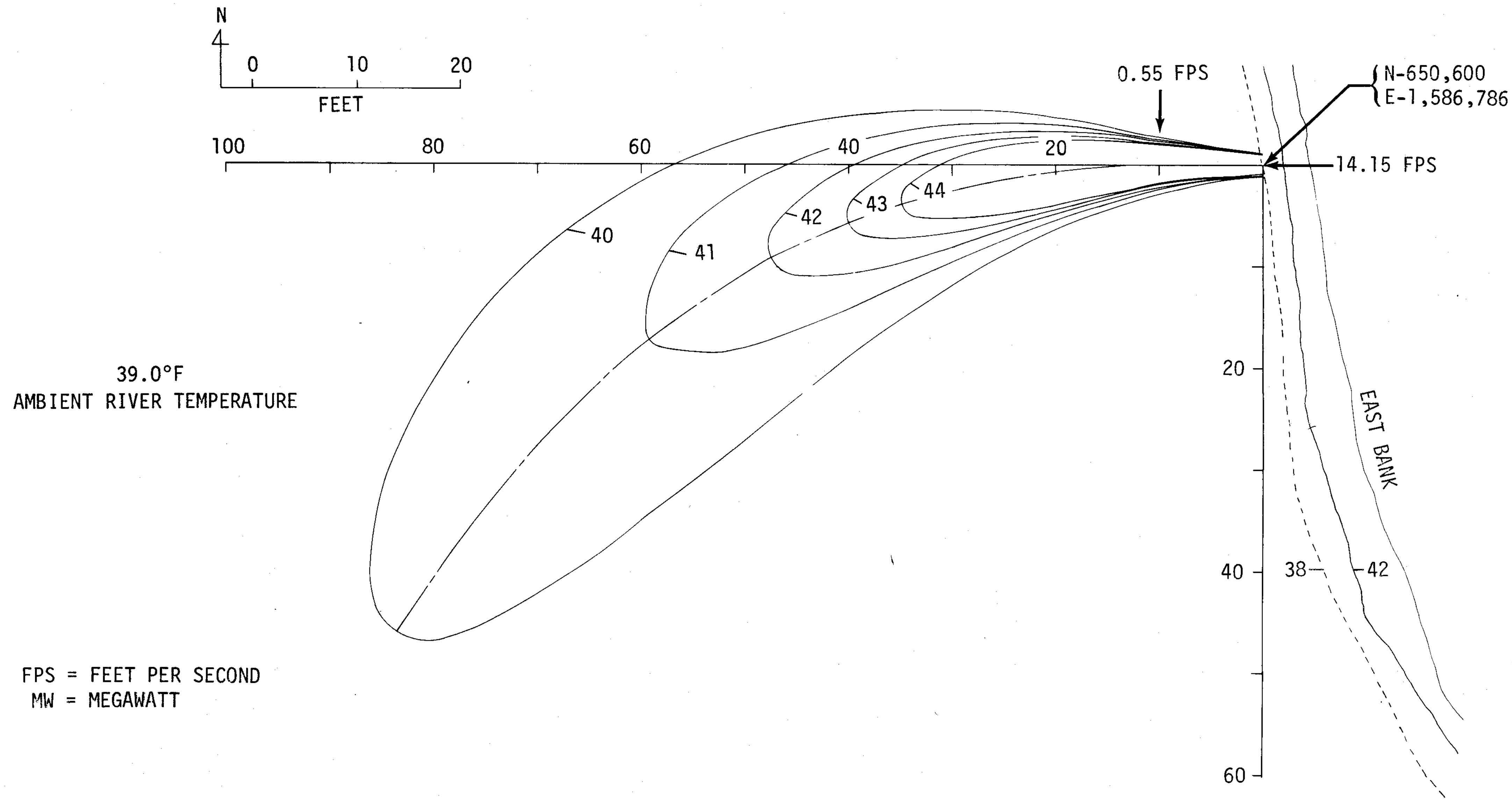
GULF POWER CO.
CARYVILLE STEAM PLANT

TEMPERATURE ISOTHERMS AT 1,000 MW CAPACITY ADVERSE WINTER AND MINIMUM PLANT EFFLUENT RATE

FIGURE: 5.1-4



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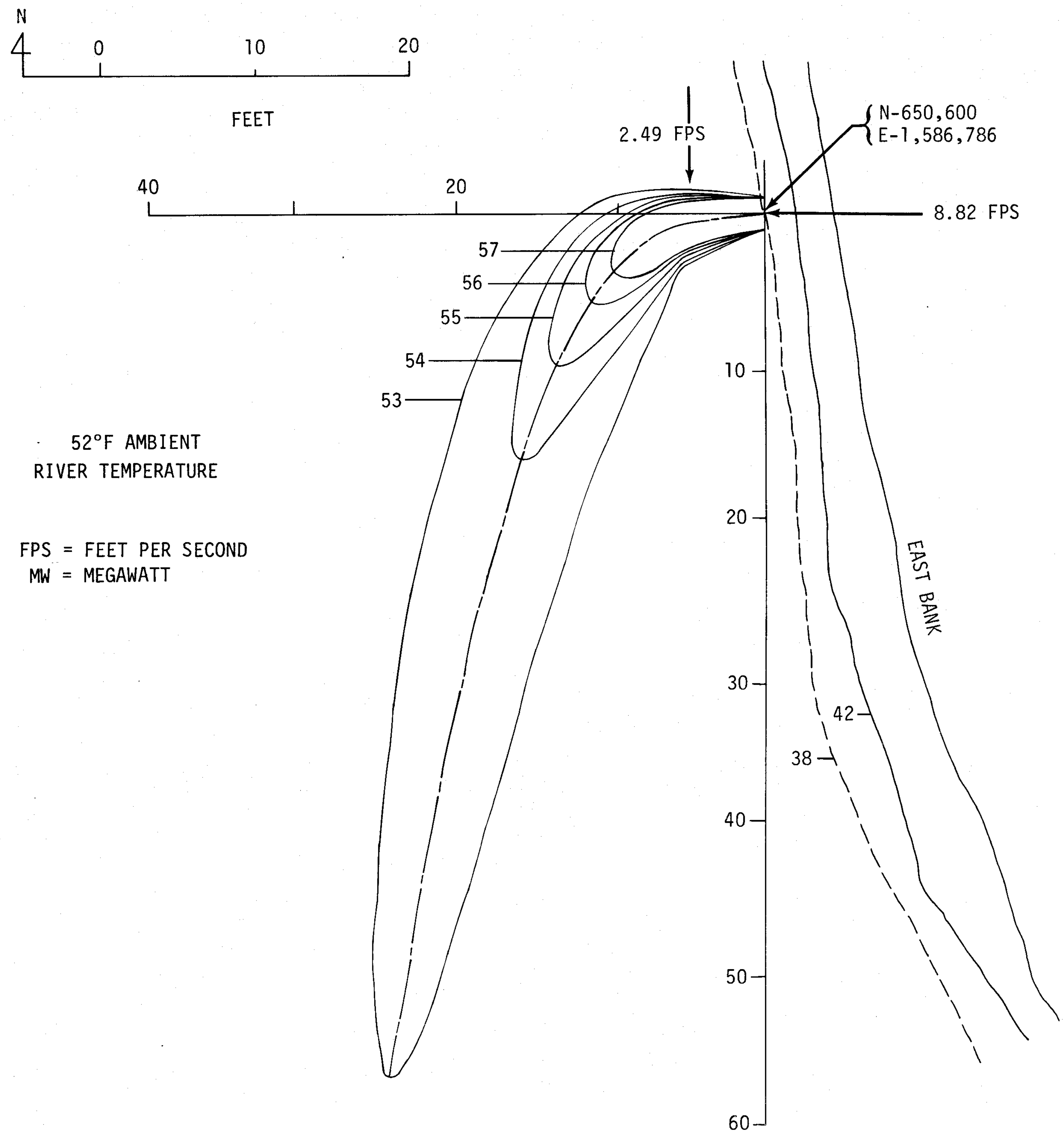
GULF POWER CO.
CARYVILLE STEAM PLANT

TEMPERATURE ISOTHERMS AT ULTIMATE 3,000 MW CAPACITY, ADVERSE WINTER AND MAXIMUM PLANT EFFLUENT RATE

FIGURE 5.1-5



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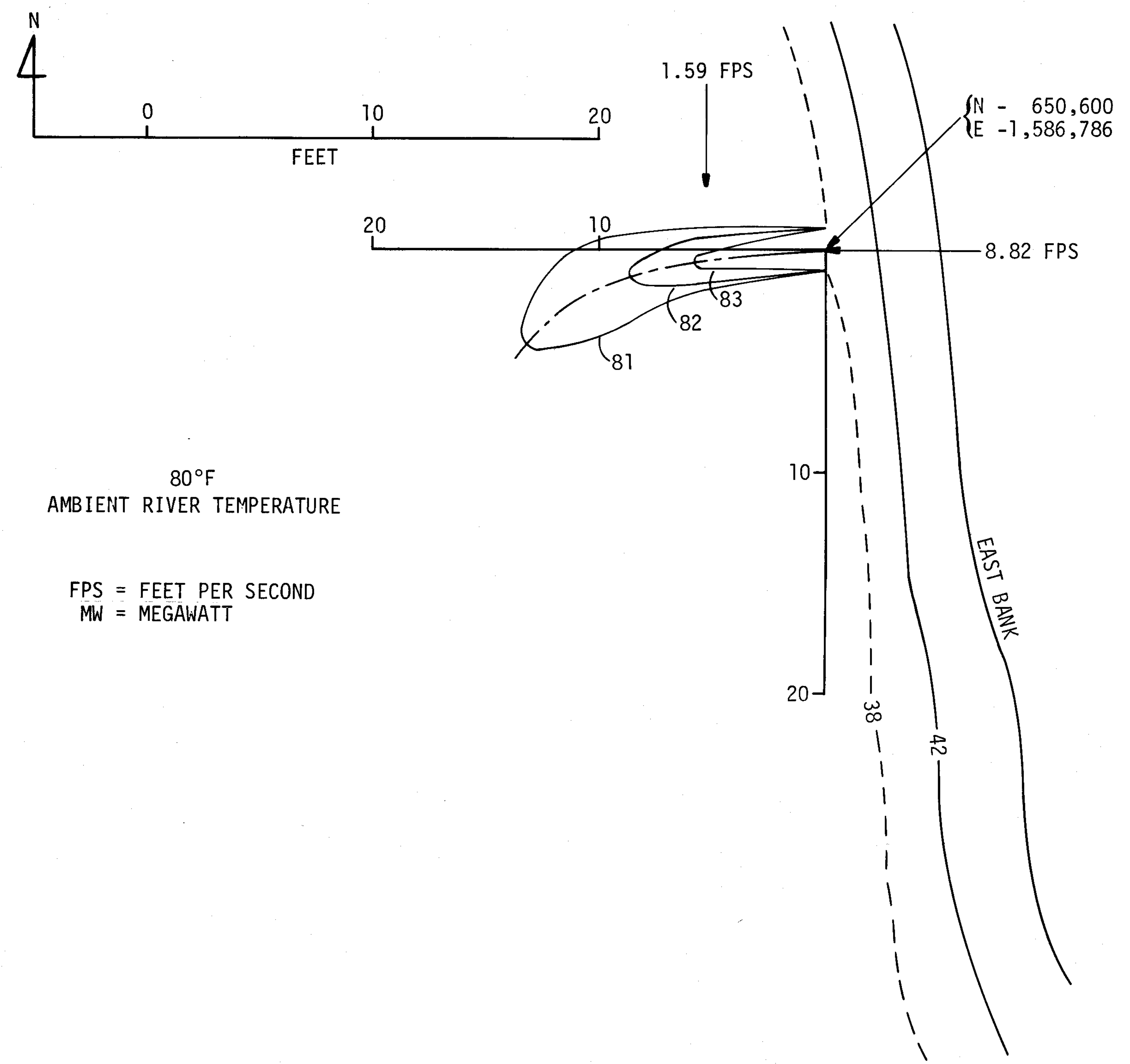
TEMPERATURE ISOTHERMS AT ULTIMATE 3,000 MW CAPACITY, AVERAGE WINTER AND AVERAGE PLANT EFFLUENT RATE

FIGURE: 5.1-6



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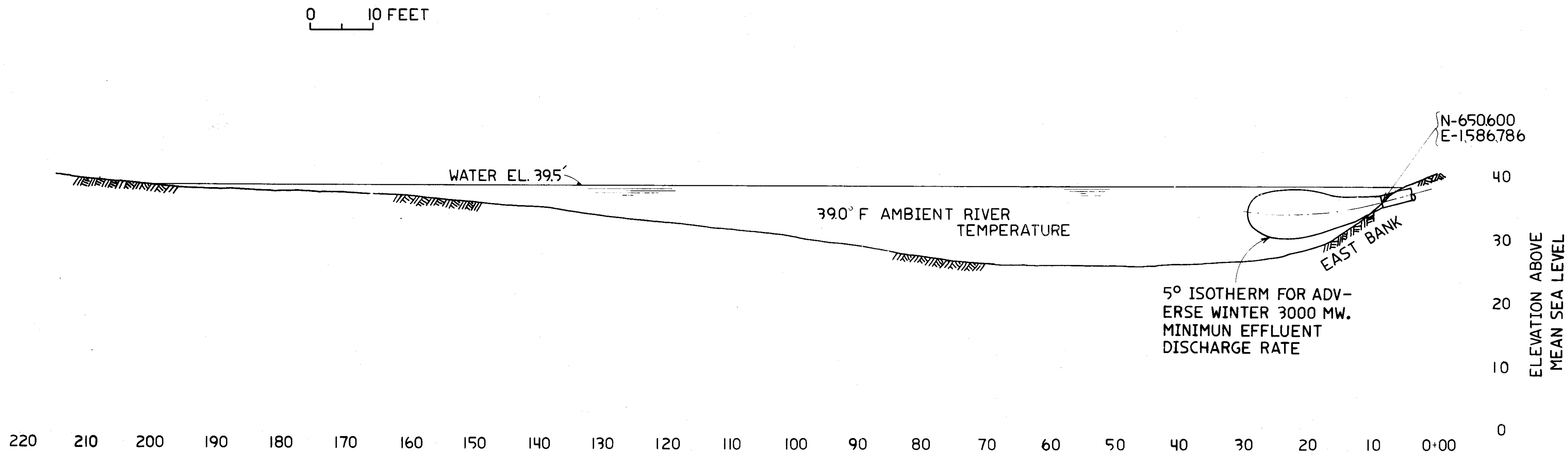
GULF POWER CO.
CARYVILLE STEAM PLANT

TEMPERATURE ISOTHERMS AT ULTIMATE 3,000 MW CAPACITY, AVERAGE SUMMER AND AVERAGE PLANT EFFLUENT RATE

FIGURE 5.1-7



RIVER CROSS SECTION AT THE DISCHARGE STRUCTURE

Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSVERSE RIVER CROSS SECTION SHOWING THE MAXIMUM SIZE THERMAL PLUME

FIGURE 5.1-8

5.2

5.2 Effects of Chemical and Biocide Discharges

5.2.1 Water Quality Standards Governing Discharges

Results of natural ambient river water analysis are given in table 3.4-1. 3

The quality and quantity of the plant's waste water stream is discussed in subsection 3.5.3.4, "Plant Discharge."

The Florida Department of Pollution Control (FDPC) has established applicable water quality standards (1). As stated in chapter 17-3.05 of the Florida Administrative Codes (FAC), the only constituents of the plant effluent which are specifically limited by the water quality limits on these constituents, listed below, are applied "only after reasonable opportunity for mixture of wastes with receiving waters has been afforded" (1).

Constituents	FDPC Limit
Total Dissolved Solids	500 milligrams per liter (MG/L) a monthly average not be exceed 1,000 MG/L at any time
Chlorides	250 MG/L
pH	6.0 to 8.5

No specific criteria are given for sulfates and potassium. However, according to section 17-3.04(4), when these occur "in any amounts in any individual body of water, they shall be suspected of degrading the quality of the particular lake or stream." 3

The plant effluent will also be in compliance with applicable U.S. Environmental Protection Agency regulations.

5.2.2 Effluent Effects on Biota

For effects of chemical and biocide discharges on biota, refer to Section 2 of Appendix D. 3

5.2.3 Dispersion of Effluent in the River

Gulf used an analytical model to predict the mixing of the effluent in the river, as discussed below.

5.2.3.1 Discussion of the Analytical Model - Several analytical models are available for predicting plume configurations (2, 3, 4, 5, 6). After studying the river bottom topography, river hydrology, and the proposed discharge structure location, Gulf decided that the three-dimensional submerged discharge model (6), would give the most representative results.

The proposed discharge point is located on a concave bank where the river makes a sharp turn of approximately 90 degrees. Rather strong eddies and turbulence exist in the river due to the existence of a secondary flow (7), in the transverse direction across the river. These strong eddies tend to accelerate the mixing process for the effluent, but the effect of the eddies is neglected by the three-dimensional submerged discharge model (6). Therefore, the actual plume size will be smaller than predicted by this model, especially in the region where the jet velocity is close to the river velocity. Under low river flow conditions, the upper edge of the plume may reach the water surface some distance downstream of the discharge point, thereby restricting mixing somewhat. However, due to the existence of the secondary flow, which tends to keep the plume submerged, Gulf considers this model adequate.

5.2.3.2 Description of Cases Studied - Operation of the plant will result in different discharge rates with corresponding differences in levels of discharge constituents depending on the level of plant operation. The largest plume will occur when the river flow rate is low because less water will be available for mixing and dilution. The 7-day/10-year low flow value generally recognized by the U.S. Geological Survey and the Northwest Florida Water Management District was also chosen for use in the predictions. From table 2.5-7, the 7-day/10-year low flow was taken as 870 cubic feer per second (CFS). At this flow rate, the discharge pipe centerline is estiamted to be submerged approximately three feet while the full river depth is estimated to be approximately 10 feet. 3

Gulf estimates that the plant effluent discharge rate may vary from 1.84 CFS to 7.41 CFS per 500 MW generating capacity. Due to the variability of the chemical constituents, generic type chemical plumes for various flow conditions are given.

Plumes analyzed include the following:

Case No.	MW	River Flow (CFS)	Plant Effluent Rate (CFS)
1	500	870	7.41
2	1,000	870	3.68
3	1,000	870	14.82
4	3,000	870	11.04
5	3,000	870	44.46
6	3,000	1,700	27.72
7	3,000	5,290	27.72

3

No computation of the minimum effluent from a 500 MW plant size is possible because the three-dimensional submerged discharge model (6) will not give valid results when discharge velocities are near the river velocity. The 500 MW plant size plume will be smaller than

the 1,000 MW plant size plume, not only because the quantity of water discharged is less, but because the river current velocity is higher than the discharge velocity. The river current velocity tends to "pull" the discharged water from the outlet, resulting in much faster mixing with the river.

<u>5.2.3.3 Results of Computations</u> - Results of the computation in
subsection 5.2.3.2 above have been analyzed and the concentration
ratios plotted for the various combinations of flow conditions on 3
figures 5.2-1 through -7. With the concentration ratios given, one
is able to determine the concentration of any constituent when the
original concentration at the point of discharge is known.

Figures 5.2-3 and -5 are the worst-case plots of the predicted chemical plumes for plant sizes of 1,000 MW and 3,000 MW, respectively.

Both of the cases described above are for a low river flow rate. For
higher and more normal river flow rates, the plume size will be slightly
smaller than the corresponding case for low river flows. This is because
both the river flow velocity and the water surface level will be higher,
making the ambient turbulence stronger and additional dilution water
available above the plume. Figures 5.2-6 and -7 are worst-cast 3,000 MW 3
plumes for river flows of 1,700 CFS and 5,290 CFS, respectively. The
value of 1,700 CFS represents the daily average flow which is exceeded
approximately 50 percent of the time, whereas the value of 5,290 CFS is
the monthly average river flow rate based on 42 years of record.

<u>5.2.3.4 Compliance With Water Quality Standards</u> - Plant operation
will result in the discharge of an effluent varying from a minimum of
1.84 CFS for 500 MW to a maximum of 44.46 CFS for 3,000 MW. The TDS 3
level at the point of discharge is slightly greater than 500 MG/L but
will quickly be reduced to acceptable limits within a reasonable zone
of mixing.

Normal variations and fluctuations in the quantity, quality, and temperature of the river water used for plant make-up water is not expected to significantly affect the level of concentrations in the plant effluent stream.

5.2.4 Drift

Nearly all of the waste heat from the Caryville steam plant will be rejected to the atmosphere by means of evaporative-type, natural-draft cooling towers. A small amount of circulating water is entrained and carried out of the tower by the saturated air leaving the tower. This small quantity of water is called drift. Gulf will purchase state-of-the-art drift eliminators for the plant's cooling towers. This means (a) that the total mass of drift emitted from the towers is expected to be less than 0.008 percent of the circulating water flow, and (b) that

the drop size distribution of the drift will be such that over 50 percent of the drops will have a characteristic dimension of the less than 100 microns. The actual chemistry of the circulation water, which is the same as the drift, is discussed in section 3.4, "Heat Dissipation System." An actual breakdown of the variation in the various constituent levels in the towers is given in table 3.5-2. The total amount of drift leaving the towers for a 3,000 MW plant will be less than 90 GPM. Due to the natural draft cooling tower,height, which will be in excess of 450 feet, the drift will be dispersed over a large area, so that the concentration of deposited drift will be very small. Since the drift will be low in quantity, and consist mainly of concentrated river water. Gulf believes that drift is not a serious problem at the Caryville site. For these same reasons, the impact of drift on water supplies should be negligible. 3

At the present time, engineering studies are being performed by Gulf to evaluate cooling tower systems. When drift eliminator specifications have been finalized, Gulf will make estimates of drift deposition rates at various distances from the cooling towers using a drift deposition model developed by Pickard, Lowe, and Associates of Washington, D. C. The physics of this model were discussed during two symposia in 1974 (8, 9).

5.2.5 References

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(3) Carter, H. H. "A preliminary Report on the Characteristics of a Heated Jet Discharged Horizontally into a Transverse Current, Part I - Constant Depth." Technical Report 61, Chesapeake Bay Institute, The Johns Hopkins University, November, 1969.

(4) Stolzenback, K. D. and D.R.F. Harleman. An Analytical and Experimental Investigation of Surface Discharges of Heated Water, Water Pollution Control Series 16130 DJV 02/71, Feb., 1971.

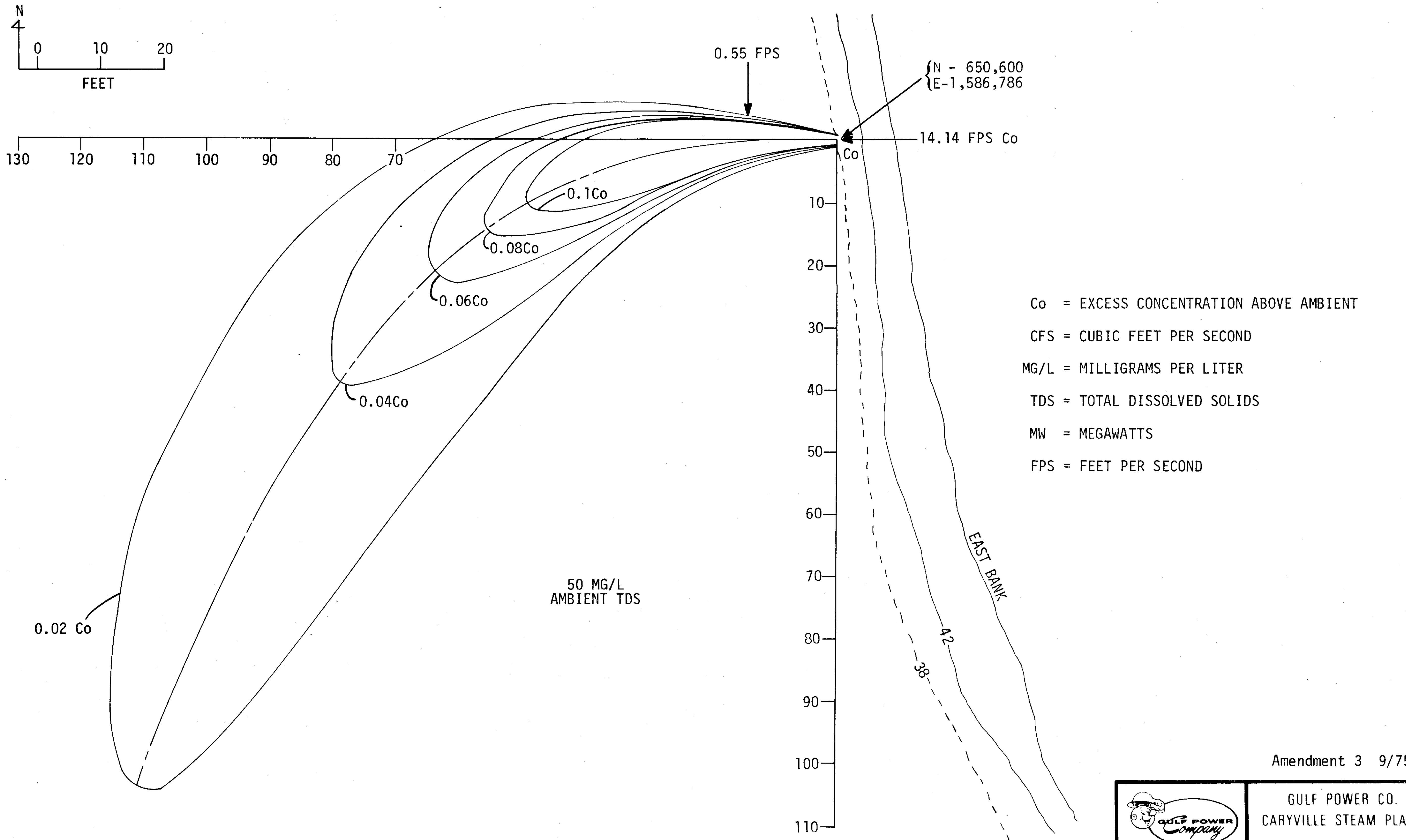
(5) Shirazi, M. A. and L. R. Davis. Workbook of Thermal Plume Prediction, Volume 2, Surface Discharge, EPA-R2-72-005b, National Environmental Research Center, U. S. EPA, Corvallis, Oregon, 97330, May 1974.

(6) Hirst, E. "Buoyant Jets with Three-dimensional Trajectories." J. of the Hydraulics Division, ASCE, Vol. 98, No. HY11, pp. 1999-2014, November 1972.

(7) Engelund, F. "Flow and Bed Topography in Channel Bends." J. of the Hydraulics Division, ASCE, Vol. 100, No. HY11, pp. 1631-1648, November 1974.

(8) Laskowski, S. M. A Mathematical Transport Model For Salt Distribution from a Salt Water Natural Draft Cooling Tower, Proc AEC and State of Maryland Symposium on Cooling Tower Environment, University of Maryland, 1974.

(9) Laskowski, S. M. A Mathematical Transport Model for Salt Distribution from a Salt Water Natural Draft Cooling Tower, Proc AM Meteorological Society and World Meteorological Organization Symposium on Atmospheric Diffusion and Air Pollution, Santa Barbara, California, 1974.

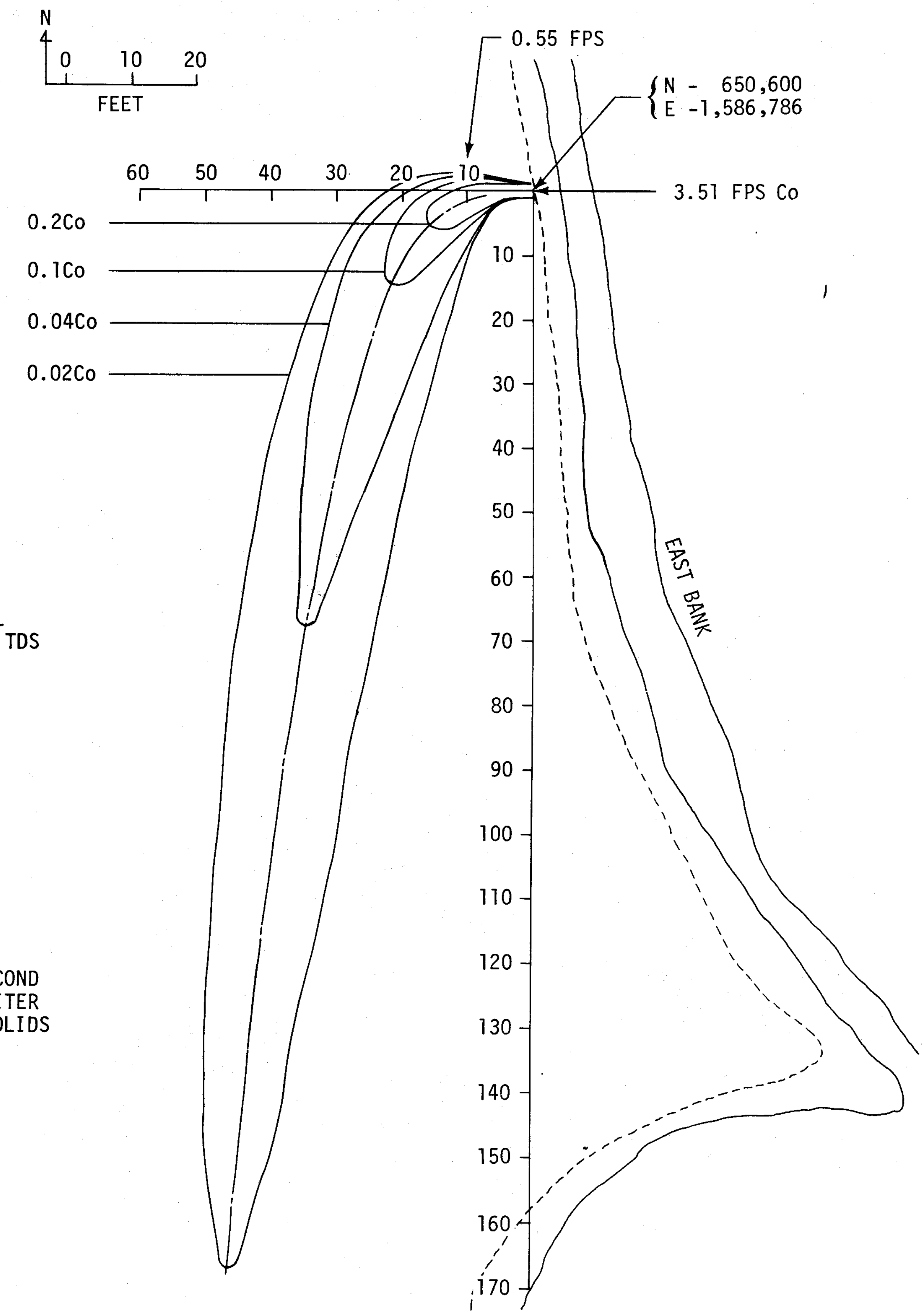


Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 870 CFS RIVER FLOW AND MAXIMUM EFFLUENT RATE FOR 3,000 MW

FIGURE 5-2-1



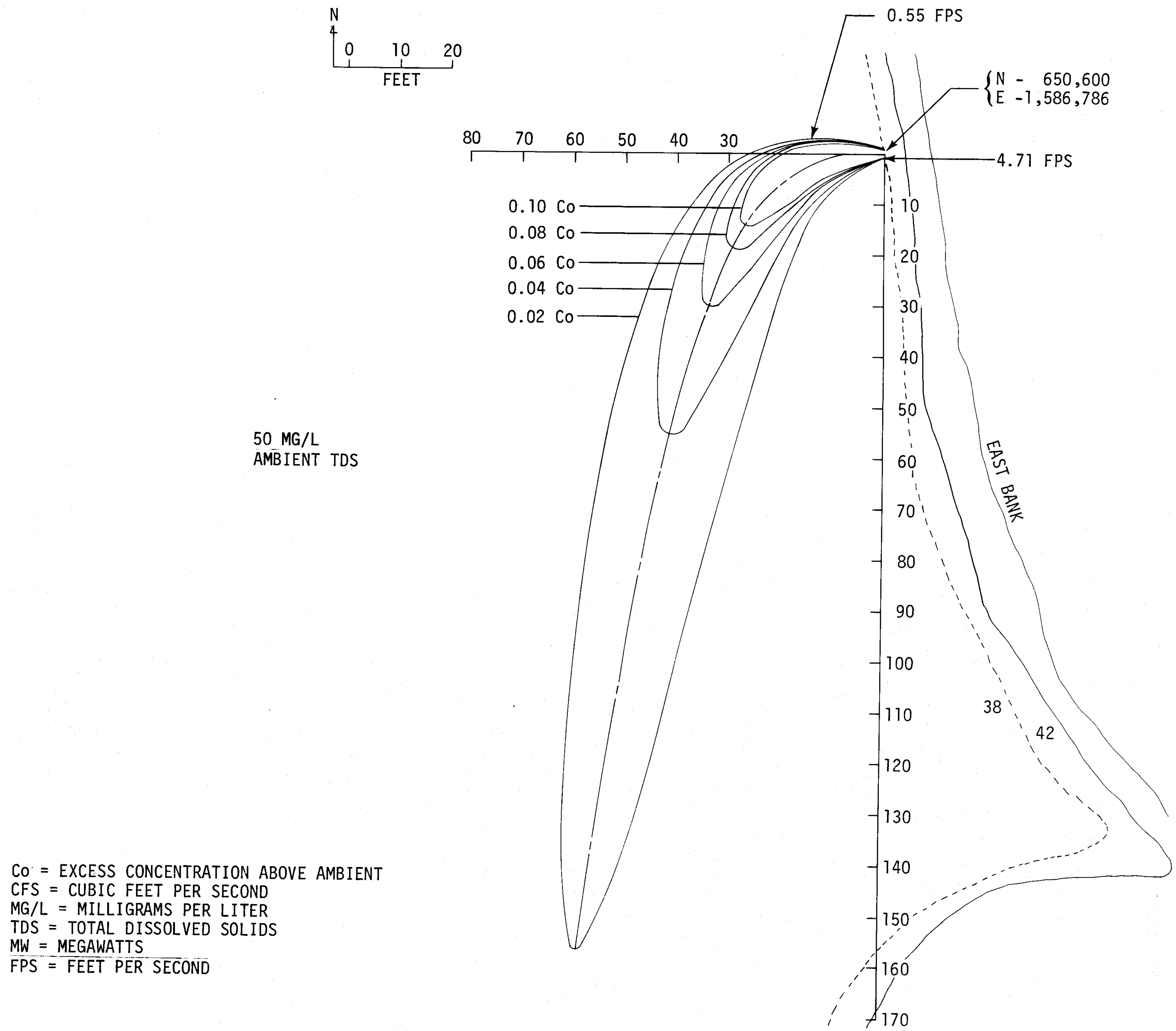
CFS = CUBIC FEET PER SECOND
MG/L = MILLIGRAMS PER LITER
TDS = TOTAL DISSOLVED SOLIDS
MW = MEGAWATTS
FPS = FEET PER SECOND

Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 870 CFS RIVER FLOW AND MINIMUM EFFLUENT RATE FOR 3,000 MW

FIGURE 5.2-2

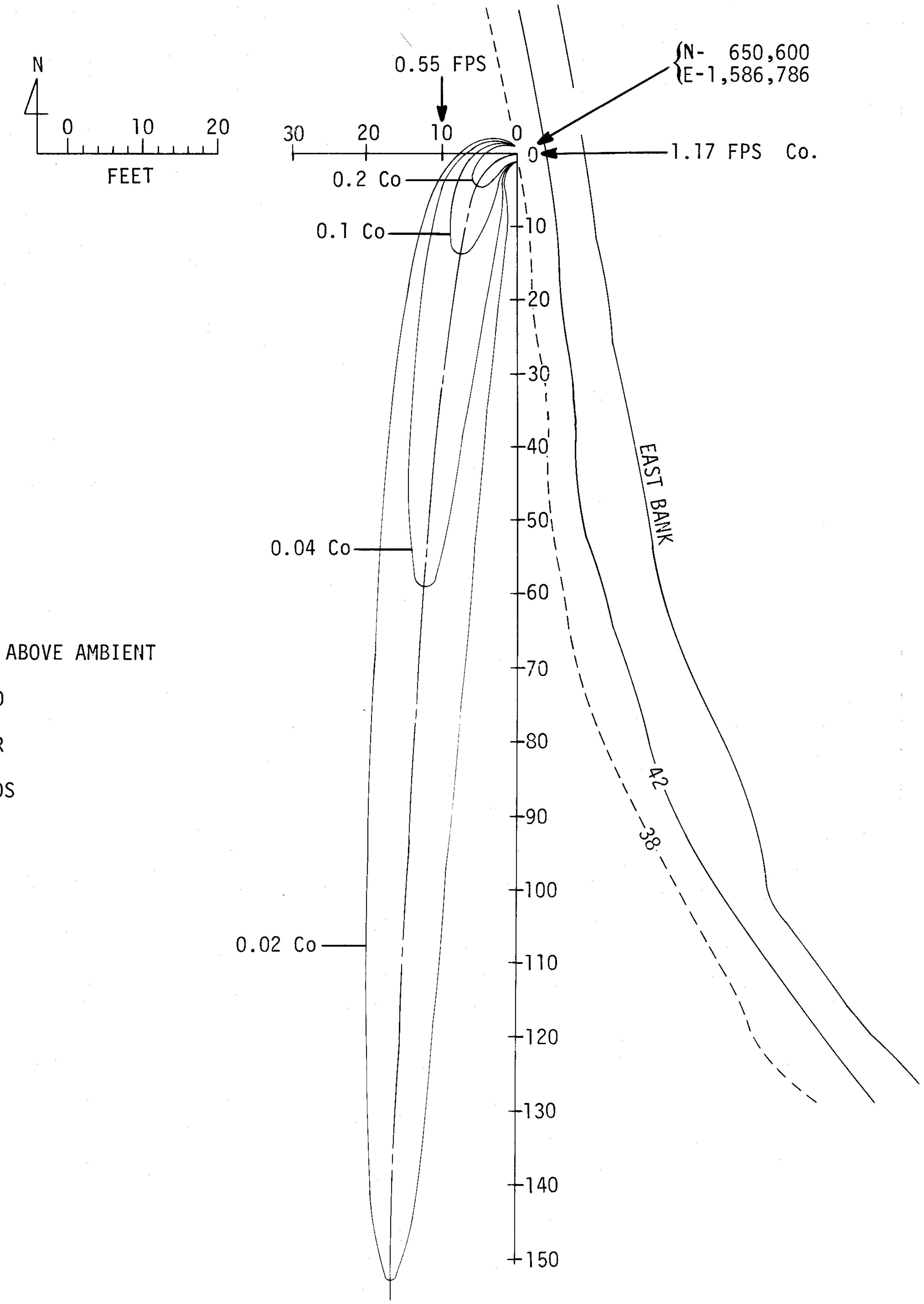


Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 870 CFS RIVER FLOW AND MAXIMUM EFFLUENT RATE 3,000 MW

FIGURE 5.2-3



50 MG/L
AMBIENT TDS

Co = EXCESS CONCENTRATION ABOVE AMBIENT

CFS = CUBIC FEET PER SECOND

MG/L = MILLIGRAMS PER LITER

TDS = TOTAL DISSOLVED SOLIDS

MW = MEGAWATTS

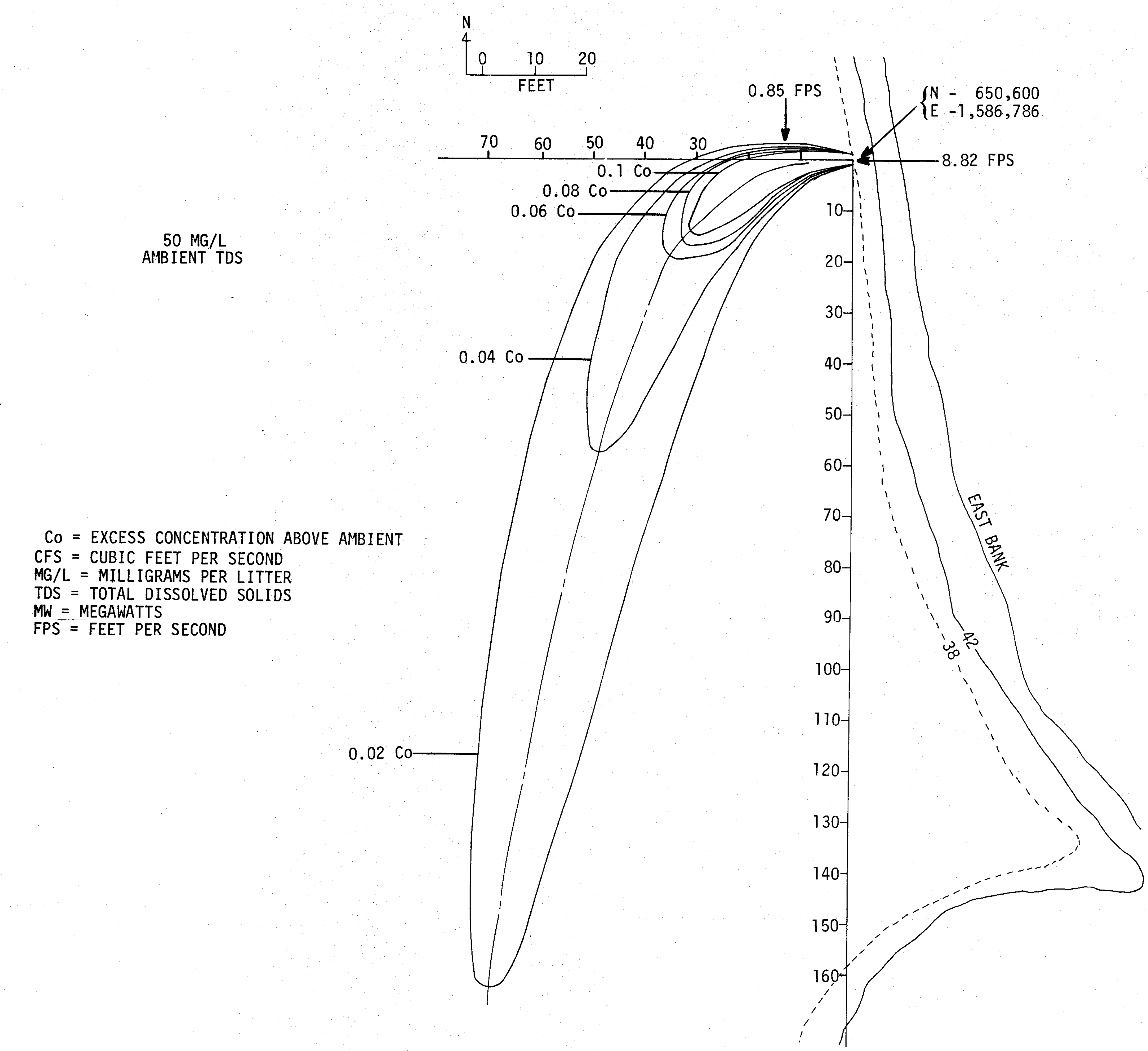
FPS = FEET PER SECOND

Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 870 CFS RIVER FLOW AND MINIMUM EFFLUENT RATE FOR 1,000 MW

FIGURE 5.2-4

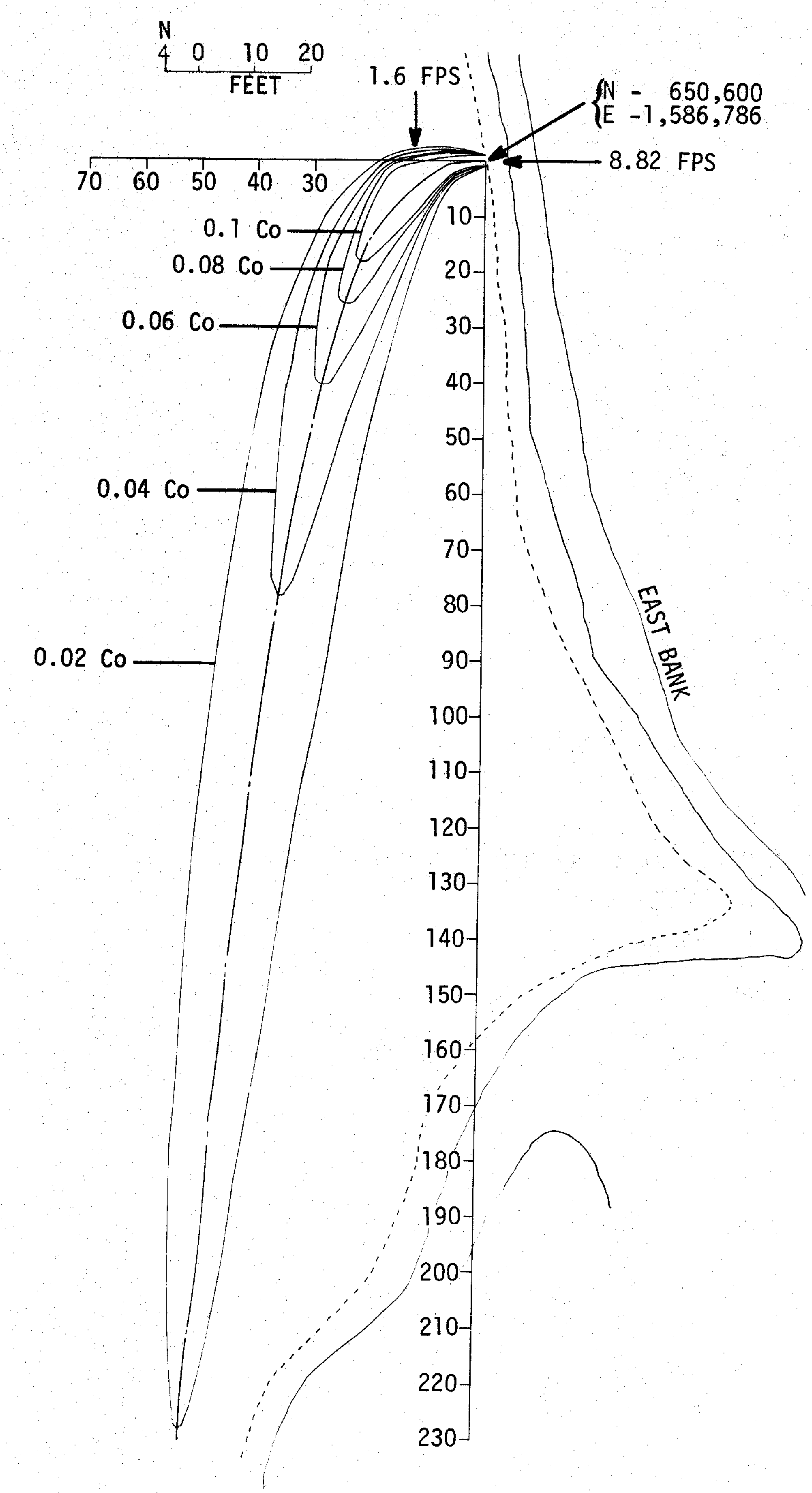


Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINE AT 1,700 CFS RIVER FLOW AND AVERAGE EFFLUENT RATE 3,000 MW

FIGURE 5.2-5



50 MG/L
AMBIENT TDS

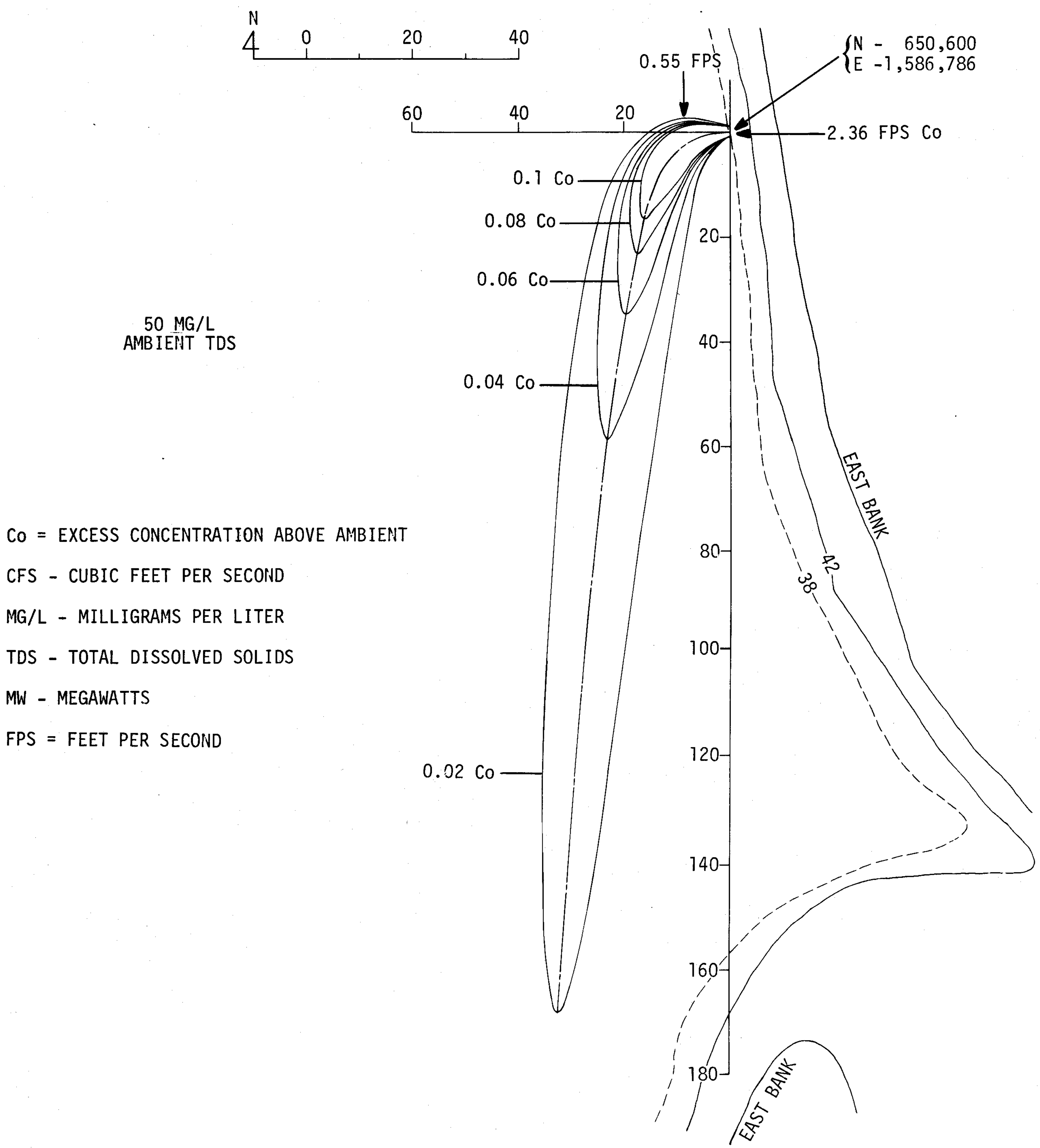
Co = EXCESS CONCENTRATION ABOVE AMBIENT
CFS = CUBIC FEET PER SECOND
MG/L = MILLIGRAMS PER LITER
TDS = TOTAL DISSOLVED SOLIDS
MW = MEGAWATTS
FPS = FEET PER SECOND

Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 5,290 CFS RIVER FLOW AND AVERAGE EFFLUENT RATE FOR 3,000 MW

FIGURE: 5.2-6



Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 870 CFS RIVER FLOW AND MAXIMUM EFFLUENT RATE FOR 500 MW

FIGURE 5.2-7

5.3

5.3 Effects of Sanitary and Other Waste Discharges

Because Gulf will process the liquid effluent of the sewage treatment plant through the plant's waste water treatment system, there will be no measurable effect on the environment.

Details of the sanitary waste treatment system are discussed in section 3.6, "Sanitary and Other Wastes' Systems."

5.4

5.4 Effects of Air Emissions

The Caryville Steam Plant will, as described in section 3.7, "Air Emissions," consist of two 500 megawatt (MW) operating Units by 1981, with an ultimate total site capacity of 3,000 MW. The use of coal as the primary fossil fuel for unit operation will result in the emission of gaseous chemical wastes, primarily sulfur dioxide, particulate matter, and nitrogen oxides. 1

Gulf investigated anticipated emission impact for three cases of plant operation: (a) Unit 1, (b) Units 1 and 2, and (c) total site. Air quality modeling, described in this section, was used to assess the incremental impact of plant emission on region air quality. Ground level concentrations of sulfur dioxide, particulate matter, and nitrogen oxides were evaluated over short-term and long-term periods and compared with applicable air quality standards. Gulf found the incremental impact of plant emissions on the air quality of the region depends on the detailed operating characteristics of the fossil units, the chemistry of the boiler fuel employed in the units, and the dispersion capacity of the atmosphere in the site vicinity.

The analytical assessment of the studies of the Caryville plant emissions impacting air quality is provided in this section.

5.4.1 Emission Parameters Related to Air Quality

The emission parameters which were used in the air quality modeling are given in table 5.4-1. They are based on emissions at the U. S. Environmental Protection Agency (EPA) New Source Performance Standards (1) for operation at the nameplate rating, for use in long-term modeling, and at the overpressure condition (i.e., 110 percent of the nameplate rating) for use in short-term modeling.

5.4.2 Air Quality Models

Gulf used four air quality models to estimate the impact of the Caryville plant on the surrounding region. These models, all of which are recognized by the EPA, Region IV, as being the best available for predicting ground level pollutant concentrations, are known as (a) the Air Quality Display Model (AQDM), (b) the EPA 24-Hour Power Plant Model (CRS1), (c) Point Multiple (PTMTP), and (d) Point Maximum (PTMAX). AQDM was used to calculate the annual average ground level concentrations of sulfur dioxide, particulate matter, and nitrogen oxides. CRS1 was used, in conjunction with PTMTP, to calculate the maximum 24-hour ground level concentrations of sulfur dioxide and particulate matter. PTMAX was used, in conjunction with PTMTP, to calculate the maximum three-hour ground level concentrations of sulfur dioxide. Although short-term nitrogen oxides standards are presently under consideration by the Florida Department of Pollution Control (FDPC), there are currently no short-term standards for nitrogen oxides. Therefore, no short-term 1

calculations for nitrogen oxides were made. A full discussion of the air quality models and their reliability is given in subsection 6.5.3, "Air Quality Models."

5.4.3 Annual Average Ground Level Concentrations

The Air Quality Display Model (AQDM), which is described in subsection 6.5.3.1, "The Air Quality Display Model (AQDM)," was run using meteorological data in the form of "Wind Distribution by Pasquill Stability Classes" for Tallahassee, Florida, to calculate annual average ground level concentrations. The annual average midafternoon mixing height (2) of 1,200 meters and an average ambient temperature of 293°K (67.7°F) were also input into the AQDM. The plume rise equation used in the AQDM is 1
the most recent form of the Briggs equation (3,4). Gulf ran the AQDM with a two kilometer (km) by two km receptor grid over a 56 km x 56 km area, and with a one km x one km grid over a 14 km x 17 km area in the region of the maximum concentration. Emission data were based on operation of the units at nameplate rating.

5.4.3.1 Sulfur Dioxide - Figures 5.4-1 and -2 illustrate the annual average ground level sulfur dioxide concentrations with isopleth maps of the study area, for Unit 1 operation only. The maximum concentration for this case is calculated to be 1.00 microgram per cubic meter ($\mu g/m^3$) at a location 7.6 km south of the plant. A maximum annual ground level concentration resulting from operation of Units 1 and 2, illustrated in figures 5.4-3 and -4, is calculated to be 0.69 $\mu g/m^3$ at a location 9.6 km south of the plant. The annual average ground level concentrations of sulfur dioxide resulting from total site operation are shown in figures 5.4-5 and -6. The maximum concentration of sulfur dioxide for this case is calculated to be 1.55 $\mu g/m^3$ at a location 14.6 km south of the plant. The maximum annual average concentrations of sulfur dioxide for the three operating cases are all within the EPA Nation Ambient Primary Standard (5) of 80 $\mu g/m^3$, the State of Florida Ambient Air Quality Standard (6) of 60 $\mu g/m^3$, and the EPA Prevention of Significant Deterioration Class II Standard (7) of 15 $\mu g/m^3$. The calculated concentrations and standards for sulfur dioxide are summarized in table 5.4-2.

5.4.3.2 Particulate Matter - The annual average ground level concentrations of particulate matter are illustrated in figures 5.4-7 and -8, for Unit 1 operation. The maximum particulate concentration for this case is calculated to be 0.08 $\mu g/m^3$, at a location 7.6 km south of the plant. A maximum particulate matter concentration resulting from operation of units 1 and 2, illustrated in figures 5.4-9 and -10, is calculated to be 0.06 $\mu g/m^3$, at a location 9.6 km south of the plant. The annual average ground level concentrations of particulate matter resulting from total site operation are shown in figures 5.4-11 and -12. The maximum concentration for this case is calculated to be 0.13 $\mu g/m^3$ at a location 14.6 km south of the plant. The maximum annual average concentrations of particulate matter for the three operating cases are all well within the EPA National Ambient Primary Standard of 75 $\mu g/m^3$,

the National Secondary and State of Florida Standards of 60 $\mu g/m^3$, and the Prevention of Significant Deterioration Class II Standard of 10 $\mu g/m^3$. The calculated maximum concentrations and standards for particulate matter are summarized in table 5.4-3.

5.4.3.3 Nitrogen Oxides - The annual average ground level concentration of nitrogen oxides is illustrated in figures 5.4-13 and -14, for the case of Unit 1 operation. The maximum nitrogen oxides concentration for this case is calculated to be 0.59 $\mu g/m^3$ at a location 7.6 km south of the plant. A maximum nitrogen oxides concentration resulting from operation of Units 1 and 2, illustrated in figures 5.4-15 and -16 is calculated to be 0.40 $\mu g/m^3$ at a location 9.6 km south of the plant. The annual average ground level concentrations of nitrogen oxides resulting from total site operation are shown in figures 5.4-17 and -18. The maximum concentration for this case is calculated to be 0.91 $\mu g/m^3$ at a location 14.6 km south of the plant. The maximum annual average concentrations of nitrogen oxides for the three operating cases are all well within the EPA National Ambient Primary and Secondary Standards, and well within the State of Florida Standard of 100 $\mu g/m^3$. The calculated concentrations and standards for nitrogen oxides are summarized in table 5.4-4.

5.4.4 Maximum 24-Hour Ground Level Concentrations

Gulf used the EPA 24-Hour Power Plant Model and PTMTP, which are described in subsection 6.5.3.2, "The EPA 24-Hour Power Plant Model (CRS1)," with surface meterological data from Tallahassee, Florida, and mixing height data from Montgomery, Alabama. Gulf used these data to calculate the maximum 24-hour ground level concentration of sulfur dioxide and particulate matter for the three cases of plant operation used in subsection 5.4.3 above, but with the units operating at overpressure (i.e. 110 percent of the nameplate rating of the Unit). Gulf made no calculations for nitrogen oxides, since there is not currently a 24-hour standard for nitrogen oxides. 1

5.4.4.1 Sulfur Dioxide - The maximum 24-hour ground level concentration of sulfur dioxide is calculated to be 23.9 $\mu g/m^3$ at a location 1.4 km south of the plant, for the operation of Unit 1. For the operation of Units 1 and 2, the maximum 24-hour concentration is 38.3 $\mu g/m^3$ and occurs at a location 1.5 km south of the plant. The maximum 24-hour ground level concentration of sulfur dioxide for the total site is calculated to be 61.4 $\mu g/m^3$ at a location 1.6 km south of the plant. These maximum 24-hour concentrations for the three operating cases are all within the EPA National Ambient Primary Standard of 365 $\mu g/m^3$, the State of Florida Standard of 260 $\mu g/m^3$, and the Prevention of Significant Deterioration Class II Standard of 100 $\mu g/m^3$. The maximum 24-hour ground level concentrations and standards for sulfur dioxide are summarized in table 5.4-5.

5.4.4.2 Particulate Matter - The maximum 24-hour ground level concentration of particulate matter is calculated to be 2.0 $\mu g/m^3$ at a

location 1.4 km south of the plant, for the operation of Unit 1. For the operation of Units 1 and 2, the maximum 24-hour concentration is 3.2 $\mu g/m^3$ at a distance of 1.5 km south of the plant. For total site operation, the maximum 24-hour ground level concentration of particulate matter is 5.1 $\mu g/m^3$ at a location 1.6 km south of the plant. The maximum 24-hour ground level concentrations for the three operating cases are all within the EPA National Ambient Primary Standard of 260 $\mu g/m^3$, the National Ambient Secondary and State of Florida Standards of 150 $\mu g/m^3$, and the EPA Prevention of Significant Deterioration Class II Standard of 30 $\mu g/m^3$. The maximum 24-hour ground level particulated concentrations and standards are summarized in table 5.4-6.

5.4.5 Maximum Three-Hour Ground Level Concentrations

Gulf calculated the maximum three-hour ground level concentration of sulfur dioxide by the EPA (Research Triangle Park) recommended procedures, 1
using the two computer models: PTMAX and PTMTP. PTMAX provides maximum concentrations and their distances from the source for selected combinations of windspeed and stability class, resulting from the emissions of a single point source. Accordingly, Gulf made one run of PTMAX for each stack at the appropriate operating conditions. The stability class and windspeed which resulted in the greatest maximum concentration, which was stability class A and windspeed of 3.0 meters per second for each run, was input into PTMTP, along with emission data appropriate to the operating condition, to obtain the predicted maximum one-hour concentration of sulfur dioxide. Multiplication of this concentration by 0.8 -- the procedure recommended by EPA -- converts it to the maximum three-hour concentration. The maximum three-hour ground level concentration of sulfur dioxide was calculated to be 175 $\mu g/m^3$ at a distance of 1.1 km from the plant, for the operation of Unit 1. For the operation of Units 1 and 2, the maximum three-hour concentration is 228 $\mu g/m^3$ at a distance of 1.3 km from the plant. The maximum three-hour ground level concentration of sulfur dioxide for the total site is calculated to be 493 $\mu g/m^3$ at a distance of 1.4 km from the plant. The maximum three-hour ground level concentration for the three operating cases are all within the EPA National Ambient Secondary and State of Florida Standards of 1,300 $\mu g/m^3$, and well within the EPA Prevention of Significant Deterioration Class II Standard of 700 $\mu g/m^3$. The maximum three-hour ground level sulfur dioxide concentrations and standards are summarized in table 5.4-7.

5.4.6 Effect on Short-Term Predicted Ground Level Concentrations of Varying Stack and Receptor Elevation Parameters

Gulf made several runs of the model CRS1 to investigate the effects of stack configuration, stack height, and receptor height on the predicted maximum concentrations. The short-term model CRS1, which predicts 24-hour ground level pollutant concentrations, was used because the 24-hour standards are considered by EPA, Region IV, to be the most restrictive.

5.4.6.1 Stack Configuration Variation Effects - Gulf made a run of CRS1 to investigate the effects of using three stacks rather than two. The total site emissions of sulfur dioxide at the overpressure condition were used, but with stack No. 2 replaced by two stacks identical to stack No. 1, and the emissions from stack 2 divided equally between the two replacement stacks. For the total site operation with three 700-foot stacks, the EPA Prevention of Significant Deterioration Class II Standard of 100 $\mu g/m^3$ for sulfur dioxide was exceeded. Further runs of CRS1 indicated that the standard would not be met unless the heights of the three stacks were 1,200 feet, for which the maximum 24-hour ground concentration of sulfur dioxide was calculated to be 94.6 $\mu g/m^3$.

5.4.6.2 Stack Height Variation Effects - Using CRS1, Gulf investigated the effects of total site emission of sulfur dioxide using two 600 foot stacks rather than two 700 foot stacks. The predicted 24-hour maximum ground level concentation of sulfur dioxide was found to increase by 1.0 $\mu g/m^3$ to 62.4 $\mu g/m^3$. This result is within the EPA Prevention of Significant Deterioration Class II Standard of 100 $\mu g/m^3$ for sulfur dioxide. However, this result should be viewed with caution, as CRS1 does not consider the effects of downwash due to turbulence in the wake of the plant buildings. In order to escape the possible effect of downwash, a highly conservative rule of thumb specifies that the stack height be at least 2.5 times the height of surrounding buildings. This design criterion was first recommended in 1932 (8) and has endured to the present time (9). The stack No. 1 and stack No. 2 boiler houses are, respectively, 249 feet and 269 feet in height. Stacks of 600 feet would not be consistent with the 2.5 rule 1
of thumb for either of the two boiler houses.

5.4.6.3 Receptor Elevation Variation Effects - Gulf ran the program PTMTP with (a) the sulfur dioxide emissions for total site operation with two 700 foot stacks and (b) the meteorological conditions resulting in the maximum 24-hour ground level concentration from a previous CRS1 run. The elevation of the receptors was input to PTMTP at 100 feet in order to determine the maximum 24-hour concentration of sulfur dioxide at this elevation. This concentration was calculated to be 61.4 $\mu g/m^3$, which to the nearest 0.1 $\mu g/m^3$ is the same concentration as that calculated for ground level. Thus, the model predicts no significant change in maximum 24-hour sulfur dioxide concentration from ground level to 100 feet above ground level.

5.4.7 References

(1) Environmental Protection Agency Regulations on Standards of Performance for New Stationary Sources, 40 CFR 60: 36 FR 24876, December 23, 1971; Effective August 17, 1971; Amended by 37 FR 14877, July 26, 1972; 38 FR 13562, May 23, 1973; 38 FR 28564, October 15, 1973, Effective November 14, 1973; 39 FR 9308, March 8, 1974; and 39 FR 13776, April 17, 1974; 39 FR 15396, May 3, 1974; 39 FR 20790, June 14, 1974.

(2) Holzworth, G. C. Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States, Environmental Protection Agency, Research Triangle Park, North Carolina, 1972.

(3) Briggs, G. A. "Some Recent Analyses of Plume Rise Observation." Proceedings of the Second International Clean Air Conference, ed. by H. M. Englun and W. T. Beery, Academic Press, New York, pp. 1029-1032, 1971.

(4) Briggs, G. A., "Discussion: Chimney Plumes in Neutral and Stable Surroundings." Atmospheric Environment, Vol. 6, pp. 507-510, 1972.

(5) Environmental Protection Agency Regulations on National Primary and Secondary Ambient Air Quality Standards, 40 CFR 50; 36 FR 22384, November 25, 1971; as amended by 38 FR 25678, September 14, 1973.

(6) Air Pollution, Florida Administrative Code, Chapter 17-2, Amended February 11, 1972; September 24, 1973; April 9, 1974; April 28, 1974.

(7) Environmental Protection Agency Regulations on Prevention of Significant Air Quality Deterioration, Code of Federal Regulations, Subpart A, Part 52, Chapter I, Title 40, December 5, 1974.

(8) Committee Appointed by the Electricity Commissioners, The Measures Which Have Been Taken in This Country and in Others to Obviate the Emission of Soot, Ash, Grit and Gritty Particles from the Chimneys of Electric Power Stations, Her Majesty's Stationery Office, London, 1932.

(9) Briggs, G. A. Plume Rise, USAEC Critical Review Series, TID-25075, Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia, p. 7, 1969.

TABLE 5.4-1

EMISSION PARAMETERS OF CARYVILLE STEAM PLANT USED FOR AIR QUALITY MODELING

	NAMEPLATE RATING			OVERPRESSURE		
	STACK 1 UNIT 1	STACK 1 UNITS 1&2	STACK 2 REMAINING UNITS	STACK 1 UNITS 1	STACK 1 UNITS 1&2	STACK 2 REMAINING UNITS
Stack Load (megawatts (MW))	500.0	1,000.0	2,000.0	546.0	1,092.0	2,200.0
Sulfur (percent)	0.7	0.7	0.7	0.7	0.7	0.7
Sulfur Dioxide Emission Rate (pounds per million British Thermal Unit (lb/million BTU))	1.2	1.2	1.2	1.2	1.2	1.2
Sulfur Dioxide Emission Rate (grams per second (g/s))	725.9	1,451.8	2,903.5	792.7	1,585.4	3,194.1
Sulfur Dioxide Emission Rate (tons per day (T/day))	69.1	138.3	276.5	75.5	151.0	304.2
Particulate Emission Rate (lb/million BTU)	0.1	0.1	0.1	0.1	0.1	0.1
Particulate Emission Rate (g/s)	60.5	121.0	241.9	66.1	132.2	266.2
Particulate Emission Rate (T/day)	5.7	11.6	23.0	6.3	12.5	25.3
Nitrogen Oxides Emission Rate (lb/million BTU)	0.7	0.7	0.7	0.7	0.7	0.7
Nitrogen Oxides Emission Rate (g/s)	423.5	846.9	1,693.7	462.4	923.7	1,863.2

TABLE 5.4-1 (Continued)

	NAMEPLATE RATING			OVERPRESSURE		
	STACK 1 UNIT 1	STACK 1 UNITS 1&2	STACK 2 REMAINING UNITS	STACK 1 UNITS 1	STACK 1 UNITS 1&2	STACK 2 REMAINING UNITS
Nitrogen Oxides Emission Rate (T/day)	40.3	80.7	161.4	44.1	88.1	177.4
Stack Height (meters (M))	213.4	213.4	213.4	213.4	213.4	213.4
Stack Diameter (M)	6.74	9.54	13.49	6.74	9.54	13.49
Exit Temperature (degrees Kelvin (°K))	397.0	397.0	397.0	403.0	403.0	403.0
Exit Velocity (meters per second (M/S))	22.86	22.86	22.86	23.89	23.89	23.89
Heat Rate (BTU per kilowatt hour (BTU/KWH))	9,602.0	9,602.0	9,602.0	9,603.0	9,603.0	9,603.0
Heat Input (million BTU per hour (MBTU/hr))	4,801.0	9,602.0	19,204.0	5,243.0	10,486.0	21,127.0

TABLE 5.4-2

MAXIMUM ANNUAL GROUND LEVEL SULFUR DIOXIDE CONCENTRATIONS RESULTING FROM CARYVILLE STEAM PLANT

1.2 POUNDS PER 10^6 BRITISH THERMAL UNIT EMISSION								
Operating Capacity (Megawatts)	U.S. Environmental Protection Agency National Ambient Standard*		Predicted Maximum Annual Concentration*	Location of Maximum Concentration (Universal Transverse Merçator Coordinates)		Distance of Maximum from Caryville Steam Plant (Kilometers)	State of Florida Ambient Air Quality Standard*	U.S. Environmental Protection Agency Prevention of Significant Deterioration Class II Standard*
	Primary	Secondary		Easting (Kilometers)	Northing (Kilometers)			
500	80		1.00	615.5	3,399.5	7.6	60	15
1,000	80		0.69	615.5	3,397.5	9.6	60	15
3,000	80		1.55	615.5	3,392.5	14.6	60	15

*Maximum annual arithmetic mean concentration in micrograms per cubic meter.

TABLE 5.4-3

MAXIMUM ANNUAL GROUND LEVEL PARTICULATE CONCENTRATIONS RESULTING FROM CARYVILLE STEAM PLANT

0.1 POUNDS PER 10^6 BRITISH THERMAL UNIT EMISSION								
Operating Capacity (Megawatts)	U.S. Environmental Protection Agency National Ambient Standard*		Predicted Maximum Annual Concentration*	Location of Maximum Concentration (Universal Transverse Mercator Coordinates)		Distance of Maximum from Caryville Steam Plant (Kilometers)	State of Florida Ambient Air Quality Standard*	U.S. Environmental Protection Agency Prevention of Significant Deterioration Class II Standard*
	Primary	Secondary		Easting (Kilometers)	Northing (Kilometers)			
500	75	60	0.08	615.5	3,399.5	7.6	60	10
1,000	75	60	0.06	615.5	3,397.5	9.6	60	10
3,000	75	60	0.13	615.5	3,392.5	14.6	60	10

*Maximum annual arithmetic mean concentration in micrograms per cubic meter

TABLE 5.4-4

MAXIMUM ANNUAL GROUND LEVEL NITROGEN OXIDES CONCENTRATIONS RESULTING FROM CARYVILLE STEAM PLANT

0.7 POUNDS PER 10^6 BRITISH THERMAL UNIT EMISSION								
Operating Capacity (Megawatts)	U.S. Environmental Protection Agency National Ambient Standard*		Predicted Maximum Annual Concentration*	Location of Maximum Concentration (Universal Transverse Mercator Coordinates)		Distance of Maximum from Caryville Steam Plant (Kilometers)	State of Florida Ambient Air Quality Standard*	U.S. Environmental Protection Agency Prevention of Significant Deterioration Class II Standard*
	Primary	Secondary		Easting (Kilometers)	Northing (Kilometers)			
500	100	100	0.59	615.5	3,399.5	7.6	100	NA**
1,000	100	100	0.40	615.5	3,397.5	9.6	100	NA**
3,000	100	100	0.91	615.5	3,392.5	14.6	100	NA**

*Maximum annual arithmetic mean concentration in micrograms per cubic meter
**NA = Not Applicable

TABLE 5.4-5

MAXIMUM 24-HOUR GROUND LEVEL SULFUR DIOXIDE CONCENTRATIONS RESULTING FROM CARYVILLE STEAM PLANT MAXIMUM OVERPRESSURE OPERATION 110 PERCENT 2

1.2 POUNDS PER 10^6 BRITISH THERMAL UNIT EMISSION

Operating Capacity (Megawatts)	U.S. Environmental Protection Agency National Ambient Standard*		Predicted Maximum 24-Hour Concentration*	Location of Maximum Concentration (Universal Transverse Mercator Coordinates)		Distance of Maximum from Caryville Steam Plant (Kilometers)	State of Florida Ambient Air Quality Standard*	U.S. Environmental Protection Agency Prevention of Significant Deterioration Class II Standard* 2
	Primary	Secondary		Easting (Kilometers)	Northing (Kilometers)			
546	365	—	23.9	615.7	3,405.7	1.4	260	100
1,092	365	—	38.3	616.0	3,405.7	1.5	260	100
3,292	365	—	61.4	615.5	3,405.5	1.6	260	100

*Maximum 24-hour concentration in micrograms per cubic meter not to be exceeded more than once per year

TABLE 5.4-6

MAXIMUM 24-HOUR GROUND LEVEL PARTICULATE CONCENTRATIONS RESULTING FROM CARYVILLE STEAM PLANT MAXIMUM OVERPRESSURE OPERATION 110 PERCENT 2

0.1 POUNDS PER 10^6 BRITISH THERMAL UNIT EMISSION								
Operating Capacity (Megawatts)	U.S. Environmental Protection Agency National Ambient Standard*		Predicted Maximum 24-Hour Concentration*	Location of Maximum Concentration (Universal Transverse Mercator Coordinates)		Distance of Maximum from Caryville Steam Plant (Kilometers)	State of Florida Ambient Air Quality Standard*	U.S. Environmental Protection Agency Prevention of Significant Deterioration Class II Standard*
	Primary	Secondary		Easting (Kilometers)	Northing (Kilometers)			
546	260	150	2.0	615.7	3,405.7	1.4	150	30
1,092	260	150	3.2	616.0	3,405.7	1.5	150	30
3,292	260	150	5.1	615.5	3,405.5	1.6	150	30

2

*Maximum-24 hour concentration in micrograms per cubic meter not to be exceeded more than once per year

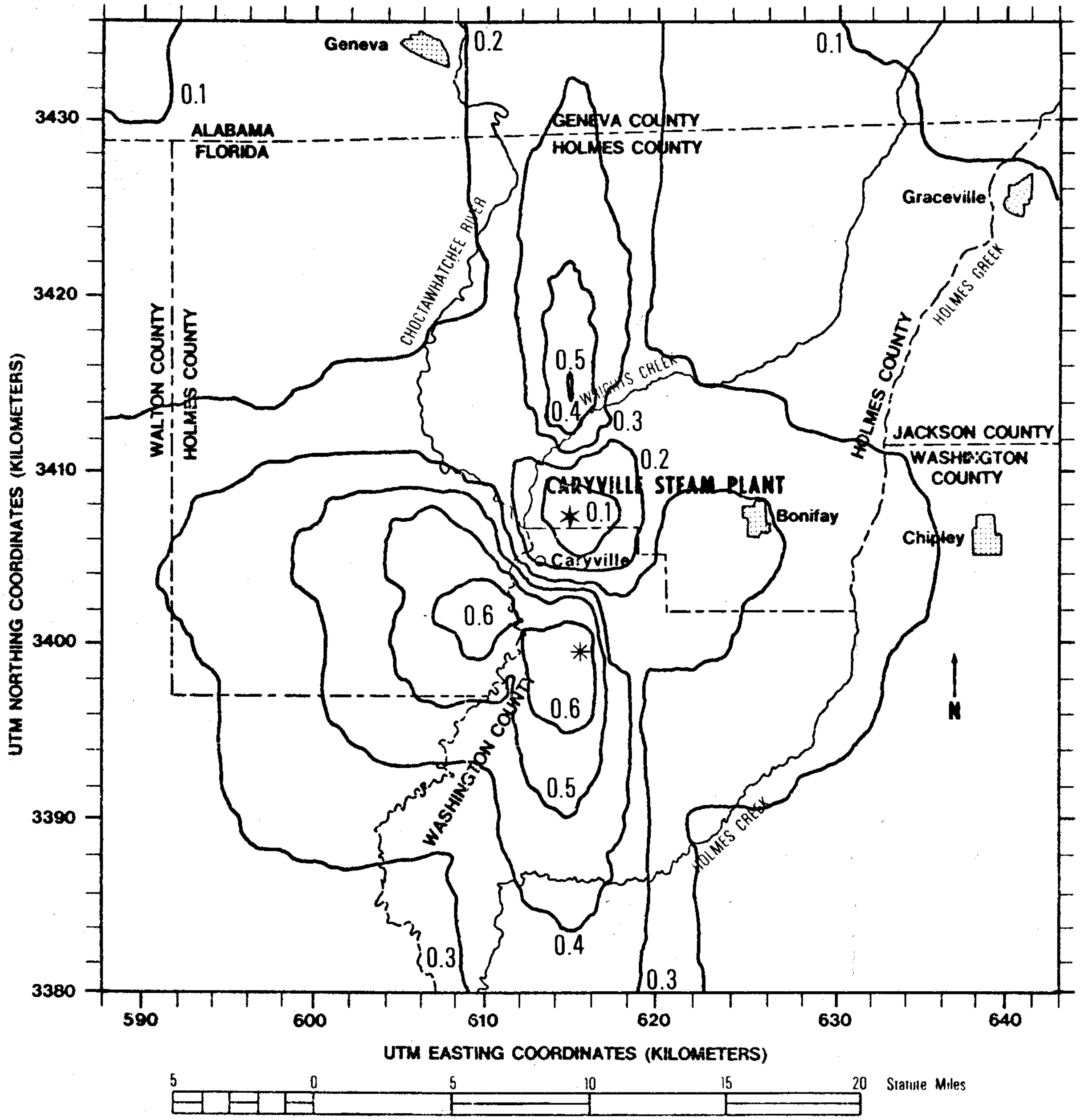
TABLE 5.4-7

MAXIMUM 3-HOUR GROUND LEVEL SULFUR DIOXIDE CONCENTRATIONS RESULTING FROM CARYVILLE STEAM PLANT
MAXIMUM OVERPRESSURE OPERATION 110 PERCENT

2

1.2 POUNDS PER 10^6 BRITISH THERMAL UNIT EMISSION							
Operating Capacity (Megawatts)	U.S. Environmental Protection Agency National Ambient Secondary Standard*	Predicted Maximum 3-Hour Concentration*	Distance of Maximum From Caryville Steam Plant (Kilometers)	Wind Speed (Meters per Second)	Stability Class	State of Florida Ambient Air Quality Standard*	U.S. Environmental Protection Agency Prevention of Significant Deterioration Class II Standard*
546	1,300	175	1.1	3.0	A	1,300	700
1,092	1,300	228	1.3	3.0	A	1,300	700
3,292	1,300	493	1.4	3.0	A	1,300	700

*Maximum 3-hour concentration in micrograms per cubic meter not to be exceeded more than once per year



*Maximum Concentration = 1.00 $\mu g/m^3$ UTM Coordinates = E 615.5 N 3399.5

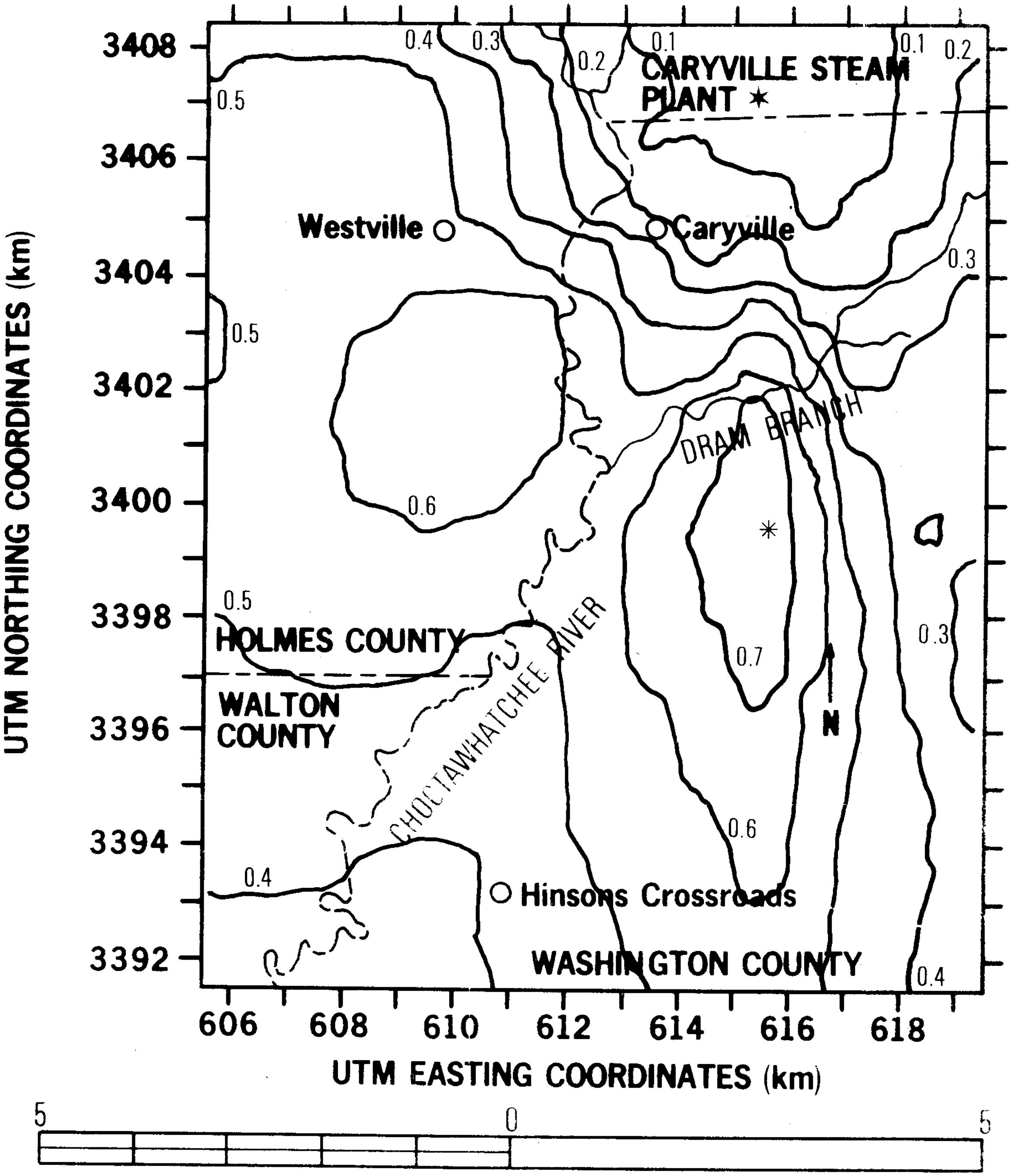
EPA Primary Standard = 80 $\mu g/m^3$ Florida Standard = 60 $\mu g/m^3$

EMITTING 1.2 lbs. OF SULFUR DIOXIDE PER 10^6 BTU

(2 km × 2km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF SO_2 ($\mu g/m^3$) RESULTING FROM UNIT 1-500 MW
		FIGURE 5.4-1



*Maximum Concentration = 1.00 $\mu g/m^3$ UTM Coordinates = E 615.5 N 3399.5

EPA Primary Standard = 80 $\mu g/m^3$ Florida Standard = 60 $\mu g/m^3$

EMITTING 1.2 lbs. OF SULFUR DIOXIDE PER 10^6 BTU

(1km x 1km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

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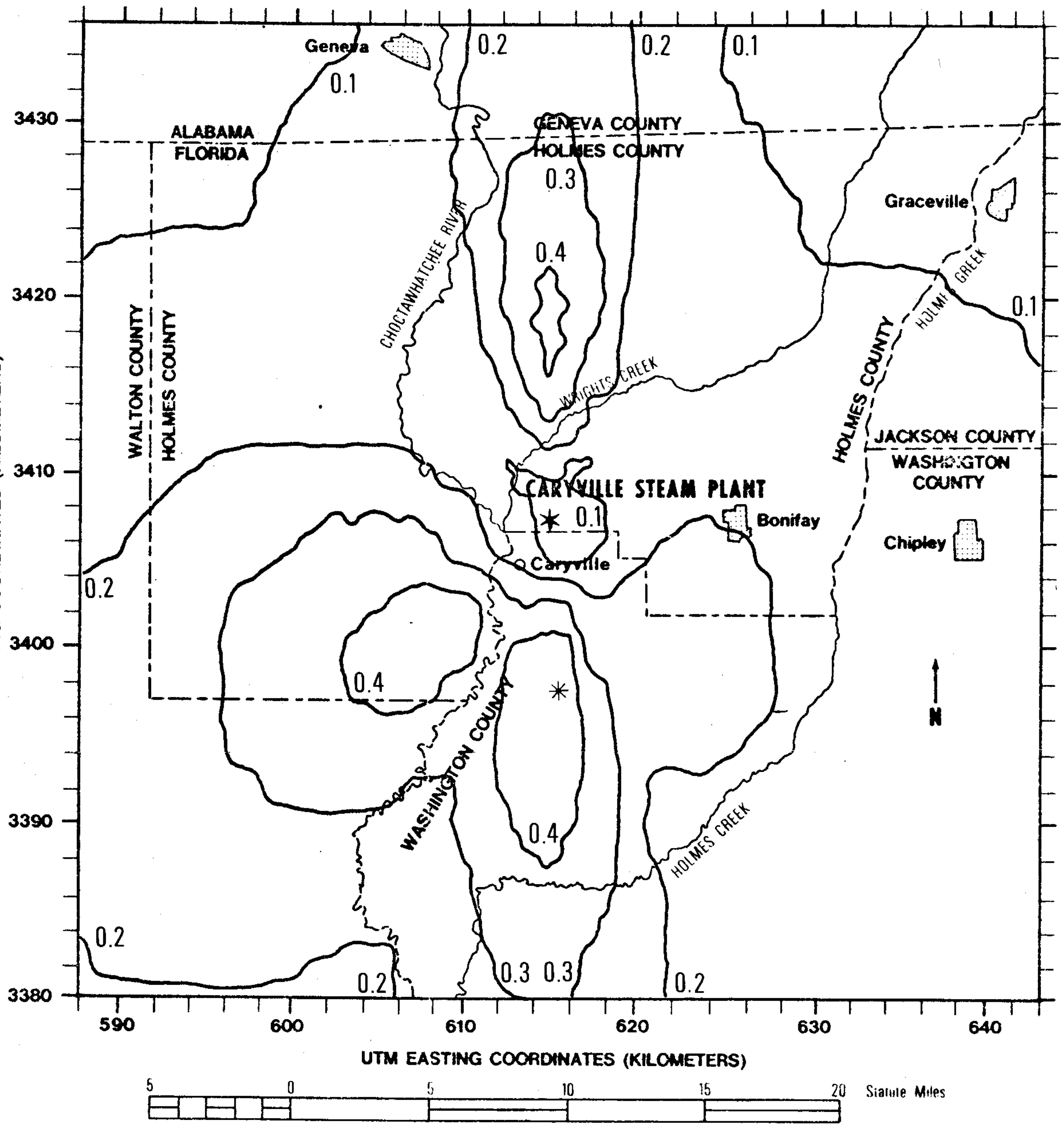
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF SO_2 ($\mu g/m^3$) RESULTING FROM UNIT 1-500 MW
		FIGURE 5.4-2



*Maximum Concentration = 0.69 $\mu g/m^3$ UTM Coordinates = E 615.5 N 3397.5

EPA Primary Standard = 80 $\mu g/m^3$ Florida Standard = 60 $\mu g/m^3$

EMITTING 1.2 lbs. OF SULFUR DIOXIDE PER 10^6 BTU

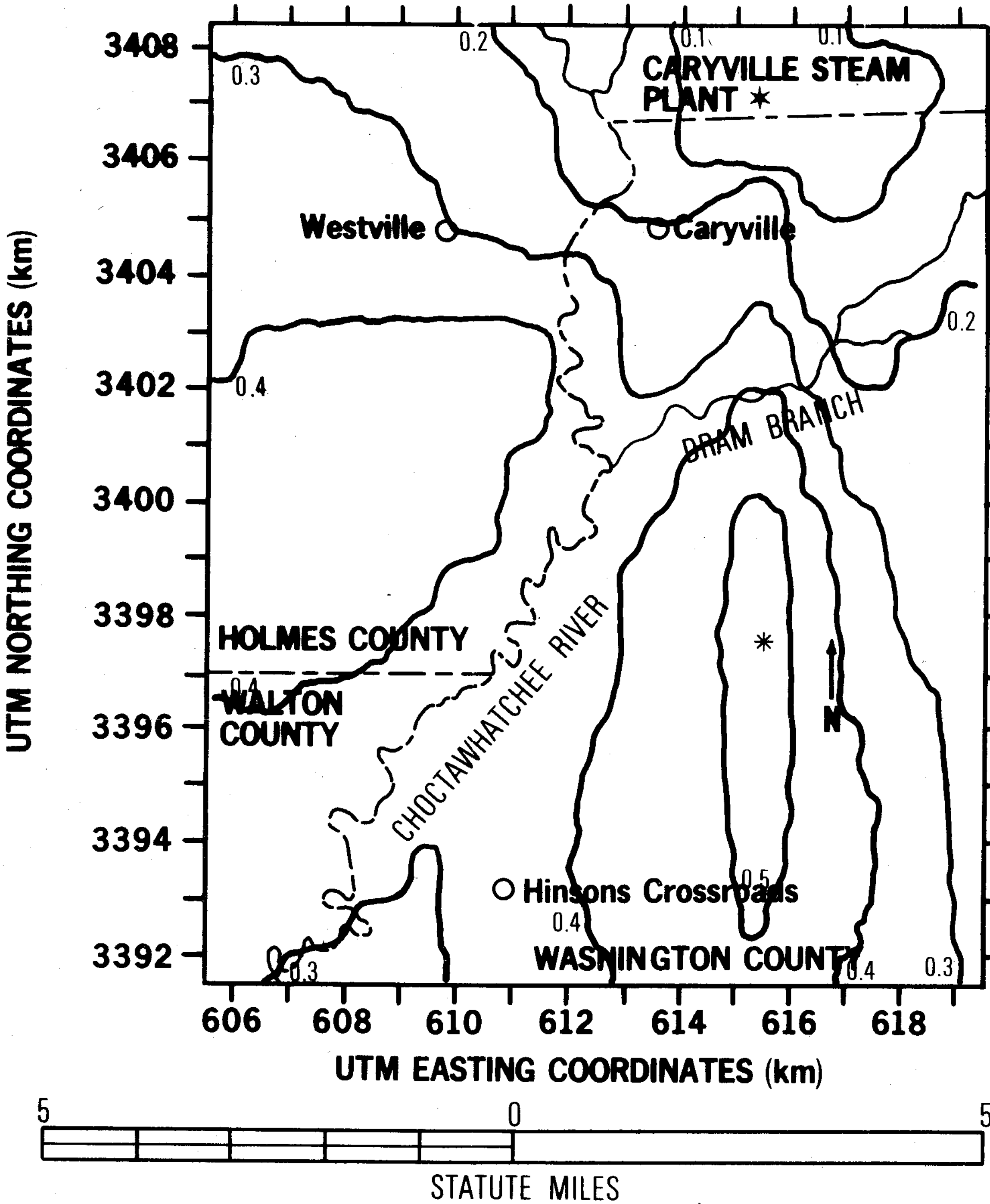
(2 km × 2km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER CO.
CARYVILLE STEAM PLANT

ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF SO_2 ($\mu g/m^3$) RESULTING FROM UNITS 1 & 2-1,000 MW

FIGURE 5.4-3



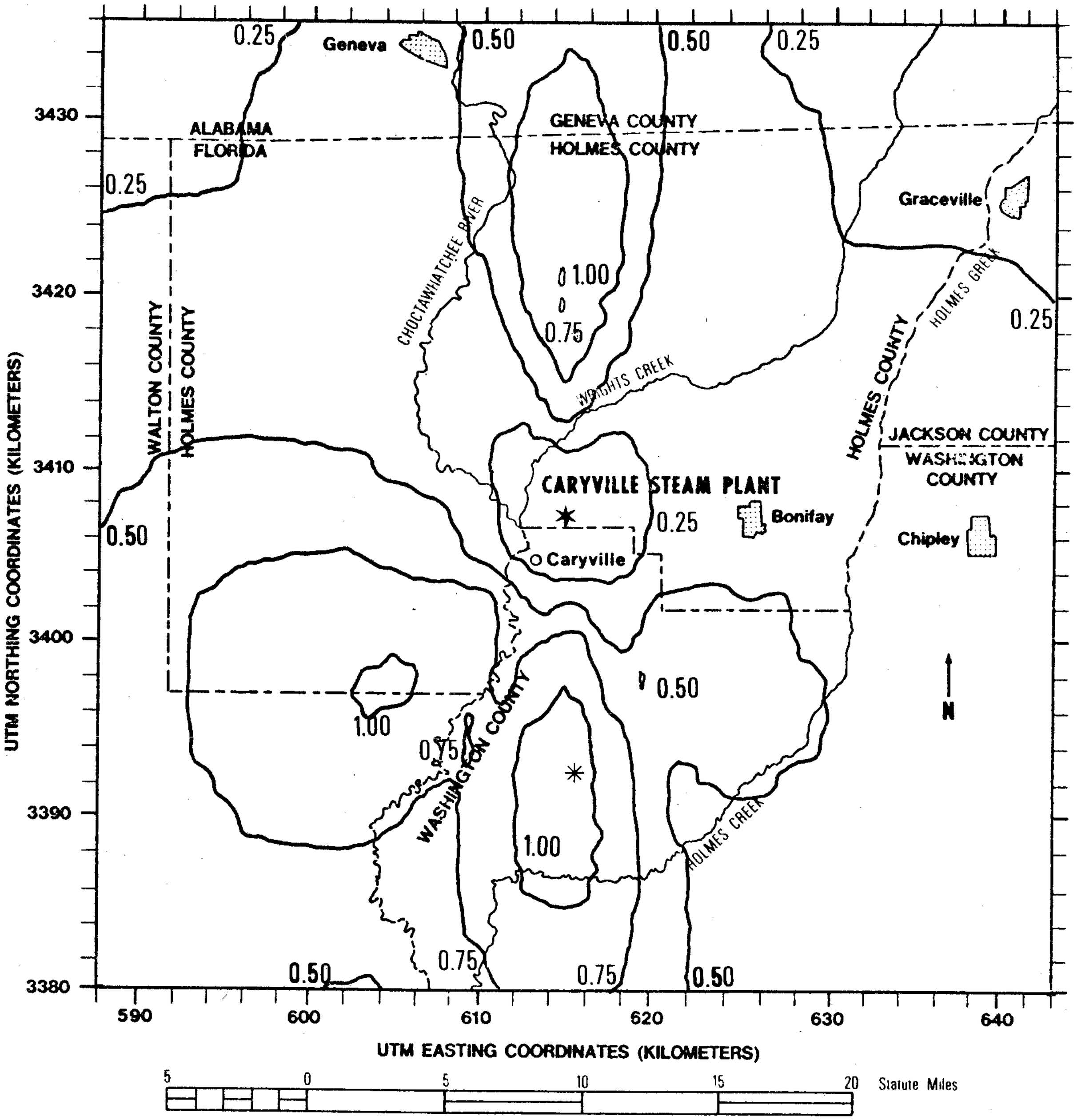
* Maximum Concentration = 0.69 μg/m³ UTM Coordinates = E 615.5 N 3397.5

EPA Primary Standard = 80 μg/m³ Florida Standard = 60 μg/m³

EMITTING 1.2 lbs. OF SULFUR DIOXIDE PER 10^6 BTU
(1km x 1km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF SO_2 (μg/m³) RESULTING FROM UNITS 1 & 2-1,000 MW
		FIGURE 5.4-4



* Maximum Concentration = 1.55 $\mu g/m^3$ UTM Coordinates = E 615.5 N 3392.5

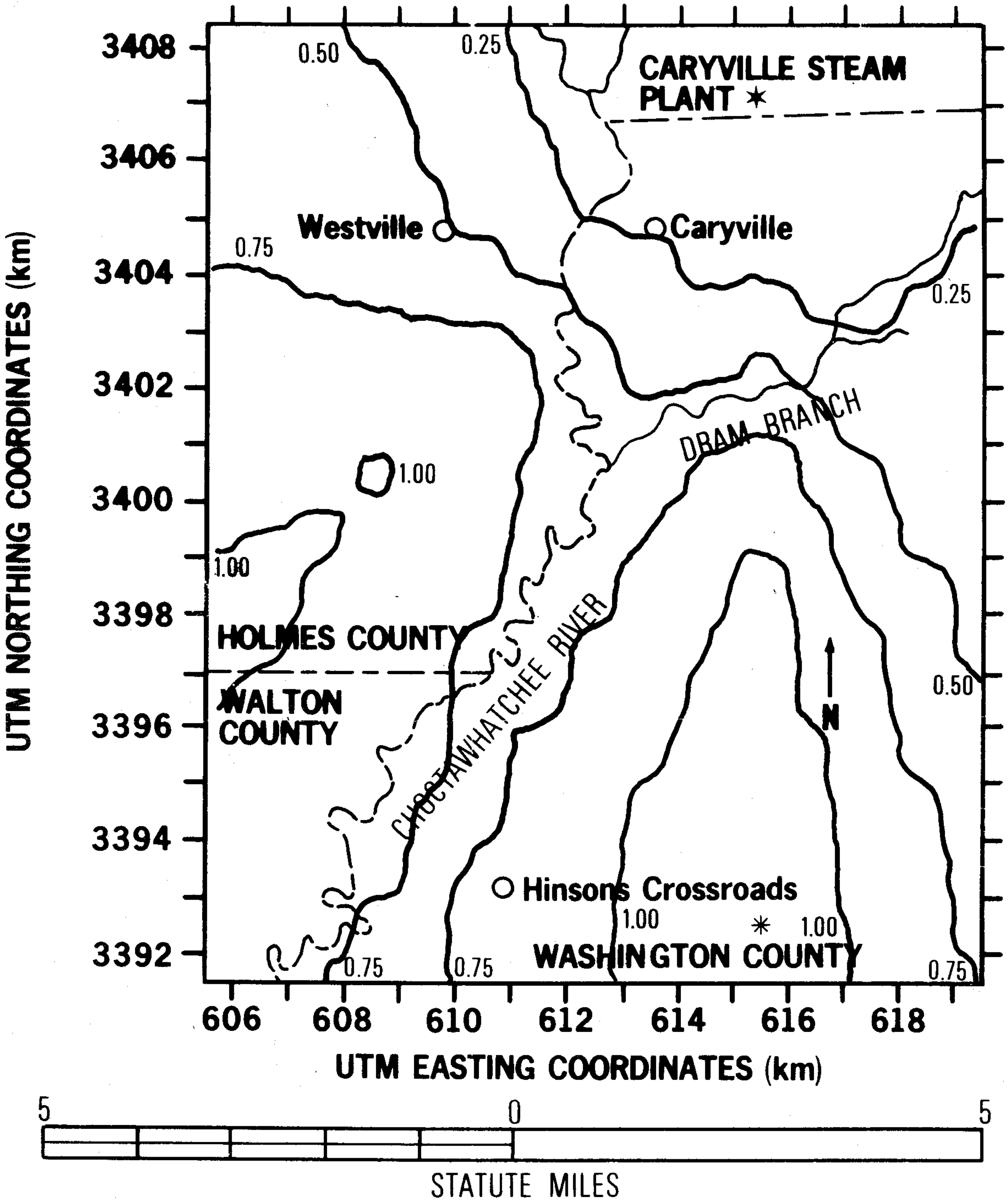
EPA Primary Standard = 80 $\mu g/m^3$ Florida Standard = 60 $\mu g/m^3$

EMITTING 1.2 lbs. OF SULFUR DIOXIDE PER 10^6 BTU

(2 km × 2km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF SO_2 ($\mu g/m^3$) TOTAL SITE - 3,000 MW
		FIGURE 5.4-5



*Maximum Concentration = 1.55 $\mu g/m^3$ UTM Coordinates = E 615.5 N 3392.5
EPA Primary Standard = 80 $\mu g/m^3$ Florida Standard = 60 $\mu g/m^3$

EMITTING 1.2 lbs. OF SULFUR DIOXIDE PER 10^6 BTU
(1km x 1km RECEPTOR GRID)

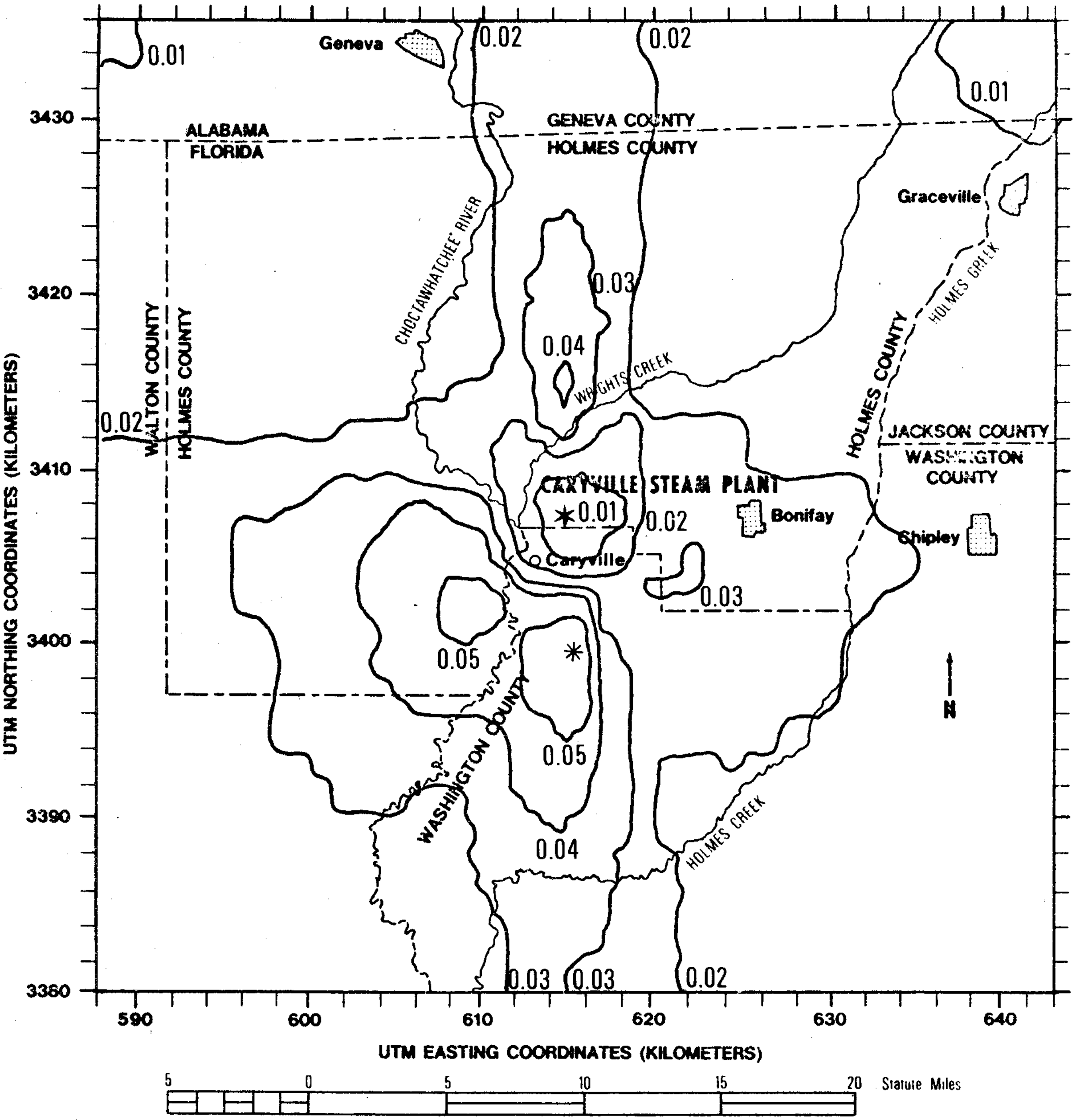
CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company

GULF POWER CO.
CARYVILLE STEAM PLANT

ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF SO_2 ($\mu g/m^3$)
TOTAL SITE - 3,000 MW

FIGURE 5.4-6



* Maximum Concentration = 0.08 $\mu g/m^3$ UTM Coordinates = E 615.5 N 3399.5

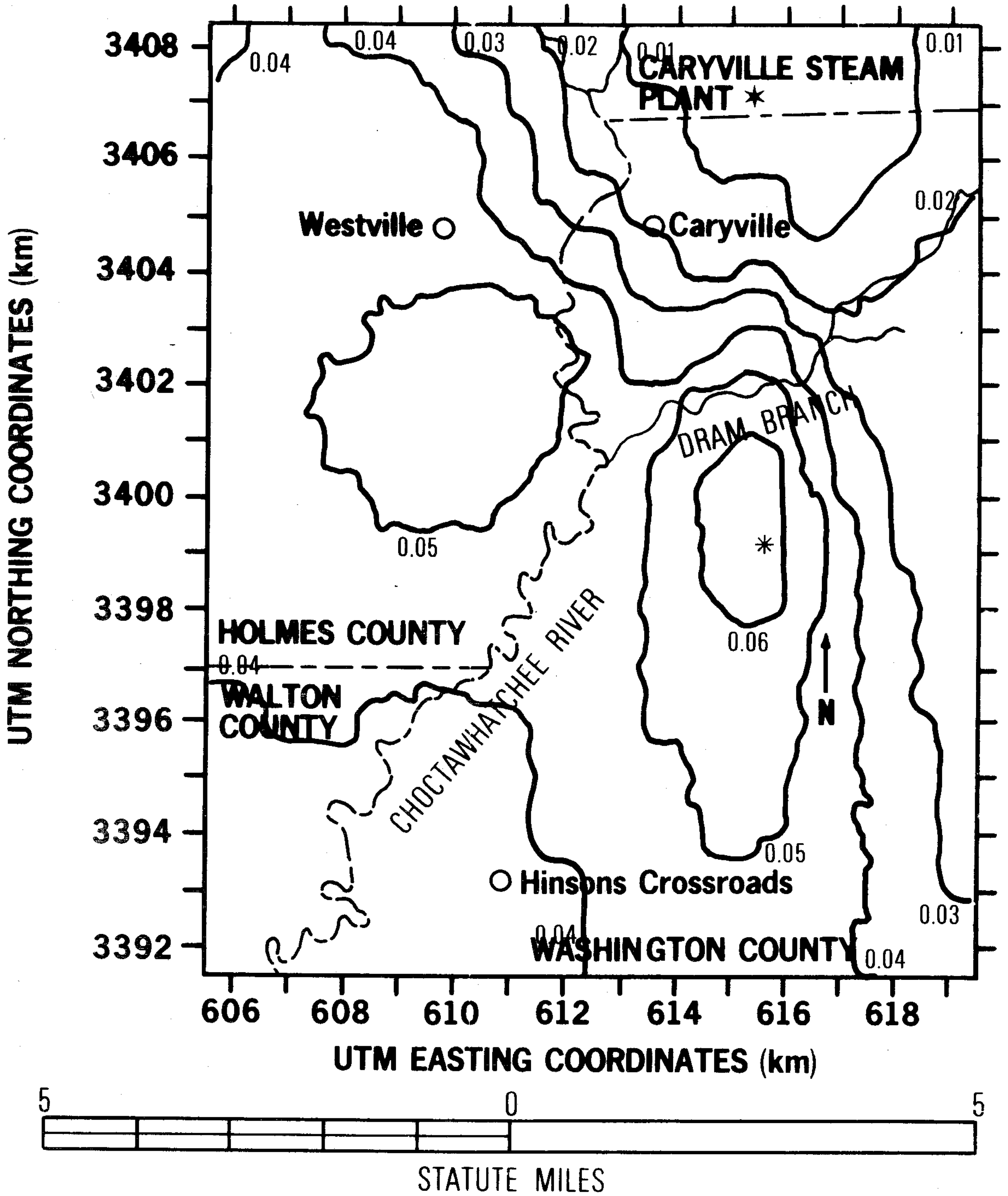
EPA Primary Standard = 75 $\mu g/m^3$ Florida Standard = 60 $\mu g/m^3$

EMITTING 0.7 lbs. OF PARTICULATES PER 10^6 BTU

(2 km × 2km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF PARTICULATES ($\mu g/m^3$) RESULTING FROM UNIT 1-500 MW
		FIGURE 5.4-7



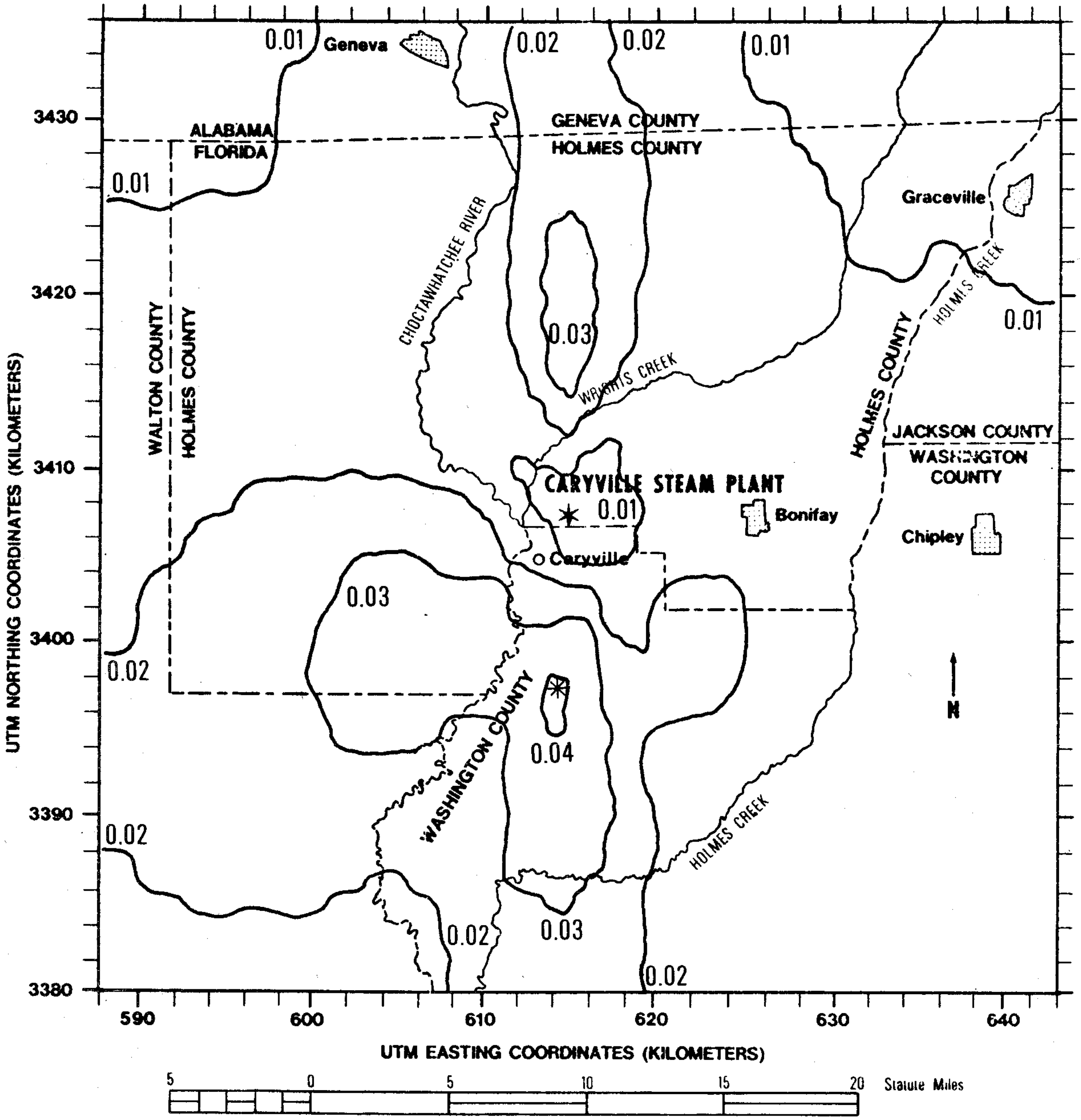
*Maximum Concentration = 0.08 μg/m^3 UTM Coordinates = E 615.5 N 3399.5

EPA Primary Standard = 75 μg/m^3 Florida Standard = 60 μg/m^3

EMITTING 0.7 lbs. OF PARTICULATES PER 10^6 BTU
(1km x 1km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF PARTICULATES (μg/m^3) RESULTING FROM UNIT 1-500 MW
		FIGURE 5.4-8



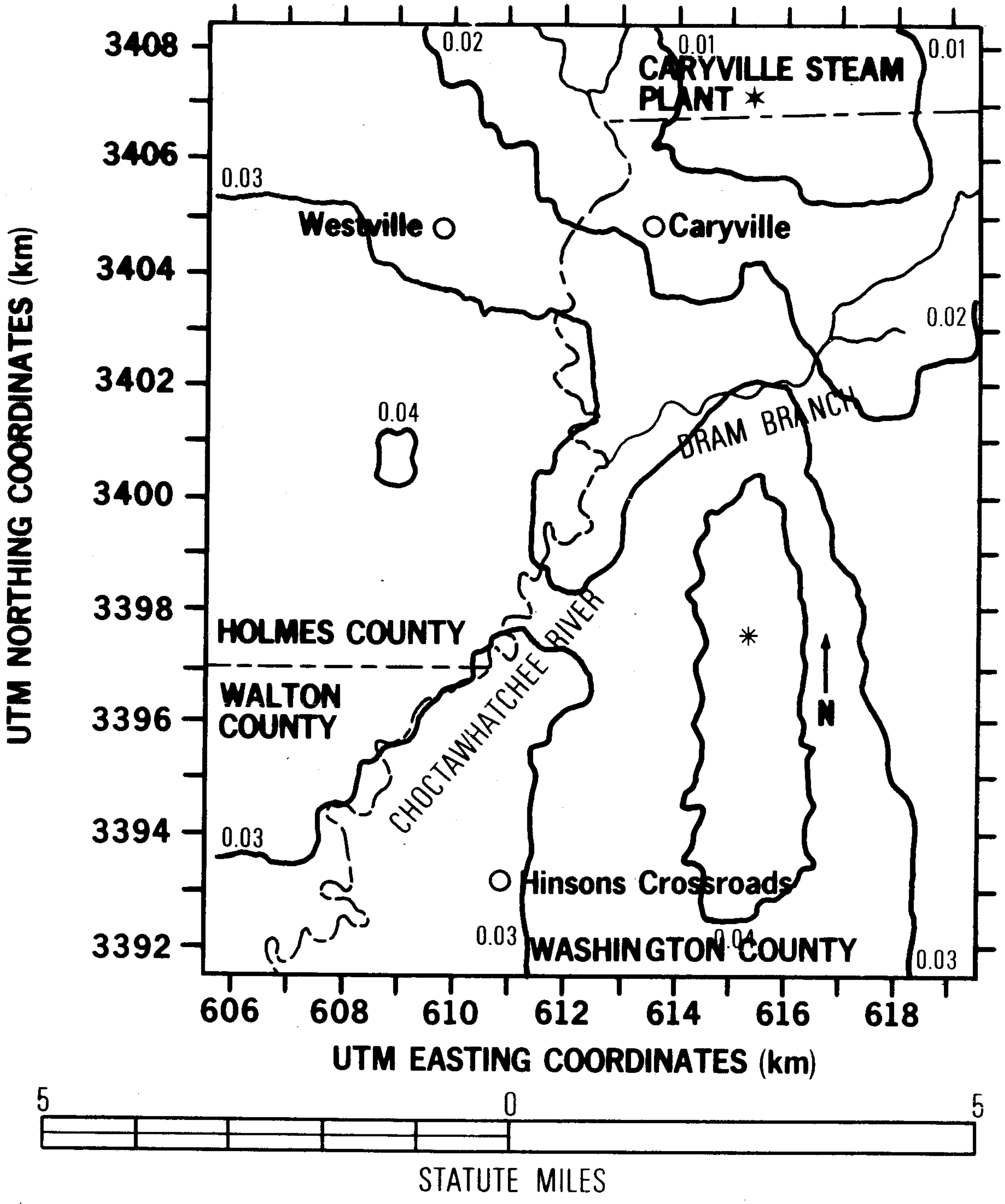
*Maximum Concentration = 0.06 μg/m³   UTM Coordinates = E615.5 N3397.5
EPA Primary Standard = 75 μg/m³   Florida Standard = 60 μg/m³

EMITTING 0.7 lbs. OF PARTICULATES PER 10^6 BTU

(2 km × 2km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF PARTICULATES (μg/m³) RESULTING FROM UNITS 1 & 2-1,000 MW
		FIGURE 5.4-9



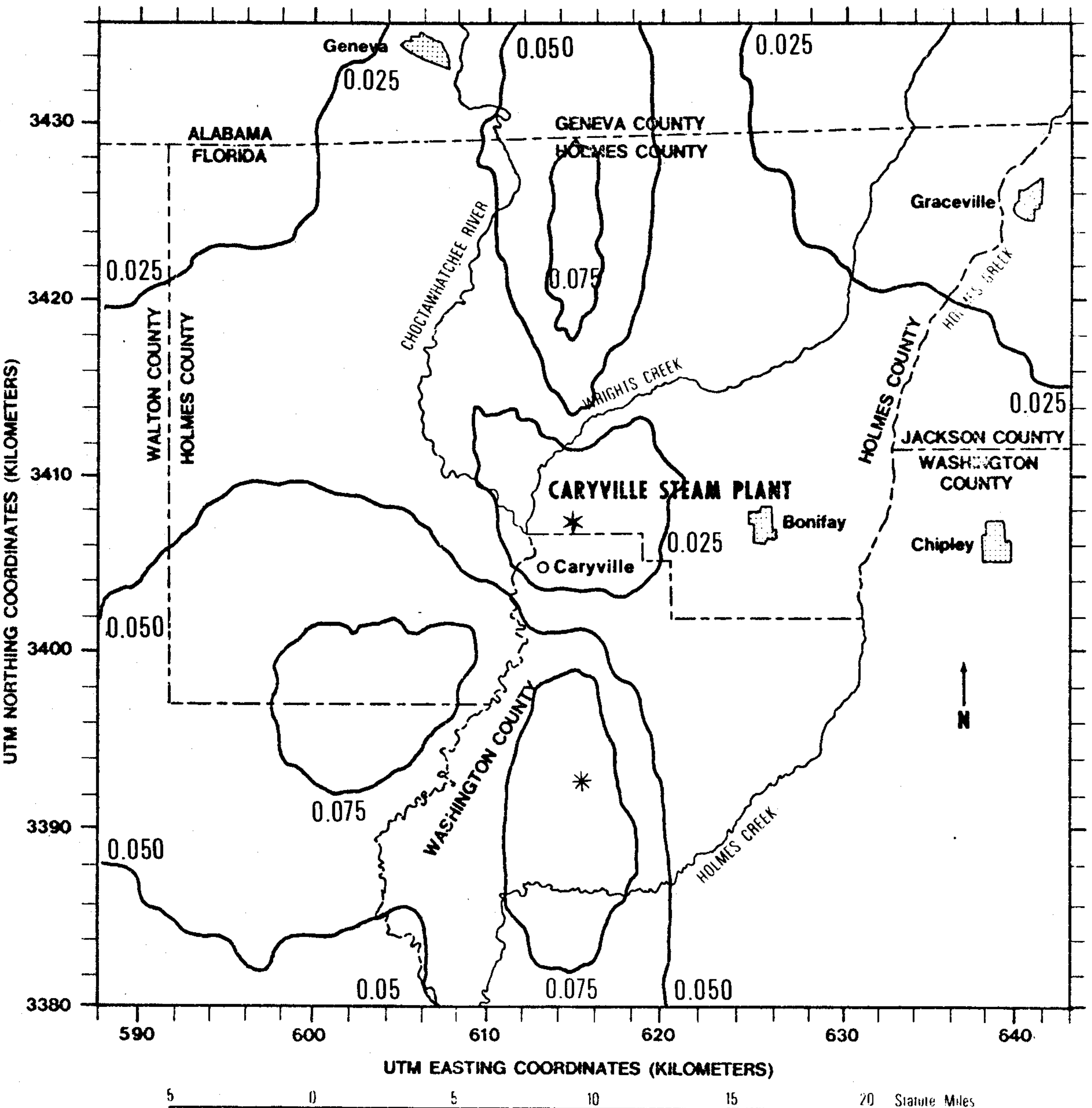
* Maximum Concentration = 0.06 μg/m³ UTM Coordinates = E 615.5 N 3397.5

EPA Primary Standard = 75 μg/m³ Florida Standard = 60 μg/m³

EMITTING 0.7 lbs. OF PARTICULATES PER 10^6 BTU
(1km x 1km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF PARTICULATES (μg/m³) RESULTING FROM UNITS 1 & 2-1,000 MW
		FIGURE 5.4-10



* Maximum Concentration = 0.13 μg/m^3 UTM Coordinates = E 615.5 N 3392.5

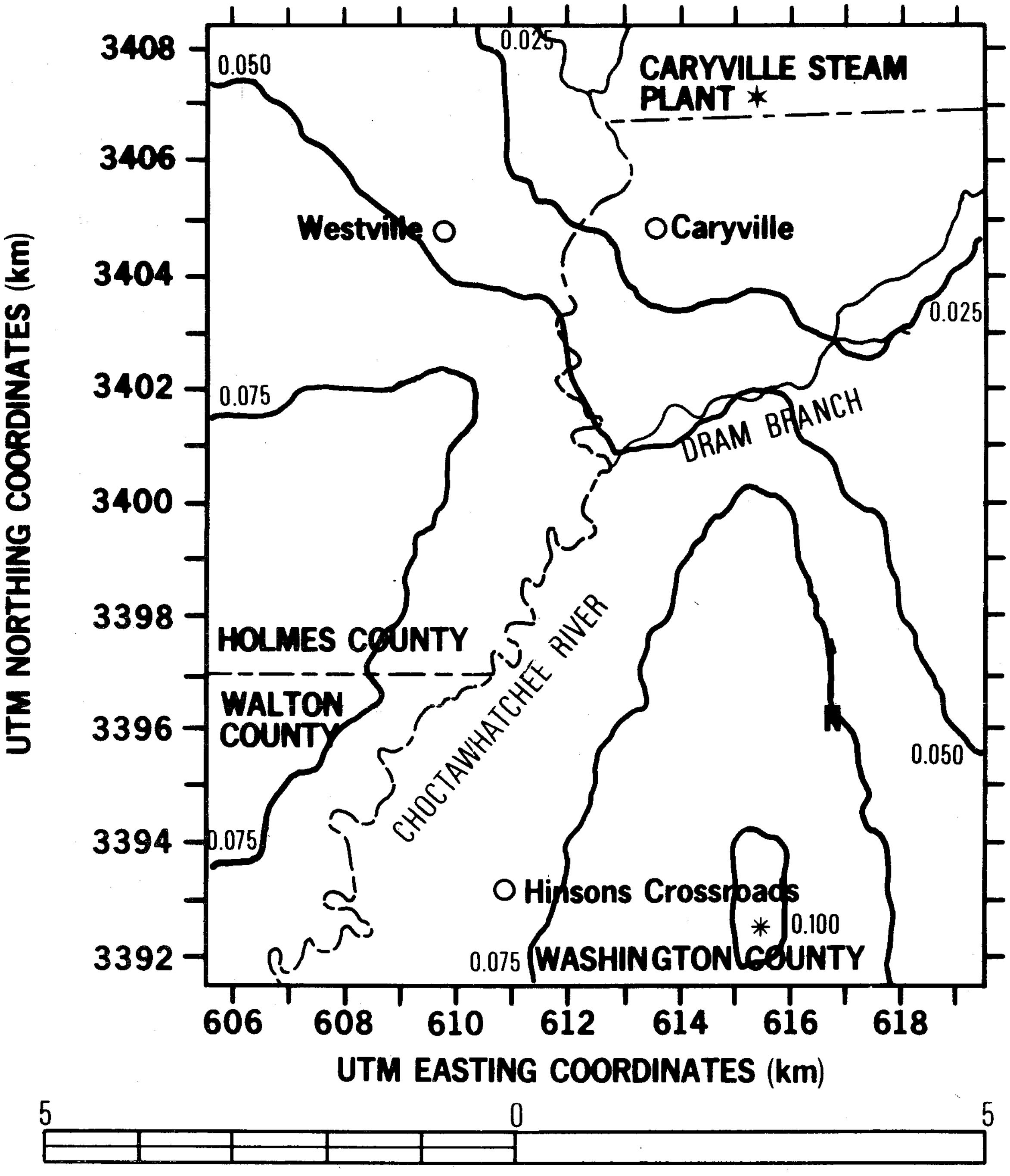
EPA Primary Standard = 75 μg/m^3 Florida Standard = 60 μg/m^3

EMITTING 0.7 lbs. OF PARTICULATES PER 10^6 BTU

(2 km × 2km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF PARTICULATES (μg/m^3) TOTAL SITE - 3,000 MW
		FIGURE 5.4-11



* Maximum Concentration = 0.13 μg/m³ UTM Coordinates = E 615.5 N 3392.5

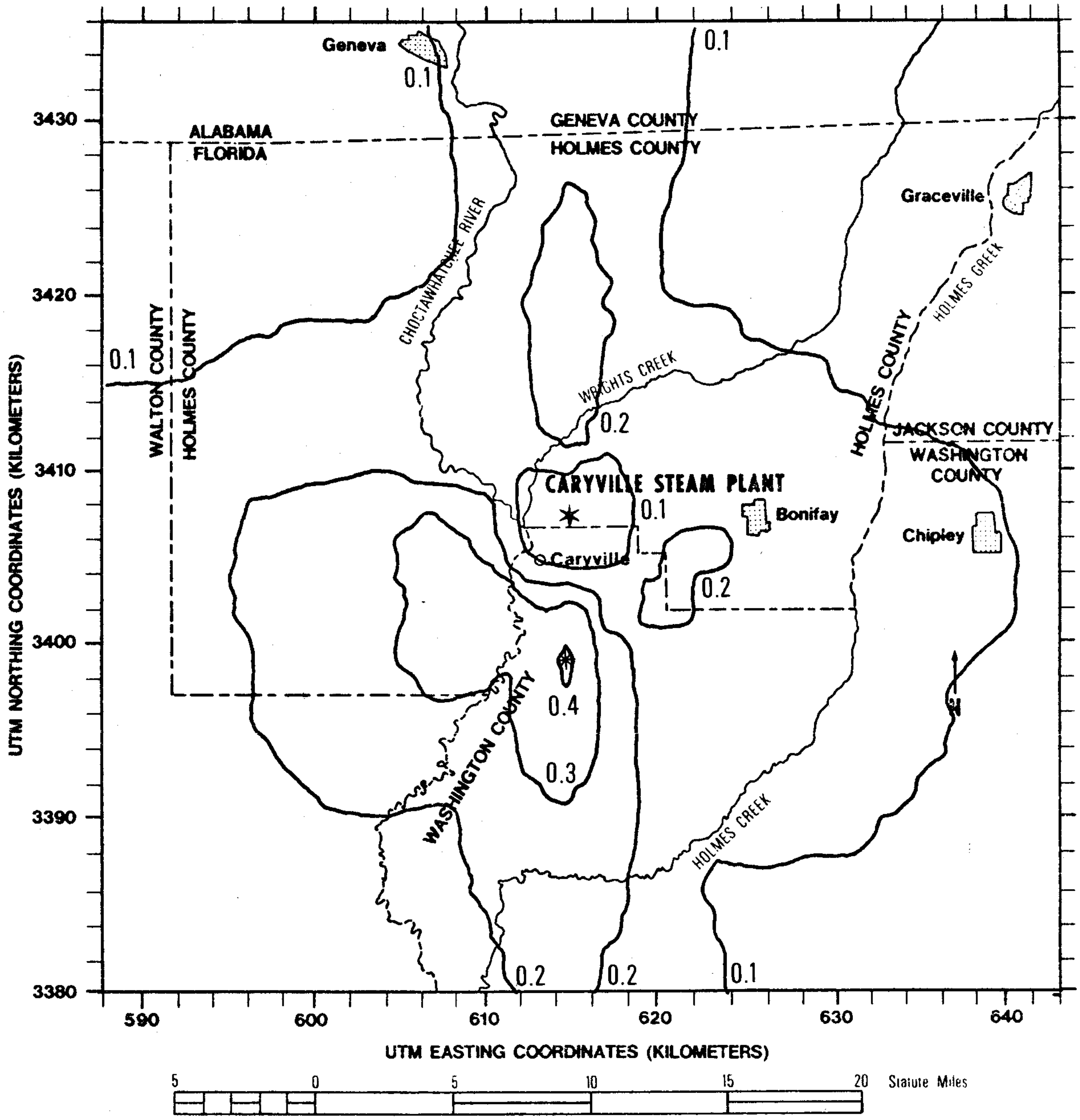
EPA Primary Standard = 75 μg/m³ Florida Standard = 60 μg/m³

EMITTING 0.7 lbs. OF PARTICULATES PER 10^6 BTU

(1km x 1km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF PARTICULATES (μg/m³) TOTAL SITE - 3,000 MW FIGURE 5.4-12

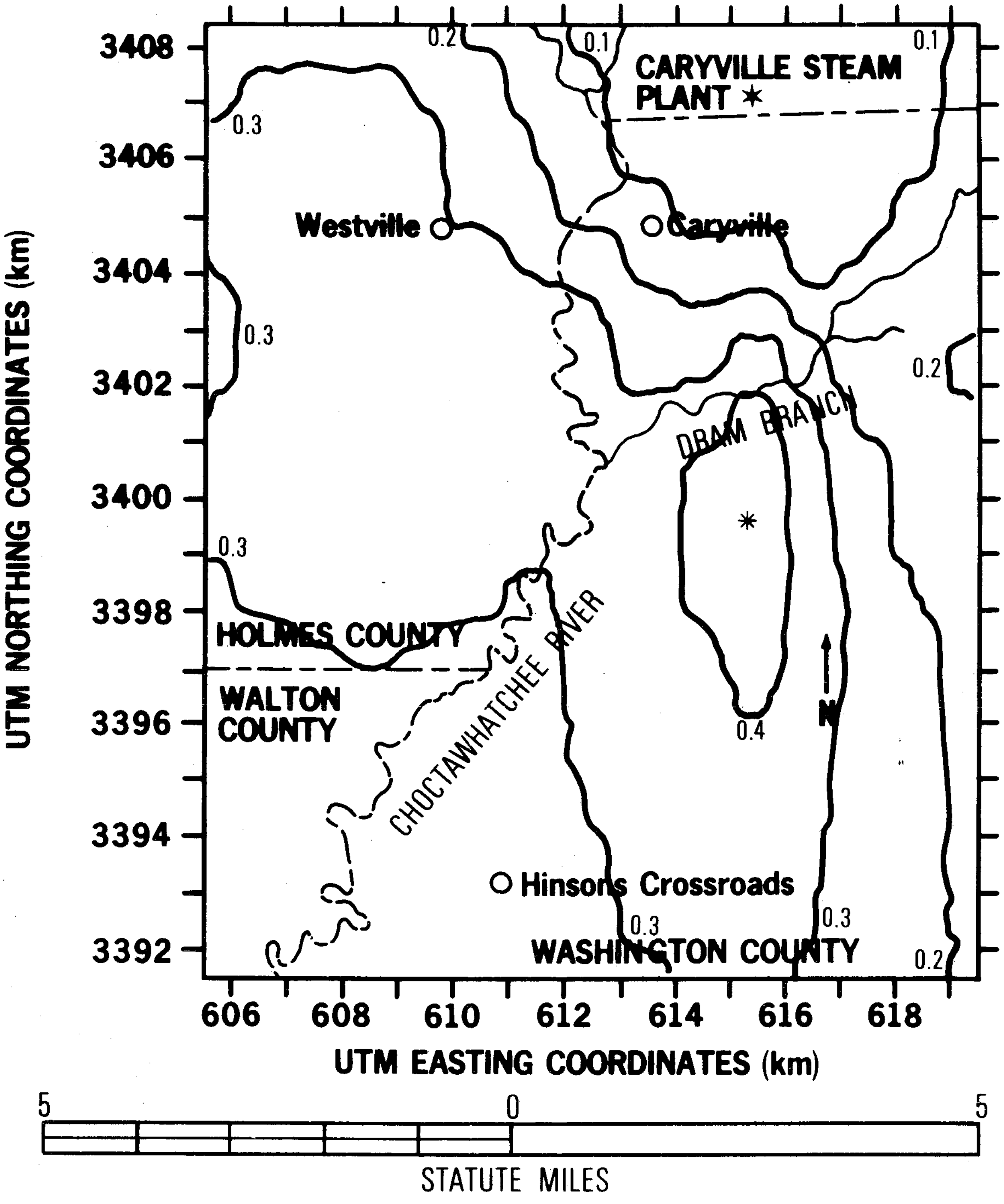


* Maximum Concentration = 0.59 μg/m³ UTM Coordinates = E 615.5 N 3399.5
EPA Primary Standard = 100 μg/m³ Florida Standard = 100 μg/m³

EMITTING 0.1 lbs. OF NITROGEN OXIDES PER 10^6 BTU
(2 km × 2km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF NO_x (μg/m³) RESULTING FROM UNIT 1-500 MW
		FIGURE 5.4-13



* Maximum Concentration = $0.59 \mu g/m^3$ UTM Coordinates = E 615.5 N 3399.5

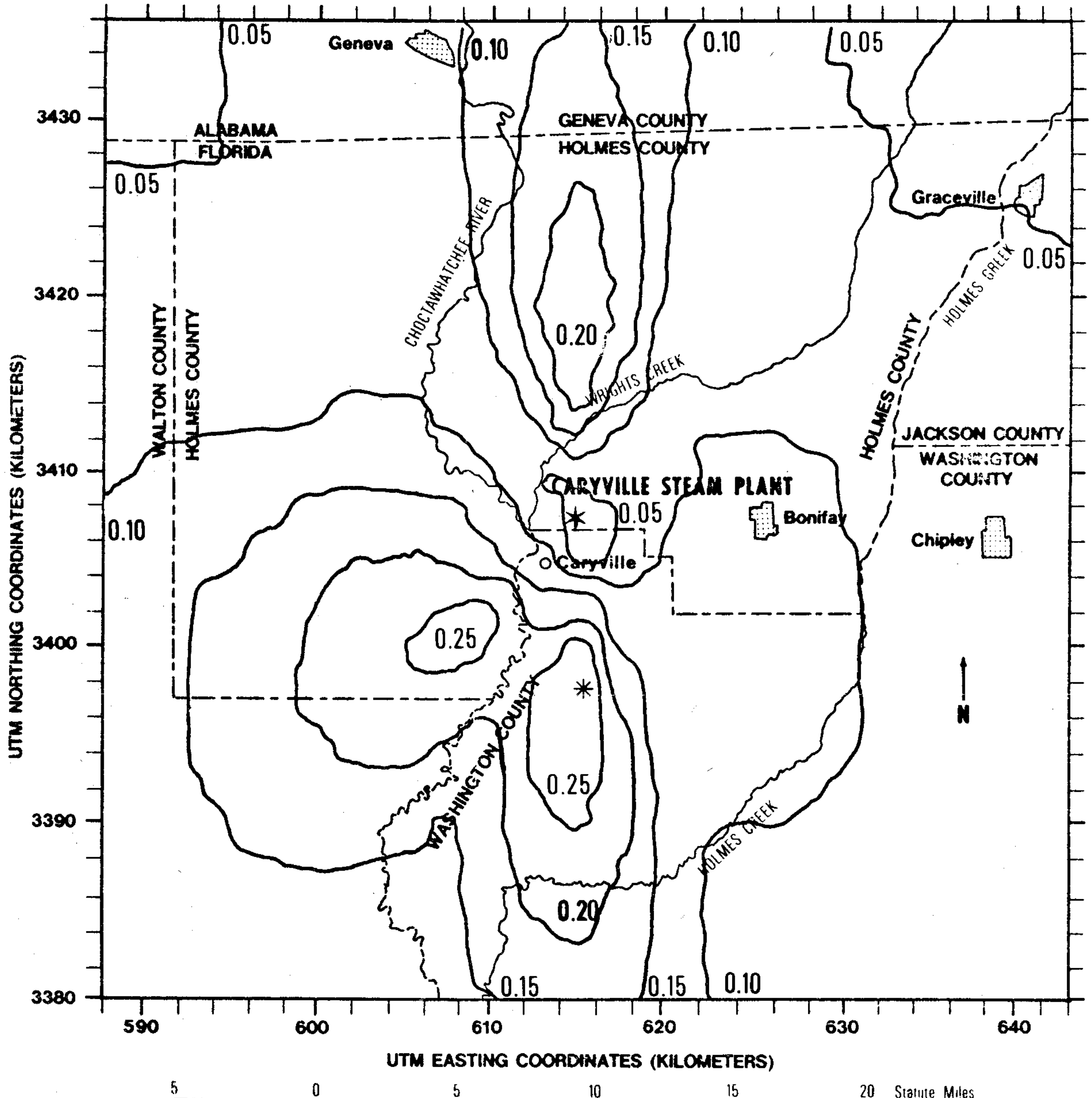
EPA Primary Standard = $100 \mu g/m^3$ Florida Standard = $100 \mu g/m^3$

EMITTING 0.1 lbs. OF NITROGEN OXIDES PER 10^6 BTU

(1km x 1km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF NO_x ($\mu g/m^3$) RESULTING FROM UNIT 1- 500 MW
		FIGURE 5.4-14



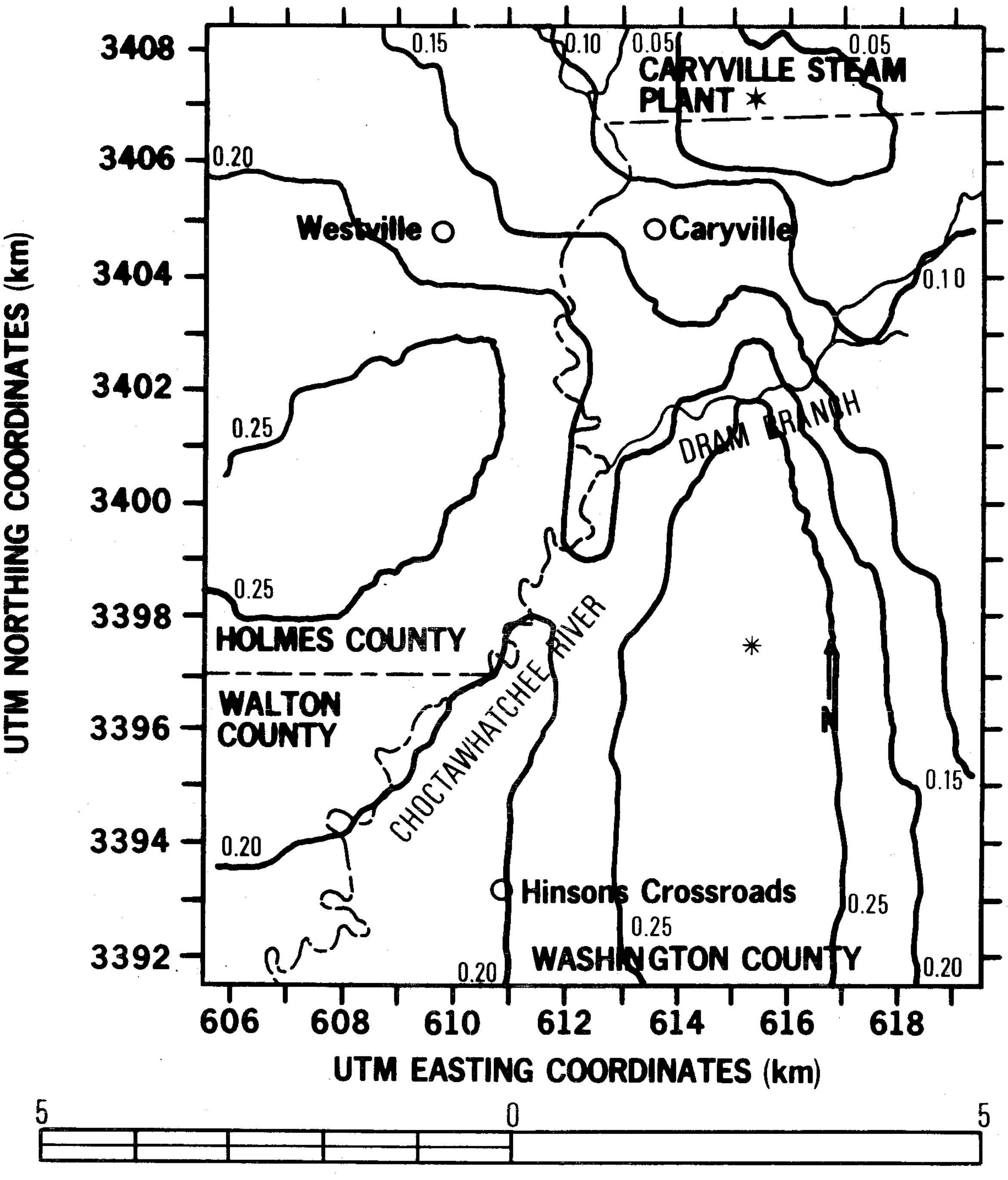
* Maximum Concentration = 0.40 $\mu g/m^3$ UTM Coordinates = E 615.5 N 3397.5

EPA Primary Standard = 100 $\mu g/m^3$ Florida Standard = 100 $\mu g/m^3$

EMITTING 0.1 lbs. OF NITROGEN OXIDES PER 10^6 BTU
(2 km × 2km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF NO_x ($\mu g/m^3$) RESULTING FROM UNITS 1 & 2-1,000 MW
		FIGURE 5.4-15



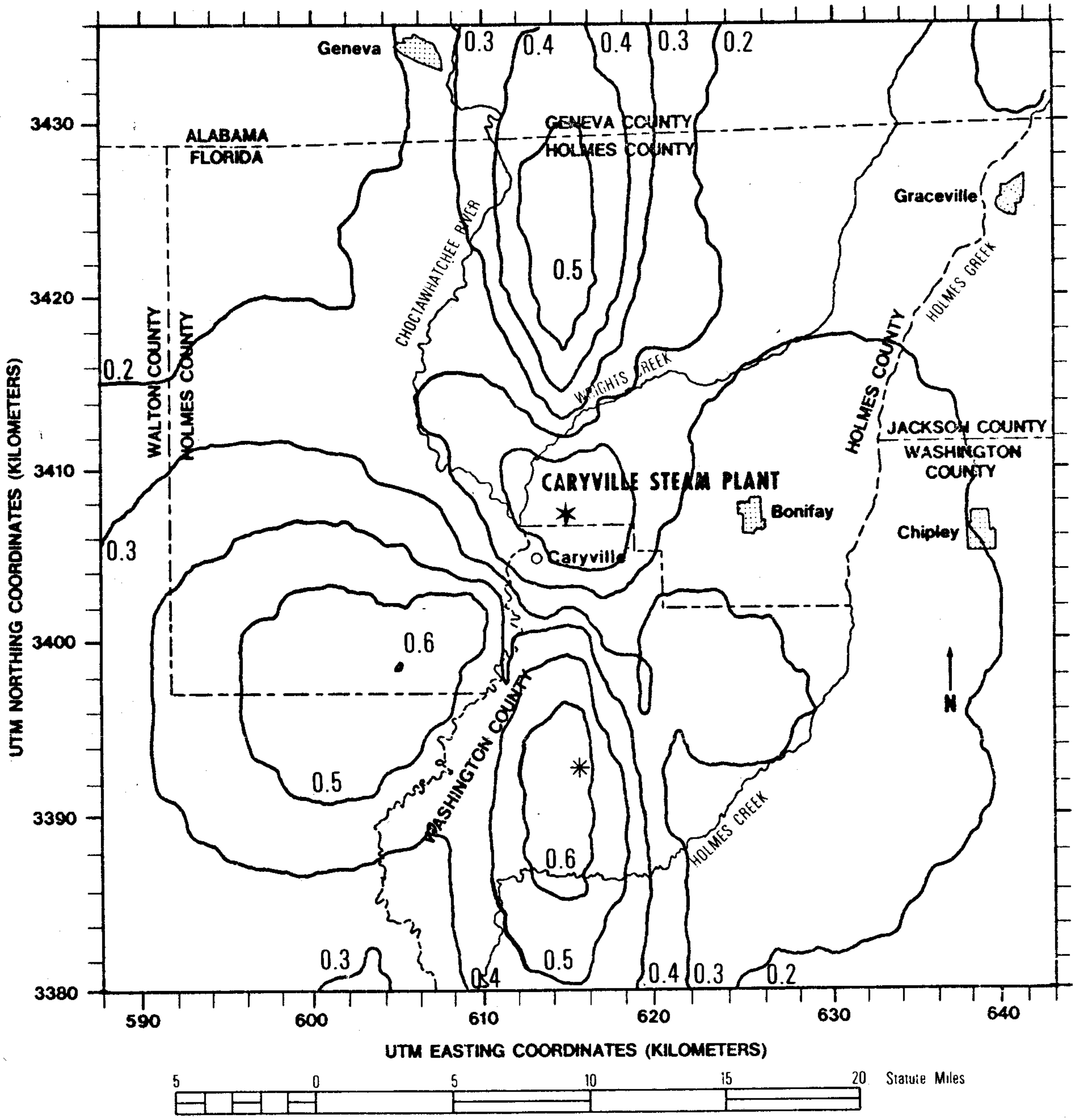
*Maximum Concentration = 0.40 $\mu g/m^3$ UTM Coordinates = E 615.5 N 3397.5

EPA Primary Standard = 100 $\mu g/m^3$ Florida Standard = 100 $\mu g/m^3$

EMITTING 0.1 lbs. OF NITROGEN OXIDES PER 10^6 BTU
(2 km × 2km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF NO_x ($\mu g/m^3$) RESULTING FROM UNITS 1 & 2-1,000 MW
		FIGURE 5.4-16



* Maximum Concentration = 0.91 $\mu g/m^3$ UTM Coordinates = E 615.5 N .3392.5

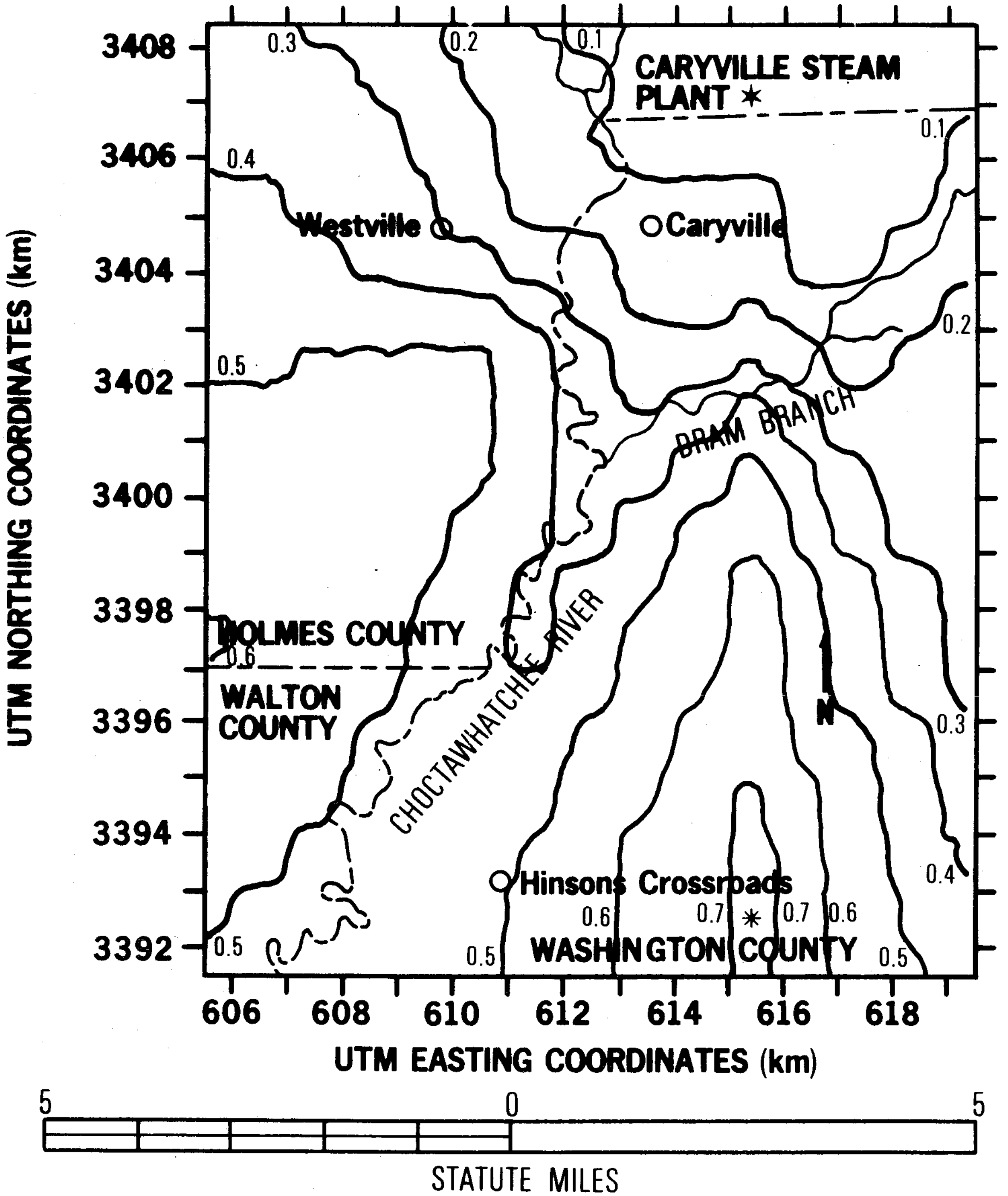
EPA Primary Standard = 100 $\mu g/m^3$ Florida Standard = 100 $\mu g/m^3$

EMITTING 0.1 lbs. OF NITROGEN OXIDES PER 10^6 BTU

(2 km × 2km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF NO_x ($\mu g/m^3$) TOTAL SITE - 3,000 MW
		FIGURE 5.4-17



*Maximum Concentration = 0.91 $\mu g/m^3$ UTM Coordinates = E 615.5 N 3392.5

EPA Primary Standard = 100 $\mu g/m^3$ Florida Standard = 100 $\mu g/m^3$

EMITTING 0.1 lbs. OF NITROGEN OXIDES PER 10^6 BTU
(1km x 1km RECEPTOR GRID)

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	ANNUAL AVERAGE GROUND LEVEL CONCENTRATION OF NO_x ($\mu g/m^3$) TOTAL SITE - 3,000 MW
		FIGURE 5.4-18

5.5 Effects Of The Operation and Maintenance Of The Associated Transmission System

By using aircraft for monthly inspections, the need for personnel and vehicles on transmission line rights-of-way will be eliminated except during the following activities:

A. annual inspection on foot or by vehicle

B. emergency vehicular and/or aerial patrol in the event of damage to lines by severe weather, etc.

C. clearing of brush at intervals of one, two, or more years as necessary by mechanical methods where possible

Other aspects of the operation and maintenance of the transmission system include the use of herbicides, access roads, and electrical effects.

5.5.1 Use of Herbicides

Herbicides will be used to control vegetation in those areas of the transmission line corridor where severe topographic change, excessive soil moisture, or standing water prevents the use of ground-clearing machinery. Herbicides to be used and their dosages, frequency of use, method of application, and effects are described below. The use of herbicides will achieve the desired vegetation control while minimizing effects on nontarget areas. 2

Following initial clearing, vegetation in the areas mentioned above will be controlled annually for the next two to three years using a farm-type tractor with a mowing and brush cutting attachment and/or by hand as required. Subsequently, herbicide treatment will be on an as-required basis.

Herbicides will be applied by helicopter from an elevation of about 15 feet above the transmission lines. Research has shown that application by helicopter results in minimizing drift of the chemical and improves underleaf coverage compared to application from fixed-wing aircraft (1).

Spraying is limited by weather conditions and is normally conducted during April. Application during the spring, when vegetation is actively growing, maximizes effectiveness of the herbicide since it is absorbed primarily through leaf pores (2).

Only herbicides not prohibited by the U. S. Environmental Protection Agency will be used in the spraying program. All herbicides will be applied according to label instructions. The herbicide expected to be most frequently applied will be butoxyethanol ester of silvex: 2-(2,4,5-Trichlorophenoxy) proprionic acid, commonly known as 2,4,5-TP.

It will be mixed to attain a final concentration of 6.1 percent silvex acid equivalent by weight. The mixture is sprayed at the rate of 15 gallons per acre (two gallons per acre of bottle-strength herbicide).

The parent compound 2,4,5-T has been widely used to control woody plants and herbaceous weeds in nonfarm forests, along rights-of-way, in pastures, rangelands, and rice fields for over two decades (3). The herbicide 2,4,5-TP has been shown to be more effective than 2,4,5-T in control of certain species of plants including maple <u>(Acer spp.)</u>, red bud <u>(Cercis canadensis)</u>, and trumpet-creeper <u>(Campsis radican)</u>. It is safer to use when the possibility of drift onto agricultural species is present (4). Application of 2,4,5-TP at low concentrations (less than one part per million) in aquatic habitats provides control of several hard-to-kill emersed and marginal weeds.

The herbicide can be applied in various forms. These include silvex (acid), butoxyethanol ester (BEE), propylene glycol butyl ether ester 2
(PGBEE), and potassium salt of the acid. A special report (5) discusses various studies documenting the effects of silvex. Table 5.5-1 was prepared based on this report.

Degradation of silvex in nature is achieved through photodecomposition. In water and water-sediment systems, PGBEE ester is produced. The rate of complete PGBEE degradation is dependent on initial concentrations. Silvex concentrations may take as long as five months to completely degrade (1).

5.5.2 New Access Roads

As stated in subsection 3.8.2, "Access Roads and Facilities," no new access roads are required for the development and maintenance of the proposed transmission line corridor. Therefore, as a result, exposure of resident wildlife will not increase appreciably. Increased exposure may occur, however, from resident landowners.

5.5.3 Electrical Effects

The evaluation of electrical effects of the transmission system described in subsection 3.8.1, "Noise, Ground Currents, and Ozone," indicates no potential adverse effect to either the environment, resident wildlife, or people.

5.5.4 References

(1) Pesticide Usage and Its Impact on the Aquatic Environment in the Southeast, Pesticides Study Series, No. 8, Environmental Protection Agency, Office of Water Programs Operations, 1972.

(2) Lawrence, J. M. "Aquatic Weed Control in Fish Ponds." FAO Fisheries Report 44, Vol. 5: VII/E-1, p. 83, 1966. 2

(3) Davis, D. E. "The 2,4,5-T Story, Is this the End?" Weeds Today, 5: (2) 12-18, 1974.

(4) Guidelines for Aquatic Weed Control, Florida Department of Natural Resources, pp. 48-56, 1972.

(5) Pimentel, D. Ecological Effects of Pesticides on Non-Target Species, Executive Office of the President, Office of Science and Technology, pp. 121-123, 1971.

TABLE 5.5-1

EFFECTS OF SILVEX

TAXA	FORMULATION	EXPOSURE TIME	CONCENTRATION	LD_{50} (1)	LC_{50} (2)	EFFECT
MAMMALS						
Rat	Silvex			1,070 MG/KG(3)		
Mouse	Silvex			2,140 MG/KG		
Rabbit	Silvex			850 MG/KG		
Guinea Pig	Silvex			850 MG/KG		
BIRDS						
Mallards	Silvex	Daily Dosage	2,500 and 5,000 PPM (4)		3,000 to 5,000 PPM	Reproduction Suppressed Nearly 100%
Pheasants	Silvex (Acid)					
FISHES	(Silvex)	(HOURS)			(PPM)	
Bluegills	Acid	18			70	
Bluegills	Acid	24 (6)			2.9	
Fathead Minnow	Acid	24 (6)			8.9	
Bluegills	Acid	24			19	
Rainbow Trout	Acid	24			23	
Harlequin Fish	Acid	24			48	
Bluegills	Acid	48			0.60	
Rainbow Trout	PGBEE	48			0.650	
Bluegills	BEE	48			1.2	
Salmon	Acid	48			1.23	
Bluegills	Isooctyl	48			1.4	
Bluegills	Potassium Salt	24			83	
		48			83	
Bluegills	Isooctyl Ether (5)	24			15.5	
		48			14.1	
Bluegills	Isooctyl Ether (5)	24			3.7	
		48			3.7	
Bluegills	Isooctyl Ether (5)	24			1.4	
		48			1.4	
Bluegills	Propylene Glycol Butyl Ether Ester	24			19.9	
		48			16.6	
Bluegills	Butoxyethanol Ester	24			1.2	
		48			1.2	
AMPHIBIANS		(HOURS)				
Fowler's Toad (Tadpoles)	Silvex	24			22 PPM	
Chorus Frog (Tadpoles)	Silvex	24			20 PPM	
MOLLUSCS		(HOURS)				
Oysters	Silvex (Ester)	96	1 PPM			23 % Decrease in Shell Growth
ARTHROPODS & ANNELIDS		(HOURS)				
Brown Shrimp	Silvex (Ester)	48	0.24 PPM			50% Mortality or Paralysis
Stonefly Nymphs (Pteronarcys)	Silvex	24			5.6 PPM	
Waterfleas (D. Pulex)	Silvex (PGBEE)	48			2,000 PPM	
Chironomids	Silvex		2.8 to 4.6 PPM			Populations in Plastic Pools Increased
Damselflies	Silvex		2.8 to 4.6 PPM			Populations in Plastic Pools Unaffected
Dipterans (Chrysops)	Silvex		2.8 to 4.6 PPM			Populations in Plastic Pools Decreased
PLANTS		(HOURS)				
Phytoplankton	Silvex (Ester)	4	1.0 PPM			78% Decrease in Productivity
Marine Algae	Silvex (Technical Acid)					
Chlorococcum sp.	Silvex (Technical Acid)		375 PPM			Decreased Oxygen Evolution By 100% (EC_{100})(8)
D. Tertiolecta	Silvex (Technical Acid)		200 PPM			Decreased Oxygen Evolution By 100% (EC_{100})
Chlorococcum sp.	Silvex (Technical Acid)		50 PPM			Decreased Growth By 100% (EC_{100})
D. Tertiolecta	Silvex (Technical Acid)		50 PPM			Decreased Growth By 100% (EC_{100})
TREES						
Aspen	Silvex	Growing Season	2 to 3 LB/A(7)			Causes Death of Tree
MICROORGANISMS						
Streptomyces	Silvex		1 to 50 LB/A			No Affect

(1) LD_{50} is the common acronym for "lethal dose." The subscript 50 is the percent mortality of test organisms after a specific time period.
(2) LC_{50} is the common acronym for "lethal concentration," i.e., that concentration at which 50 percent mortality results after a specific time period.
(3) MG/KG means milligram of herbicide per kilogram of weight of the test organism.
(4) PPM means parts per million.
(5) Different batches of same formulation.
(6) Soft water.
(7) LB/A means pounds per acre.
(8) EC_{100} means effective concentration.

2

5.6

5.6 Other Effects

5.6.1 Environmental Effects of Plant Operation

Gulf expects no major adverse economic or land use impacts from operation of the proposed Caryville steam plant. However, a map inspection indicates a potential traffic inconvenience which could occur due to the increased operation of coal trains where the Louisville and Nashville railroad tracks cross Florida Highway No. 179.

5.6.2 Gulf Employee Residences

The approximately 150 Gulf employees will likely reside in the nearby cities of Bonifay and Chipley since more housing is available in these cities than within the five-mile radius area shown in figure 2.2-1. Table 5.6-1 lists the available information on existing housing in Chipley. Similar information on Bonifay is not available. New local housing developments such as Sunny Hills south of Chipley may be attractive to some plant employees.

5.6.3 Schools

Schools within the area where plant employee live could be affected by the influx of plant employee children depending on the schools' capacity at the time Gulf employees relocate to the area and on the number of school-age children expected.

5.6.4 Economic Impact

Economic benefits from plant operation will occur in the form of increased retail sales, increased bank deposits, and increased tax revenues. These economic benefits could make the area more attractive to industrial growth.

The plant employees and their families will purchase retail goods and services both locally and regionally. As noted in subsection 5.6.2 above, most plant employees will probably relocate to Bonifay and Chipley. Table 5.6-2 lists the sales in the respective counties for these cities and other counties where Gulf employees could purchase retail goods and services.

Plant operation payrolls of Gulf employees could also be added to local commercial banks, which would be a local economic benefit. Table 5.6-3 shows recent commercial bank deposits, by county, for area banks.

Local, State, and Federal taxes could also be benefited by plant operation. The greatest benefit will go to Washington and Holmes counties in the form of increased ad valorem taxes from the plant site property.

Sales taxes, use taxes, and gasoline taxes will also increase.

5.6.5 Sound Levels During Plant Operation

During plant operation, the main contributors to the sound level will be cooling towers, noises emanating from the turbine/boiler building, various switchyard sources, and intermittent noise sources. (Refer to A, B, C, and D below.) Numerous atmoshperic conditions and ground coverings enter the evaluation of sound level attenuation as a function of frequency and distance from the source (1). The high-frequency terms are more subject to error at long distances but they, in turn, are attenuated much more than the low-frequency terms. As a result, the high-frequency terms seldom are critical in estimating sound levels at distances over 1,000 feet. Pure tones represent the most severe problem associated with community reaction to noise.

A. Cooling Tower Noise - Since many noise ordinances are written in terms of A-weighted sound levels, a number of studies have been performed to determine the dBA (decibels on the the "A" scale) sound level as a function of distance from cooling towers (2,3,4). Figure 5.6-1 shows a typical range of cooling tower noise emissions for a 600 to 800 MW plant without effects of topography or meteorology (2). The sound levels beyond approximately 1,000 feet are extrapolated values.

   Figures 5.6-2 and -3 show actual sound level data obtained around a natural draft cooling tower and a mechanical draft cooling tower, respectively. Note from the data given on figures 5.6-2 and -3 that the sound levels are broadband and that no significant pure tones exist.

B. Turbine/Boiler Building Noise - Although the sound level inside the turbine hall may be in the mid-90 dBA range, the exterior walls typically used in power plant construction should reduce this by approximately 20 dBA. Measurements taken at several existing plants verify this reduction (5, 6). As a comparison, the sound level at the base of the cooling towers will be approximately 85 dBA. Outside the turbine enclosure the sound level should be approximately 75 dBA. Therefore, the additional sound level contibution due to the turbogenerators as measured at the site boundary should be small.

   Since the forced draft fans are designed to be placed on the base slab with sound enclosures inside the main building, they will not produce any community noise problems.

C. Switchyard Noise - Large power transformers produce sound levels at a distance of three feet in the order of 80 to 90 dBA, and the sound specturm is predominated by low frequencies (500 Hz).

The primary characteristics of the noise emitted to the community are pure tones at even harmonics of the mains frequency, i.e., at 120 Hz, 240 Hz, etc. Audibility of these pure tones is the main contributor to community complaints (7).

D. Intermittent Source Noise - A number of intermittent sources of noise are essentially beyond the control of the operators at an electric utility plant. For example, a fault in the system can cause circuit breakers to open, over pressure on the boiler can open a safety valve, etc. The opening of a circuit breaker will produce a very short impulsive sound. Safety valves would normally not remain open for more than one to two minutes.

During the initial startup of any new plant, the steam blowdown of the entire system must be accomplished. Such a blowdown may require three days of high pressure steam vented to atmosphere. The duration of each phase of the blowdown will be one to two minutes each hour. Each time the units have to be restarted, intermittent venting also occurs. Normally, the initial blowdown would be performed during daytime hours whereas restarting may have to be accomplished at any hour. (Refer to subsection 4.2.1, "Boiler Blowdown Noise.")

Since the noise sources mentioned above are intermittent and often unpredictable, variances in existing state and local laws should be allowed.

5.6.6 References

(1) Beranek, L. L. Noise and Vibration Control, McGraw-Hill, 1971.

(2) Teplitzky, A. M. Electric Utility Noise in the Community, Inter-Noise 74 Conference, September 30 to October 2, 1974.

(3) Carlson, J. P. and A. M. Teplitzky. "Estimation and Impact of Environmental Noise from Natural Draft Cooling Towers." Noise Control Engineering, July-August, 1974.

(4) Capano, G. and W. E. Bradley. Acoustical Impact of Cooling Towers, Acoustical Society of America, April, 1974. (Also referenced in title block of figure 5.6-1.)

(5) Hickman, C. E. Sound Level Survey, Unit 1, Tennessee Valley Authority, Cumberland Steam Plant, Internal Southern Services, Inc., Document, 1973.

(6) Hickman, C. E. Noise Survey for Gulf Power Company, Internal Southern Services, Inc., Document, 1972.

(7) Schulz, M. W. Jr. and R. J. Ringlee. "Some Characteristics of Audible Noise of Power Transformers and Their Relationship to Audibility Criteria and Noise Ordinances." Power Apparatus and Systems (AIEE), June 1960.

TABLE 5.6-1

HOUSING UNITS ON APRIL 1, 1970, AND NUMBER OF NEW NON-FARM HOUSING UNITS AUTHORIZED BY BUILDING PERMITS IN SELECTED MUNICIPALITIES: 1970, 1971, 1972

	NUMBER OF UNITS ON APRIL 1, 1970*		NUMBER OF UNITS AUTHORIZED BY PERMIT*					
			1970		1971		1972	
Municipality	All Housing Units	Year-Round Single-Family Structures Only	Single-Family	Multi-Family	Single-Family	Multi-Family	Single-Family	Multi-Family
Chipley	1,235	1,051	9	0	23	0	43	0

*Source: Florida Statistical Abstract, 1973.

Rentals
Assistance to Gulf employees

CSP-ER-5

TABLE 5.6-2

TAXABLE SALES BY COUNTY AND FISCAL YEARS ENDING JUNE 30, 1971 and 1972

County	1971 Taxable Sales	1971 Number of Accounts	1972 Taxable Sales	1972 Number of Accounts
Bay	$172,423,815	2,526	$191,715,389	2,380
Holmes	$ 9,469,787	249	$ 11,132,334	273
Jackson	$ 45,980,062	792	$ 55,506,684	893
Walton	$ 17,324,461	480	$ 20,784,920	470
Washington	$ 9,207,153	269	$ 11,268,470	278

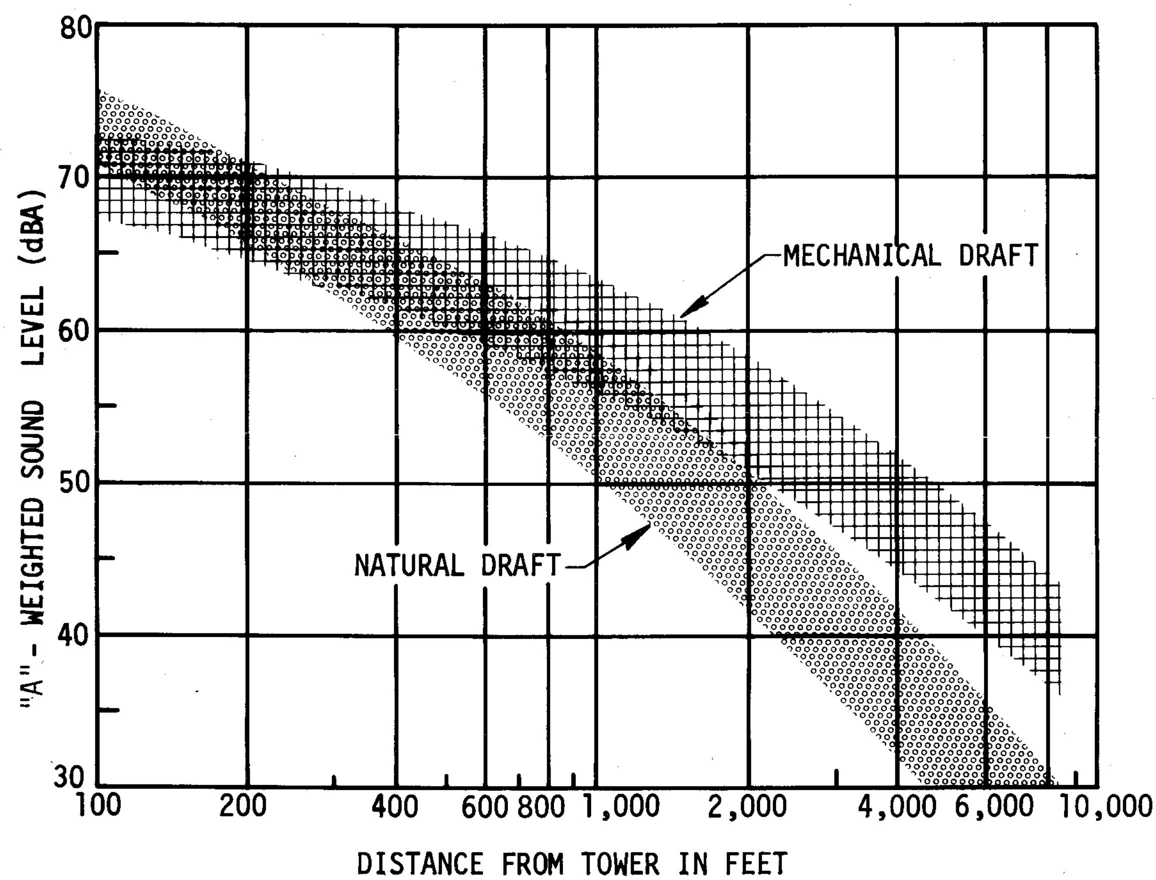
Source: Florida Statistical Abstract, 1973.

TABLE 5.6-3

TOTAL DEPOSITS BY SELECTED TYPES OF COMMERCIAL BANKS, BY COUNTY, AS OF FEBRUARY, 1972 AND 1973

County	TOTAL DEPOSITS ($000)	
	February, 1973	February, 1972
Holmes	11,904	10,255
Jackson	48,739	41,557
Walton	19,899	16,775
Washington	9,278	7,273
Okaloosa	123,899	101,431

Source: Florida Statistical Abstract, 1973.



GULF POWER CO.
CARYVILLE STEAM PLANT

TYPICAL RANGE OF COOLING TOWER NOISE (4) EMISSIONS FOR 600 TO 800 MW PLANT WITHOUT EFFECTS OF TOPOGRAPHY OR METEOROLOGY

FIGURE 5.6-1

DATE: 4/6/73

PRIMARY NOISE SOURCE: Cooling Tower

EQUIP. MAKE & MODEL: Research Cottrell

OPERATING CONDITIONS: ·Natural draft cooling tower used with 700 MW unit

INSTRUMENTATION

SLM: TYPE ______ SER. # ______

TRANSDUCER: TYPE GR-1560-P6 SER. # 1950

ANALYZER: TYPE GR-1558-BP SER. # 2279

CABLE: TYPE ______ LENGTH ______

CALIBRATOR: TYPE GR-1562-A SER. # 3122

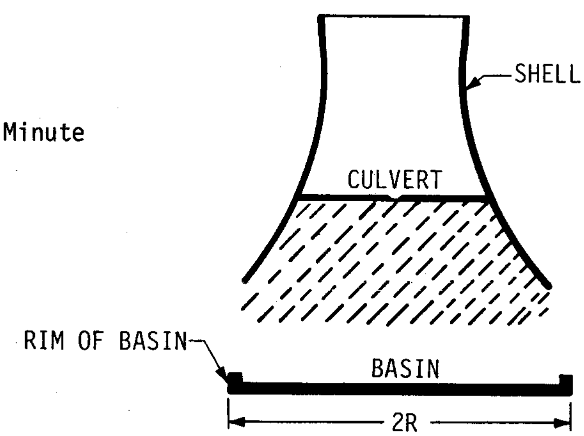
OTHER: Windsereen

TIME	CALI-BRA-TION	TEMP.	% RH	MMHG	WIND MPH	WIND DIR.
14:00	OK					

TEST NO.	TIME	POSI-TION	CONDITIONS	SOUND PRESSURE LEVEL, dB RE 20μ N/M² rms: A-SCALE LEVEL	OVER ALL LEVEL	OCTAVE BAND CENTER FREQUENCY, Hz.: 31.5	63	125	250	500	1000	2,000	4000	8000
1	14:00	A1	Rim of basin	85	86	65	74	68	68	77	78	77	78	79
2		B1	10 feet from rim of basin	83	84	66	73	64	64	74	75	75	75	75
3		C1	50 feet from rim of basin	77	78	63	72	65	60	67	68	70	70	69
4		D1	100 feet from rim of basin	73	75	63	68	66	57	63	65	67	67	64
5		E1	200 feet from rim of basin	69	72	64	68	65	62	57	60	62	60	53
6		F1	300 feet from rim of basin	66										
7		G1	400 feet from rim of basin	62										
8		H1	1,000 feet from rim of basin	50										

DIAGRAM - SHOW MEASURING LOCATIONS:

Descriptive Data:
Counterflow tower
Water flow = 258,400 Gallons Per Minute
Culvert to basin = 37 Feet



GULF POWER CO.
CARYVILLE STEAM PLANT

NATURAL DRAFT COOLING TOWER NOISE

FIGURE 5.6-2

DATE: 11/2/72

PRIMARY NOISE SOURCE: Cooling Tower
EQUIP. MAKE & MODEL: Marley - 8 cells
CLIENT DESIGNATION:
OPERATING CONDITIONS: Mechanical draft cooling tower used with a 320 MW unit

INSTRUMENTATION

SLM: TYPE ______ SER. # ______
TRANSDUCER: TYPE GR-1560-P6 SER. # 1950
ANALYZER: TYPE GR-1558-BP SER. # 2279
CABLE: TYPE ______ LENGTH ______
CALIBRATOR: TYPE GR-1562-A SER. # 3122
OTHER: Windscreen

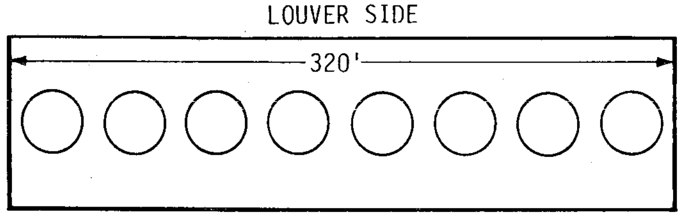
TIME	CALI-BRA-TION	TEMP.	%RH	MMHG	WIND MPH	WIND DIR.
12:30	OK	75				

TEST NO.	TIME	POSI-TION	CONDITIONS	SOUND PRESSURE LEVEL, dB RE 20μ N/M² rms										
				A-SCALE LEVEL	OVER ALL LEVEL	OCTAVE BAND CENTER FREQUENCY, Hz.								
			Louver side of tower			31.5	63	125	250	500	1000	2000	4000	8000
1	12:40	A1	5 feet	84	95	89	82	83	82	75	75	75	77	80
2		B1	50 feet	80	92	82	80	75	76	72	72	72	70	73
3		C1	100 feet	73	83	78	76	70	66	67	66	65	64	64
4		D1	200 feet	70	80	75	75	72	66	65	64	63	63	62
5		E1	300 feet	67	83	72	73	68	62	62	62	60	59	57
6		F1	Narrow end of tower											
7		G1	5 feet	68	81	74	71	71	67	63	61	59	57	56
8		H1	50 feet	64	79	75	71	70	66	59	56	54	53	51

DIAGRAM - SHOW MEASURING LOCATIONS:

Descriptive Data:
Mechanical draft tower
Eight cells

LOUVER SIDE



GULF POWER CO.
CARYVILLE STEAM PLANT

MECHANICAL DRAFT COOLING TOWER NOISE

FIGURE 5.6-3

5.7

5.7 Resources Committed

Irreversible and irretrievable committments addressed in this section are related to the operation of the Caryville plant. Operation will affect water, air, and energy resources as described in 5.7.1 through 5.7.3 below.

The irreversible and irretrievable committment of resources involved in the plant's construction is discussed in section 4.4, "Resources Committed."

5.7.1 Water Resources and Aquatic Organisms

5.7.1.1 Water Resources - The Caryville plant will use wet type natural draft cooling towers to dissipate the waste heat. (Refer to section 3.4, "Heat Dissipation System.") The operation of these cooling towers will entail drift and the evaporation of water to the atmosphere, thus constituting a consumptive use of surface water. The expected consumptive rate for the initial 500 megawatt (MW) installation is 4,345 gallons per minute (GPM). The subsequent addition of another 500 MW Unit will double this. The ultimate site development of 3,000 MW will result in the evaporation of 26,070 GPM. Although water lost to the atmosphere by evaporation will not be available for immediate use as surface water, the water vapor will be returned to the hydrologic cycle, as discussed in section 2.5, "Hydrology." This does not constitute an irreversible or irretrievable committment of a resource. 2

5.7.1.2 Aquatic Organisms - Certain life stages of various aquatic organisms of the Choctawhatchee River may be entrained, impinged, or entrapped by the operation of the plant's intake system. The quantity of organisms entrained is expected to be minimal due to the small percentage of river flow which will be withdrawn (approximately one percent under average flow conditions and approximately eight percent under 10-year/7-day low flow conditions). The loss of aquatic organisms is judged to be reversible at the end of plant operation.

5.7.2 Air Resources

The committment of air resources associated with the operation of the plant is due to the dispersion of gaseous waste from the plant's stacks. This committment is in the form of a slight increase in the ambient level of sulfur dioxide, nitrogen oxides, and particulates in the atmosphere in the vicinity of the plant. The committment will last for the projected lifetime of the plant with the extent of the committment varying under different operating conditions. Modeling studies presented in section 5.4, "Effects of Air Emissions," illustrate the extent of the committment of air resources. This committment is judged to be reversible at the end of plant operation.

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Amendment 1 6/75

5.7.3 Energy Resources

Conversion of fossil fuels into electrical energy constitutes an irreversible and irretrievable committment of resources associated with the operation of the Caryville steam plant. The fossil fuels consumed by the operation of the plant will include coal and No. 2 fuel oil. Other energy forms will be consumed in providing fuels for the plant.

Energy associated with the coal and No. 2 fuel oil will be converted by the plant into electrical energy; this conversion will be irreversible and irretrievable. The by-products of this conversion process will include ash, other products of combustion, and waste heat. These by-products may be considered a "resource" in the future, depending on the development of technology to facilitate their use in supporting other aspects of man's activities. 1

As mentioned in section 3.2, "Fuel," the expected load factor for the life of the Caryville plant will be approximately 50 percent. Based on this load factor, the annual coal consumption for the initial 500 MW installation will be 1,057,000 tons. The consumption of No. 2 fuel oil for light-offs and low-load flame stabilization is estimated to be 128,400 gallons annually. This consumption would increase to 6,342,000 tons of coal and 770,400 gallons of oil annually for the ultimate development of 3,000 MW.

The consumption of energy required to provide fuel to the plant site will also constitute an irretrievable committment of resources. The proposed method of transport is by rail for the coal supply and tank car or tank truck for the oil supply. The amount of energy necessary to provide fuel to this site will depend on the ultimate location from which the fuel is shipped and the process by which it is mined or otherwise obtained.

6. MEASUREMENTS AND MONITORING

6.0 Environmental Measurements And Monitoring Programs

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

CHAPTER TABLE OF CONTENTS

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

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Amendment 2 8/75
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6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

LIST OF TABLES

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

LIST OF FIGURES

6.1 Surface Waters

The river flow data presented in subsection 2.5.2, "Surface Water," were taken from U. S. Geological Survey (USGS) records of the Caryville gaging station on the Choctawhatchee River.

Gulf has placed three staff gages (SG1, SG2, and SG3) in three selected ponds in the area of the proposed plant site to monitor water level fluctuations, and is monitoring the gages once per month. The pond in which SG1 is located is approximately one-half mile east of the northern intersection of Holley Lane and Walker Avenue (Florida Coordinate System N-657,400; E-1,592,210). The pond in which SG2 is located (N-656,060; E-1,590,630) is approximately 2,000 feet southwest of the pond containing SG1. The pond in which SG3 is located (N-650,790; E-1,589,290) is approximately 1,000 feet west of Walker Avenue and 400 feet northwest of Blackman Cemetery. (See figure 2.4-4.) 2

Staff gages are also located at four of the seven surface water monitoring stations described in section 6.2, "Physical and Chemical Parameters." The stations with staff gages are H10 (Hathaway Mill Creek), W10 (Wrights Creek), D10 (Detention Pond Drainage Ditch), and L10 (Little Dram Branch). These gages are being monitored once per month.

The USGS will operate and maintain continuous level recorders at two surface water monitoring stations described in section 6.2. These stations are H10 (Hathaway Mill Creek) and W10 (Wrights Creek). 2

Also to be operated and maintained by the USGS are a continuous conductance monitor and a continuous temperature monitor located at surface water station C30 (Highway No. 90 bridge). Station C30 is also described in section 6.2.

The program for monitoring surface waters near the proposed plant site during site preparation and plant construction is reported in section 6.2.

6.2 Physical and Chemical Parameters

The purpose of this section is to describe the monitoring programs used to measure physical and chemical parameters of surface water which may be affected during construction or operation of the Caryville plant.

6.2.1 Baseline Data

Gulf's monitoring program to obtain baseline data began in May, 1974, at selected points on the Choctawhatchee River. These preliminary locations were analyzed and used in determining the final monitoring program that was inaugurated in June, 1975. This program is planned to obtain baseline data at surface water locations that could possibly be affected by activities at the proposed plant site. The data collected should also indicate any fluctuating influences to the surface waters near the Caryville site. To collect these data, seven monitoring stations were selected as shown in figure 6.2-1. Samples collected at each station will be analyzed by an independent laboratory for the parameters listed in table 6.2-1. This table also indicates parameters to be analyzed at each monitoring station at the time of sample collection. 2

Parameters chosen to provide baseline data were selected to include those of the following categories: (a) parameters that had limitations imposed on them by the U. S. Environmental Protection Agency (EPA) in Effluent Guidelines and Standards for Steam Electric Power Generating Point Source Category (1), (b) parameters suspected of degrading the quality of a particular lake or stream as listed in section 17-3.04 of the Florida Administrative Code (2), (c) parameters that have specific limitations in section 17-3.05 of the Code (3), and (d) parameters that require monitoring according to the EPA's standard form National Pollutant Discharge Elimination System (NPDES) permit for steam electric power plants (4). Fluorides, sulfides, BOD, phenols, cyanides, and detergents are parameters designated as potential pollutants by the State of Florida but are not included in table 6.2-1 because it is expected that the Caryville plant will not measurably influence these parameters.

Although the monitoring program to obtain baseline data will be established initially for a period of 14 months, periodic review will be made to assess the need for revising and/or continuing the program. 2

6.2.1.1 Monitoring Station C10 - This station is located near the center of the Choctawhatchee River approximately 4,500 feet upstream of the confluence of the River with the main branch of Wrights Creek (Florida Grid Coordinates N-658,050; E-1,582,620). (See figure 6.2-1.)

Station C10 is located upstream of any influence which could be attributed to construction or operation of the proposed plant. This station will therefore provide baseline data indicative of an unaltered condition of the Choctawhatchee River before, during, and after plant construction and during operation. Samples will be collected monthly at a depth of five feet and analyzed for the parameters listed in table 6.2-1.

Amendment 2 8/75
Amendment 1 6/75

6.2.1.2 Monitoring Station C20 - This station is located near the center of the Choctawhatchee River approximately 3,200 feet downstream of the confluence of the River with the main branch of Wrights Creek (Florida Grid Coordinates N-652,620; E-1,585,530). (See figure 6.2-1.)

Station C20 is located approximately 300 feet downstream of a branch of Wrights Creek which enters the Choctawhatchee River downstream of the confluence mentioned in 6.2.1.1 above. This location was chosen because it is just upstream of the proposed location of the Caryville steam plant discharge, while being downstream of the entrances of Wrights Creek into the Choctawhatchee River.

This station will provide baseline data characteristic of the Choctawhatchee River after the influence of Wrights Creek but prior to any influence of discharge from the Caryville plant. Samples will be collected monthly at a depth of five feet and analyzed for the parameters listed in table 6.2-1.

6.2.1.3 Monitoring Station C30 - This station is located near the center of the Choctawhatchee River approximately 15 feet upstream of the U. S. Highway No. 90 bridge (Florida Grid Coordinates N-648,110; E-1,582,720). (See figure 6.2-1.)

Site of USGS Gage

Station C30 is located downstream of a sawmill and log storage area, and was chosen to evaluate the impact of the sawmill and log storage area on the Choctawhatchee River during the baseline data collection period. Also, this monitoring station is located downstream of the proposed Caryville steam plant discharge point, and therefore will provide data indicative of the water quality of the Choctawhatchee River at this location prior to the influence of plant construction or operation. The station is located upstream from a wayside park and recreation facility maintained by Florida's Department of Transportation. It will provide 2
baseline data on the river flowing past this facility and will not be affected by the facility.

The data obtained at station C30 will be useful in assessing the impact of the plant. Samples will be collected monthly at a depth of five feet and analyzed for the parameters listed in table 6.2-1.

6.2.1.4 Monitoring Station H10 - This station is located near the center of Hathaway Mill Creek approximately 30 feet downstream from the dam at the old Hathaway Mill site (Florida Grid Coordinates N-661,670; E-1,591,280). (See figure 6.2-1.)

USGS Gage

Hathaway Mill Creek drains surface water and seepage from the northern section of the Caryville plant site where an ash disposal area is planned. Therefore, baseline data collected at station H10 will facilitate evaluation of the effect of the ash disposal area on the surface waters north of the plant site. Samples will be collected monthly at middepth and analyzed for the parameters listed in table 6.2-1.

6.2.1.5 Monitoring Station W10 - This station is located near the center of Wrights Creek approximately 15 feet upstream of the bridge on an improved county road north of the plant site (Florida Grid Coordinates N-666,810; E-1,589,090). (See figure 6.2-1.)

This station is upstream from the entrance of Hathaway Mill Creek into Wrights Creek and was chosen to provide data characteristic of Wrights Creek prior to any influence from Hathaway Mill Creek and, hence, from the northern section of the plant site. The data collected will also serve to point out any water quality changes that may take place further upstream on Wrights Creek and not attributable to the plant site. Samples will be taken monthly at mid-depth and analyzed for the parameters in table 6.2-1.

6.2.1.6 Monitoring Station D10 - This station is located on the eastern end of a drainage culvert beneath Holley Lane which runs north and south just west of the Caryville plant site (Florida Grid Coordinates N-653,080; E-1,590,310). (See figure 6.2-1.)

The ditch leading to this culvert drains rainfall runoff water from an area in the Caryville plant site where a detention pond will be located during plant construction and operation. Monitoring station D10 was selected because this location will receive rainfall runoff from the plant site during construction and operation. During construction, water from the detention pond used to control construction runoff will flow past station D10. During plant operation, the detention pond will receive rainfall runoff from the yard drains. The pond will discharge into the natural drainage ditch on which station D10 is located.

This station will provide baseline data that will be useful in indicating the impact of major plant construction and operation on rainfall runoff streams.

The drainage ditch on which station D10 is located carries water only during wet weather; consequently, a precise monthly sampling schedule will not be possible. Samples will therefore be collected every other month during wet weather conditions, yielding a total of six samples per year. In the event that wet weather conditions do not occur during a sampling month, samples will be collected during consecutive months under wet weather conditions in order to secure six samples per year. The samples will be collected at middepth and analyzed for the parameters listed in table 6.2-1.

6.2.1.7 Monitoring Station L10 - This station is located on Little Dram Branch just upstream of the Brown Avenue Bridge approximately 3,300 feet south of U. S. Highway No. 90 (Florida Grid Coordinates N-645,400; E-1,591,110). (See figure 6.2-1.)

Little Dram Branch drains the southern portion of the Caryville plant site where an ash disposal area is planned. This station was selected

to facilitate evaluation of the impact of the ash disposal area on surface waters south of the plant site. Station L10 is a wet-weather station and samples will be collected and analyzed in the same manner as that described for station D10 in 6.2.1.6 above.

6.2.2 Construction and Operation Data 1

Following review of data collected during the baseline data collection period, final details of the monitoring programs to obtain data during construction and operation will be established and implemented. The monitoring programs will comply with all National Pollutant Discharge Elimination System (NPDES) permit monitoring requirements.

TABLE 6.2-1

PHYSICAL AND CHEMICAL PARAMETERS ANALYZED IN BASELINE SURFACE WATER MONITORING PROGRAM

PARAMETER	METHOD OF ANALYSIS[a]	
Temperature[b]	Std p 348	
pH[b]	Std p 276	
Dissolved Oxygen[b]	EPA p 56	
Specific Conductance	Std p 323	
Total Suspended Solids	EPA p 268	
Oil and Grease	Std p 254	
Total Phosphorus	EPA p 249	
Total Aluminum	EPA p 92	
Total Arsenic	Std p 62	
Total Cadmium	EPA p 101	
Total Chromium	EPA p 105	
Total Copper	EPA p 108	
Total Iron	EPA p 110	
Total Lead	EPA p 112	
Total Manganese	EPA p 116	
Total Mercury	EPA p 118	
Total Nickel	EPA p 141	
Total Selenium	Atomic absorption	
Total Zinc	EPA p 155	1
Total Dissolved Solids	EPA p 266	
Total Calcium	EPA p 103	
Total Magnesium	EPA p 114	
Total Sodium	EPA p 147	
Total Potassium	EPA p 143	
Phenolphthalein Acidity	EPA p 1	
Total Hardness	Std p 179 (calculation)	
Bicarbonate	Std p 370	
Carbonate	Std p 370	
Hydroxide	Std p 370	
Chloride	ASTM '73, p 273	
Sulfate	Std p 334	
Nitrate	EPA p 197	
Carbon Dioxide	Std p 92	
Dissolved Silica	Std p 303	
Color	Std p 160	
Turbidity	EPA p 295	

a) In the above table "Std" means Standard Methods for the Examination of Water and Waste Water, 13th Edition, 1971; "EPA" means Methods for Chemical Analysis of Water and Wastes, 1974, Environmental Protection Agency, Methods Development and Quality Assurance Research Laboratory, Cincinnati, Ohio; "ASTM '73" means Annual Book of Standards, Part 23, Water, Atmospheric Analysis, 1973.

b) Determined at time of sample collection.

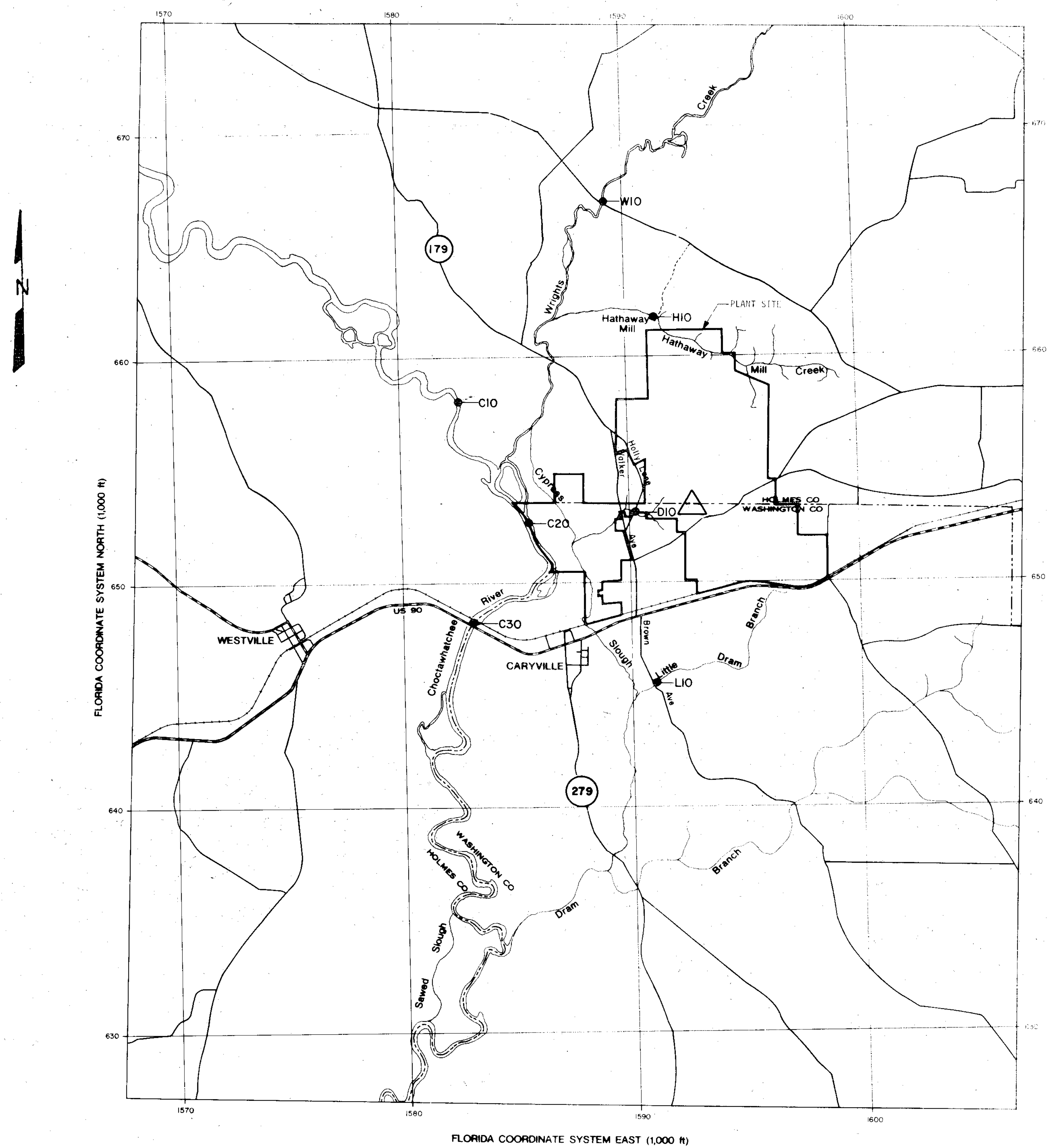
6.2.3 References

(1) Environmental Protection Agency Effluent Guidelines and Standards for Steam Electric Power Generating Point Source Category, 40 CFR 423, 39 FR 36186, October 8, 1974, Effective November 7, 1974; 40 FR 7095, February 19, 1975. 1

(2) Florida Rules of Pollution of Waters, Chapter 17-3, Rules of the Florida Department of Pollution Control, Section 17-3.04.

(3) Ibid., Section 17-3.05.

(4) Authorization to Discharge Under the National Pollutant Discharge Elimination System, EPA Form 3320-4 (10-73).



LEGEND:

W10 WRIGHTS CREEK
H10 HATHAWAY MILL CREEK
C10 CHOCTAWHATCHEE RIVER NORTH
D10 DETENTION POND DRAINAGE DITCH
C20 CHOCTAWHATCHEE RIVER
C30 CHOCTAWHATCHEE RIVER SOUTH
L10 LITTLE DRAM BRANCH
△ CARYVILLE PLANT SITE

NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

0 1 MILE
SCALE

Amendment 2 8/75
Amendment 1 6/75

GULF POWER CO.
CARYVILLE STEAM PLANT

SURFACE WATER PHYSICAL AND CHEMICAL MONITORING LOCATIONS

FIGURE 6.2-1

6.3

6.3 Ecological Parameters

6.3.1 Terrestrial Ecology Methods

6.3.1.1 General - Gulf conducted its initial ecology studies of the proposed site by studying the following sources of information:

A. aerial photographic prints, including black and white (1:500 scale) and infrared (1:5,000 scale),

B. U. S. Geological survey maps of the 7 and 1/2-minute topographic series,

C. general arrangement map illustrating layout of the proposed plant and associated survey contours, and

D. engineering schedules of site clearing and grubbing activities.

Transparencies of the details of general arrangements were prepared for purposes of overlay on aerial photographs. Those systems most likely to be impacted were scheduled for a ground truth survey study in the same sequence as the engineering activities and aerial photographs were studied for the purpose of outlining those vegetational communities lying in the path of future construction. This technique allowed a visual display of those communities to be impacted by power plant siting. Gulf then broke construction activities and layout into subsystems for convenience. For example, communities within the area affected by clearing and grubbing prior to construction of offices and warehouses were scheduled initially for study. Plots were then established for purposes of developing ground truth survey information. The number of plots assigned to a given area was determined by the magnitude of the proposed construction activiity in terms of the extent, homogeneity and type of vegetational communities, and physical features of the area, including relief. In certain instances, transect lines were established for purposes of developing information for layout alternatives. However, these were confined to activities outside the plant island. This included impact for layout of intake and discharge canal rights-of-way and for layout of the railroad right-of-way. Other plots were established where associated activities were planned which could potentially result in ecological effects. This included laying out of plots in areas designated for test wells where future pump tests would be performed. In addition, other plots were established in ecological subsystems where aerial and topographic observation did not indicate natural differences to exist. These differences were observed during the course of survey work on site. This included locating plots in depression areas (hydric systems), especially where certain of these were locally higher than those in surrounding or adjacent areas. Also included in this category were plots located along drainage contours.

During the ground truth survey of assigned plots, Gulf recorded its observations of potential relationships to physical systems and included such factors as seepage in an area, limestone outcropping, direction of slope, relative moisture conditions of the soil, and leaf litter accumulation on the soil surface. In instances where plots were placed in swamp areas or depressions, additional observations and measurements were made including water depth, leaf litter layer thickness, and type of inorganic substrate. Water chemistry and other related physical parameters which were determined included pH, conductivity, dissolved oxygen, and staff gauging to monitor water level fluctuations.

6.3.1.2 Field Reference and Location of Plots - Gulf divided the proposed site into 1,000 foot square plots following the Florida grid system and assigned each 1,000 foot square quadrat a number both for convenience and for accuracy as follows: beginning with the quadrat bordered by N-661,000; N-662,000 and E-1,588,000; E-1,589,000 as quadrat number one, the remaining quadrats were numbered sequentially in an easterly direction for a total of 11 quadrats. Quadrat number 12 was the next quadrat directly south of quadrat one, etc. This numbering system was continued until a total of 145 quadrats had been plotted. (See figure 2.7-6.)

Plant voucher specimens have been collected of each new taxa when first encountered. These were pressed, dried, mounted, and identified (2, 3, 4).

6.3.1.2.1 Vegetational Sampling - Once a suitable community stand had been chosen, Gulf established a number of sample plots and selected starting points at random. The overall plot was run, however, at as nearly a constant topographic elevation as possible to ensure that it represented a single physiographic situation. These plots were 10 meters by 10 meters and of variable number as discussed below.

6.3.1.2.2 Species/Area Curves - The average number of vegetational species per unit area is a measure of biological diversity. In addition, development of species/area curves for a given community type allows a minimum sample size to be established. In practice, this information is necessary to ensure an adequate inventory of species. Therefore, plot numbers above were increased until the species/area curve flattened out. Species/area curves established for various community types are shown in figures 6.3-1 through -9.

6.3.1.2.3 Tree Component - Gulf recorded woody plants with a diameter breast high (dbh) of one inch or greater as trees. Two 10 meter by 10 meter quadrats were established and analyzed at each sample plot. (These figures indicate the minimum number of samples.)

Estimated crown size and dbh were determined and recorded. In addition, the age of selected trees was determined using a tree borer and the same trees were measured for height using an abney level (5).

6.3.1.2.4 Shrubs and Small Tree Components - Woody plants one meter or more in height and less than one inch dbh were recorded in two categories: shrubs and small trees.

Three one meter by ten meter quadrats were established and analyzed at each sample plot. These quadrats fell within the two 10 meter by 10 meter tree quadrats. (These figures indicate the minimum number of samples.)

Occurence, height, and estimated crown cover were determined and recorded (6).

6.3.1.2.5 Herbs and Grass Components - Woody plants less than one meter in height and herbaceous plants were recorded in the category of herbs and grasses. Five one meter by one meter quadrats were established and analyzed at each sample plot. (These figures indicate the minimum number of samples.) Occurrence, height, and estimated percent cover were recorded by species.

6.3.1.2.6 Ground Cover Component - Mosses, lichens, grasses, and litter were recorded as ground cover. Within the five one meter by one meter quadrats, estimates of percent ground cover were made and recorded for the above plants when applicable.

6.3.1.2.7 Diversity Indices - Gulf employed various diversity indices derived from information theory in its analysis of vegetational data structure (7) and, in addition, employed diversity (8). Each index is given below and defined briefly:

A. H - the calculated diversity of a sample employing the Shannon-Weiner function, $H_{(s)}$, which is

$$H_{(s)} = \sum_{r=1}^{s} P_i \log P_i,$$

where s is the total number of species in a sample and P_i is the observed proportion of individuals that belongs to the rth species.

B. H_{max} - the maximum theoretical diversity for a sample obtained when individuals are equally apportioned among species.

C. H_{min} - the minimum theoretical diversity for a sample obtained when individuals are apportioned such that all species except one contain one individual and the final species contain the remainder of the individuals.

D. $\hat{H}$ - the evenness index $\left(\frac{\bar{H}}{H_{max}}\right)$. This index obtains a maximum of unity where individuals are equally apportioned among species. It approaches 0 when $\bar{H}$ approaches Hmin. (9).

E. R - redundancy, which is an expression of the dominance of one or more species and is inversely proportional to the wealth of species. This measure is given by the equation, $R = \frac{H_{max} - H}{H_{max} - H_{min}}$

F. D - diversity (8). The equation is $D = \frac{(D - 1)}{\log_e N}$ where s is the total number of species and N is the total number of individuals in the sample.

A computer program was developed for implementation on a Control Data Corporation (CDC) Model No. 6400 computer for purposes of calculating each index.

6.3.1.2.8 Importance Values - In summarizing and interpreting the data, the values of density, dominance, and frequency were determined for each taxa within a vegetational community type. Density refers to the number of individuals per unit area; dominance and frequency values are determined for each taxa within a vegetational community type. Whereas density refers to the number of individuals per unit area, frequency also refers to the fraction of sample plots containing the species. Thus for each species of the major community types, these values are expressed both in absolute form and in relative form, i.e., the percentage that the species value is of the total for all species. Importance Values are determined by combining the relative values for density, dominance, and frequency. These vegetational methods are determined using the following formulae:

A. Density = Den. = $\frac{\text{Number of Individuals}}{\text{Area Sampled}}$

B. Relative Density = R. Den. = $\frac{\text{Density For A Taxa}}{\text{Total Density for all Taxa}} \times 100$

C. Dominance = Dom. = $\frac{\text{Total of Basal Area or Areal Coverage Values}}{\text{Area Sampled}}$

D. Relative Dominance = R. Dom. = $\frac{\text{Dominance For A Taxa}}{\text{Total Dominance For All Taxa}} \times 100$

E. Frequency = Freq. = $\frac{\text{Number of Plots In Which Taxa Occurs}}{\text{Total Number of Plots Sampled}}$

F. Relative Frequency = R. Freq. = $\frac{\text{Frequency Value For A Taxa}}{\text{Total of Frequency Values for All Taxa}}$

G. Importance Value = Imp. Val. = $\frac{\text{Relative Density + Relative Dominance + Relative Frequency}}{\text{Three}}$

6.3.1.2.9 Idealized Vegetational Profiles - Idealized vegetational profiles were prepared using transect studies, photographs, importance values, and onsite descriptions (10).

6.3.1.3 Wildlife Methods - Gulf's survey of birds, reptiles, amphibians, and mammals was conducted within quadrants and major community types either in conjunction with or prior to vegetational surveys.

Methods employed were principally of a qualitative nature to expedite the location and habitats of rare, endangered, and/or protected species within the immediate site boundaries. Qualitative surveys consisted of observations, hand captures, random live trapping, and reporting by local residents.

To exhibit the degree of net primary productivity of major vegetational communities, an attempt was made to determine relative abundance of secondary and tertiary consumers through quantification of mammal populations. Mammals were chosen to exhibit this relationship because (a) they exhibit a higher degree of intelligence than birds, reptiles, or amphibians, (b) they generally do not migrate unless under extreme environmental stress, and (c) they remain relatively active throughout the year.

Observations and identifications of birds were performed daily while passing through various communities either within or outside the study area (11). Species sighted and the type of community in which it was observed was recorded. Mist nets were also employed in selected areas within the study area. (Mist nets are made of a fine black netting much like a hair net. They are 30 feet long and 7 feet deep, resembling a very light gill net.) Two mesh sizes of mist nets were used: 1 and 1/2 inch and 2 and 3/8 inch. Mist nets are placed over water or between rows of vegetation where birds are likely to fly. Advantages of a mist net are positive identification of obscure, hard-to-observe species and the captured bird is little harmed when attended to promptly. (Mist nets were employed at peak activity of most birds: sunrise and sunset.)

Gulf's reptile and amphibian surveys were performed on a daily basis while working in or passing through various communities in or around the immediate site boundaries, particularly around ecotones and bayhead areas. Logs and associated debris were overturned in search of organisms. Small standing bodies of water were netted with an aquatic D-frame net for amphibians. Captured specimens were identified and either photographed or preserved for future reference and vouchers (12, 13, 14). Accessible roads were also driven at night in order to capture nocturnal species crossing over them, particularly after an afternoon of rain. Paved roads are especially suited for night captures because they retain the heat of the day. Reptiles and amphibians, being ectothermic, tend to seek relief from the cool dampness of a rainy night by moving onto the warm pavement. Road kills were also examined when sighted.

Mammals were surveyed in the same locale as vegetational plots. Qualitative surveys consisted of setting traps at random within a community type. Standard 50 meter by 50 meter grids were selected for quantifying small mammal populations because of the extent and/or habitat complexity of major communities surveyed. The standard grid consisted of six parallel columns, each 10 meters apart, and six perpendicular rows, 10 meters apart. The area encompassed by this grid was 0.25 hectares. The intersection of each grid line was marked with surveyor's tape and constituted a trap station. A total of 36 stations were located at 10 meter intervals within each grid. One Sherman live trap (nine inches by three inches by three and one-half inches) was placed at each trap station. Each trap was baited with oatmeal and/or cracked corn. Each evening of a survey period, traps were set, baited, and left overnight and checked early the following morning. Small mammals trapped during the night were marked by toe clipping and released in order to identify subsequent recapture of individuals during the survey period. Records were kept on sex, weight, date of capture, and station of initial capture, as well as all subsequent recapture dates and stations. In addition to the small live trap grid, from four to 15 medium (26 inch by 10 inch by 10 inch) and large (32 inch by 10 and one-half inch by 13 inch) Tomahawk mammal traps were deployed at approximately 50 meter intervals in the area adjacent to the small mammal grid. These medium and large mammal traps were baited with several combinations of bait including cracked corn, dog and cat food, and sardines. These traps were set and baited concurrently with the small mammal live traps to capture medium sized animals such as oppossums, raccoons, bobcats, etc. Identical records, i.e., sex, weight, toe clipping, etc. were kept for all medium sized mammals captured. There was a minimum of 108 trap nights, i.e., number of traps set and baited multiplied by the number of nights of the survey period, in each live trapping survey. Results were recorded as the number of individuals of a particular species per number of trap nights in a surveying period. In one small mammal quantification study, a 50 meter by 40 meter grid was employed (30 trap stations at 10 meter intervals). This deviation from the standard 50 meter by 50 meter grid was a direct result of the extent of the particular community type surveyed. Notes were taken on tracks, scat, and road kills when encountered in each major community. Predator calling was also performed at night. Mammals collected and/or observed during the survey were identified (14, 15).

6.3.1.4 Water Chemistry - Water chemistry parameters of pH, dissolved oxygen, and conductivity were measured (16).

6.3.1.5 Area Ornithological Studies - This study consisted of four distinct parts: (a) a road transect survey of resident and migratory birds, (b) area counts of the entire area of special habitats, (c) an aerial survey for wading-bird nesting colonies and for eagle and osprey nests, and (d) a ground reconnaissance of habitats of possibly endangered species (17). 1

The road transect survey was patterned after the Federal Breeding Birds Survey Sheet shown as table 2.7-13. A 25-mile long road transect was

established including usable roads on the proposed plant site and roads adjacent to the plant site. Fifty stops were established along the 25 mile transect at one-half mile increments. The survey was started at dawn with stops made at each station for three minute periods. All birds seen and heard at each stop were recorded.

Area counts permitted the counting of birds in the best habitats and permitted searching for elusive species. Area counts were timed to present a time/ density population.

The aerial survey was conducted within a 26 to 30 mile radius of the site. Observations are recorded on figure 2.762.

Reconnaissance sampling occurred during two time periods: (a) from July 26 to July 28, 1974, and (b) from August 29 to September 6, 1974. These two sampling periods are presented below as Report Number 1 and Report Number 2, respectively.

6.3.1.5.1 Report Number 1: Proposed Plant Site Area - On July 26, 1974, an aerial survey was made for wading bird colonies in the local area. (See figure 2.7-62.) On July 27, 1974, the aerial survey was continued in the area inside a 25 mile radius of Caryville. This survey was a systematic search for wading bird colonies and any possible eagle or osprey nests. (No eagle or osprey nests were found.) Also on July 27, 1974, the northern part of the proposed plant area along Florida Highway No. 173 was surveyed by car. On July 28, 1974, the southern and western side of the proposed plant site were surveyed by car. Some roads internal to the plant area were then surveyed with the idea of relating the aerial and ground appearances of the area.

6.3.1.5.2 Report Number 2: Proposed Plant Site - Studies were conducted from August 29 to September 6, 1974, along the road transect described previously. The route was not randomly designed, but was chosen to use the roads through and adjacent to the plant site area. Figure 2.7-63 shows the route and gives a description of the stops designed to obtain uniformity in using the route.

At each stop, all birds seen and/or heard during a three minute period were recorded. Raw data were added to bird population station field sheets and tabulated on a summary sheet. (See table 6.3-1, and see table 2.7A-1 in Section 1 of Appendix D.) Species individual totals and time/ density population estimates were then made. Bird studies also include area counts made for individual parts of the study area and for the general area. These data were recorded on checklist forms and species composition and densities were determined. 2

6.3.2 Regional and Site Specific Aquatic Ecology Methods

This subsection discusses the methods used by both the U.S. Fish and Wildlife Service and by Gulf in the development of baseline aquatic data for the

Caryville steam plant. As presented in subsection 2.7.2, "Regional and Site Specific Aquatic Ecology," the baseline aquatic data includes fish, benthic invertebrates, and periphyton.

6.3.2.1 Fishery Studies - The U. S. Fish and Wildlife Service has established sampling stations in both the Choctawhatchee Bay and Choctawatchee River as shown in figure 2.7-64. Two of these sampling stations encompass the proposed intake and discharge areas: (a) in the river near its confluence with Wrights Creek, which is above the intake/discharge area, and (b) in the river near U. S. Highway No. 90 bridge, which is below the intake/discharge area. Data from these stations were available in field note form (personal communication and reference 18).

The following describes the sampling methods used by the Fish and Wildlife Service to gather fishery data and the methods used by Gulf for data analysis.

6.3.2.1.1 Sampling Methods - The fish populations were sampled by the U. S. Fish and Wildlife Service initially by making 15-foot seine hauls (19). The sampling technique was changed to electroshocking by boat, which is a superior method in situations where qualitative as well as quantitative data are desired (20). The ground cables were two to four feet in length with five pounds of lead attached to the terminal ends. Shocking was conducted for 30 minutes per station at 850 volts dc, five amps with a pulse width of six milliseconds, and an output mode of 120 pulses per second. 1

6.3.2.1.2 Data Analysis - Fish population data obtained from the U. S. Fish and Wildlife Service were averaged on a seasonal basis. This provided consistency of time intervals with sampling data for other biological parameters (benthos and periphyton); monthly samples could be used for replicate samples within the season.

Four basic parameters relevant to the biological assessment of water quality conditions were used (20) in describing fish populations above and below the proposed plant site area. The four parameters were (a) species diversity ($\overline{D}$) (21), (b) standing crop in terms of total number and wet weight, (c) species composition in terms of percent by number and wet weight for each species as well as taxonomic groups (Family), and (d) the coefficient of condition (K). The total length (TL) method was used for measurement of the fish. Since the weight of the fish varies with the cube of its length, provided the shape and specific gravity remain the same, any change in the shape or relative plumpness of the fish will cause a change in the value of c in the following formula: $W = cL^3$. Fishery biologists have used this fact in describing the condition of plumpness, or well-being, of a fish. The coefficient of condition, K, is thus computed as:

$$K = \frac{W \times 10^5}{L^3}$$

where W = weight in grams, L = length in millimeters, and 10^5 = a factor to bring the value of K near unity (22).

6.3.2.2 Macroscopic Benthic Invertebrate Studies - Randomized sampling with regard to current speed and type of substrate is impracticable in that it requires the collection of a large number of replicate samples to obtain representative results. Consistency of sampling methods and techniques is the prerequisite to comparing benthic populations found in one area with those of another. Sampling of benthic populations was conducted from August 1 to August 29, 1974, at each of the nine sampling stations shown in figure 2.7-64. Due to the physical character of the Choctawatchee River adjacent to the proposed plant site area, artificial substrates were used. The advantages to this approach are given in reference 20.

6.3.2.2.1 Sampling Methods - The artificial substrates were constructed of tempered masonite (23). Each multiple-plate sampler consisted of nine, three by three by one-eighth inch masonite plates, each plate separated from the adjoining one by a one-fourth by one inch diameter rubber washer, and all plates and washers connected by a brass nut and bolt through the center. Each sampler provides a surface area of one square foot and is suspended with the plates vertical to the stream bed to reduce silt build-up (24).

During the period August 1 to August 29, 1974, two multiple-plate samplers were placed at each sampling station. The locations were selected to allow the plates to be placed approximately six inches above the stream bed in four feet of water. A Gurley current-velocity meter was used in choosing each of the stations. The velocity recorded at each station was approximately 0.5 feet per
second. 1

Samplers were suspended from submerged wooden stakes which had been driven into the river bed and sawed off approximately two feet above the bottom. To ensure quick location and retrieval, a marker stake was driven into the stream bank and connected to the submerged stake with a nylon line. Further location of the stakes was made by triangulation and marking shoreline trees lined up with each stake.

After a 30-day interval, samplers were retrieved and placed in drawstring cotton bags. Samplers were preserved in 10 percent formalin for later sorting and examination. Prior to examination, the samplers were rinsed of their formalin preservative through a number 30 mesh sieve, sorted from debris in a white enamel tray with the aid of a desk model illuminated magnifier, and placed in taged sample vials. Following identification and counting, samples were placed on blotting paper for five minutes prior to weighing. Numerous taxonomic keys were used for identification (25 through 37). In addition, where identifications were questionable, specimens were sent to specialists for verification (38, 39).

As part of the benthic population sampling, snails and mussels were collected in the Choctawhatchee River at stations C1 through C4 shown on figure 2.7-64. The sampling was conducted by making two, 50-yard dredges per station with a Wildco model 175 biological net dredge (number one mesh with a 10 by 18 inch opening). Dredge hauls were made parallel to sand bars at depths of 18 to 24

inches in areas where water flow velocities were between 0.5 and 1.0 feet per second. The data are presented in table 2.7-24.

6.3.2.2.2 Data Analysis - To assess water quality conditions using the benthic population data, the following were determined: (a) total number of species (kinds), (b) total number of animals per unit area, (c) total number of each species of animal per unit area (species composition), and (d) total wet weight of organisms per unit area.

In addition to evaluating the above data, species diversity ($\bar{D}$) was calculated as follows:

$$\bar{D} = \frac{C}{N} (N \log_{10} N - \sum n_i \log_{10} n_i)$$

were n_i = number of each species, N = total number of organisms, and C = conversion factor, 3.321928, to convert $\log_{10}$ to $\log_2$. The Shannon-Weaver function and the machine formula were used (40).

Species diversity, as calculated above, is affected by both number of species and distribution of individuals among the species. A healthy, stable community would have a higher species diversity value than a less stable one.

Average values of biological parameters, established for each of the nine sampling stations, were derived from two replicate samples. Such derived values are representative if the variance about the mean does not exceed 25 percent coefficient of the variance (41). 1

6.3.2.3 Periphyton Studies

6.3.2.3.1 Sampling Methods - Two standard, plain, 25 by 75 millimeter glass microscope slides were suspended in a vertical position alongside the multiple-plate samplers referenced in 6.3.2.2 above. The slides remained in position during the period August 1 to August 29, 1974. One slide from each station was scraped of the attached algal growth with a razor blade into a sample bottle containing 100 milliters of Merthiolate preservative.

6.3.2.3.2 Data Analysis - Qualitative (taxonomic) determinations were made with a binocular microscope fitted with a Whipple occular micrometer set at 800 power magnification. Two taxonomic keys were primarily used (42,43). A reference list of species and a relative abundance was obtained by sending a composite sample to an algological specialist (44).

Quantitative cell counts were determined by placing the sample water in a nannoplankton counting cell (45), and examining 20 fields at 200 power magnification. All algal cells, including nannoplankton of less than five microns, were counted and reported as total number of cells per milliliter of water, as well as the number of each species per milliliter of water (46). The physical size or area occupied by algal populations is an important aspect in evaluating data (47). Population size was given in terms of the number of

areal standard units per milliliter of water, where one areal unit is equal to 400 square microns. The value was derived by determining the average size of each species multiplied by the total number of cells and by each species, calculated for one milliliter of water (46). Data were determined on percent composition by both number and areal units of major algal groups. (See table 2.7-25.)

6.3.3 Methods Used in the Transmission Line Corridor Study

Major terrestrial ecosystems to be traversed by the proposed transmission line corridor were determined by the following three methods:

A. Literature study of the region.

B. Relating information previously developed in aerial photo and detailed ground truth survey study of the proposed power plant site to aerial photo and topographic map study of the proposed transmission line corridor. Refer to subsection 2.7.1.2, "Rationale of Approval." 2

C. Low-level, flyover reconnaissance of the proposed corridor route.

6.3.3.1 Corridor Zone Studied - A corridor zone 0.5 mile wide was analyzed. This width was used to allow flexibility in the evaluation of alternatives for avoiding potentially sensitive areas along the proposed transmission line corridor route. The actual new corridor width will vary between 75 and 330 feet.

6.3.3.2 Aerial Photograph and Map - Aerial photographic study was performed on U. S. Department of Agriculture mosaic photographs of 1:12,000 scale. Map study was performed using U. S. Geological Survey quadrangle maps which included 1:24,000 and 1:62,500 scales.

6.3.3.3 Soils - Potential erosion-prone areas were defined using soil maps, ratings, and use limitations (48).

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TABLE 6.3-1

BIRD POPULATION STATION FIELD SHEETS

FIELD SHEET, BREEDING BIRD SURVEY

PROV. STATE: Fla. ROUTE NO.: ROUTE NAME: Caryville Plant Site DATE: 9 (Mo) 2 (Day) 74 (Year) PAGE: 1

Starting Time: 6:16 Ending Time: :

STOP NUMBER	1	2	3	4	5	6	7	8	9	10	TOTAL
TIME											
SPEEDOMETER											
BROWN PELICAN											
GREAT BLUE HERON											
GREEN HERON											
LITTLE BLUE HERON											
CATTLE EGRET		1								1	2
COMMON EGRET											
HERON											
IBIS											
DUCK											
TURKEY VULTURE											
BLACK VULTURE											
KITE											
RED-SHOULDER HAWK										1	1
BROAD-WG. HAWK											
HAWK											
OSPREY											
BOBWHITE		2		1			1	2		1	7
TURKEY											
SANDHILL CRANE											
RAIL											
GALLINULE											
KILLDEER											
WILLET											
SANDPIPER											
LAUGHING GULL											
GULL											
LEAST TERN											
TERN											
BLACK SKIMMER											
ROCK DOVE											
MOURNING DOVE		3	4		1	1	2		2	8	21
GROUND DOVE										8	8
YEL-BILLED CUCKOO					1						1
OWL											
CHUCK-WILL'S-WIDOW											
WHIP-POOR-WILL											
COMMON NIGHTHAWK											
CHIMNEY SWIFT		2									2
RUBY-THR. HUM'NGBD											
BELTED KINGFISHER											
YEL-SHAFTED FLICKER		1			1	1	1	1		1	6
PILEATED WOODPECKR										1	- 1
RED-BELLIED WOODP'R		1	2	1	1	2	2	1			10
RED-HD. WOODPECKER											
HAIRY WOODPECKER											
DOWNY WOODPECKER											
RED-COCKADED WDP'R											
E. KINGBIRD											
GT. CREST FLYCATCHER											
E. PHOEBE											
ACADIAN FLYCATCHER											
E. WOOD PEWEE											
ROUGH-WG. SWALLOW											
BARN SWALLOW									2		2
SWALLOW											
PURPLE MARTIN				1							1
BLUE JAY	6	3	4	4	5	3	6	2	3		36
COMMON CROW		2	3	1			2	3	1	2	14
FISH CROW											
CAROLINA CHICKADEE											
TUFTED TITMOUSE		2							2		4

STOP NUMBER	1	2	3	4	5	6	7	8	9	10	TOTAL
WHITE-BR. NUTHATCH											
BRN-HD. NUTHATCH											
HOUSE WREN											
CAROLINA WREN	1		4	4	1	4	2	1	1	1	19
WREN											
MOCKINGBIRD		1					4		4	3	12
CATBIRD											
BROWN THRASHER						1					1
ROBIN		1									1
WOOD THRUSH											
E. BLUEBIRD											
BLUE-GR. GNATCATCHER											
LOGGERHEAD SHRIKE		1				1				1	3
STARLING											
WHITE-EYED VIREO			1								1
YEL-THR. VIREO											
RED-EYED VIREO											
BLK-AND-WHT. WARB											
PROTHONOTARY WARB											
WORM-EATING WARB											
BLUE-WG. WARBLER											
PARULA WARBLER											
YELLOW WARBLER											
BLK-THR. GREEN WARB											
YEL-THR. WARBLER											
PINE WARBLER			1					1			2
PRAIRIE WARBLER											
OVENBIRD											
LA. WATERTHRUSH											
KENTUCKY WARBLER											
YELLOWTHROAT							1				1
YELLOW-BR. CHAT											
HOODED WARBLER											
AMERICAN REDSTART											
HOUSE SPARROW											
E. MEADOWLARK											
RED-WG. BLACKBIRD		2									2
ORCHARD ORIOLE											
BALTIMORE ORIOLE											
BOAT-TAIL GRACKLE											
COMMON GRACKLE		8	4	1				2		10	25
BROWN-HD. COWBIRD											
SCARLET TANAGER											
SUMMER TANAGER											
CARDINAL	1							2	1	3	7
BLUE GROSBEAK											
INDIGO BUNTING											
PAINTED BUNTING											
DICKCISSEL											
AM. GOLDFINCH											
RUFOUS-SIDED TOWHEE	2	2	2				1	2		2	11
GRASSHOPPER SPARROW											
BACHMAN'S SPARROW											
CHIPPING SPARROW											
FIELD SPARROW											
SONG SPARROW											

1

Form 3-3a (March 1969)

TABLE 6.3-1 (Continued)

FIELD SHEET, BREEDING BIRD SURVEY

PROV. STATE: Fla. ROUTE NO.: ROUTE NAME: Caryville Plant Site DATE: 9 2 74 (Mo Day Year) PAGE: 2

Starting Time: : Ending Time: :

STOP NUMBER	11	12	13	14	15	16	17	18	19	20	TOTAL
TIME											
SPEEDOMETER											
PIED-BILLED GREBE											
BROWN PELICAN											
DBL-CR. CORMORANT											
ANHINGA		1									1
GT. BLUE HERON										1	1
GREEN HERON											
LITTLE BLUE HERON											
CATTLE EGRET	1	2									3
COMMON EGRET											
HERON											
WHITE IBIS		5									5
DUCK											
TURKEY VULTURE											
BLACK VULTURE											
RED-TAILED HAWK											
RED-SHOULDER HAWK											
BROAD-WG. HAWK											
HAWK											
OSPREY											
BOBWHITE			5	3							8
TURKEY											
SANDHILL CRANE											
RAIL											
GALLINULE											
KILLDEER											
WILLET											
LAUGHING GULL											
LEAST TERN											
ROYAL TERN											
ROCK DOVE											
MOURNING DOVE	1	3		2	1	1	1		1		10
GROUND DOVE	1		2								3
YEL-BILLED CUCKOO											
GT. HORNED OWL											
BARRED OWL											
CHUCK-WILL'S-WIDOW											
WHIP-POOR-WILL											
COMMON NIGHTHAWK											
CHIMNEY SWIFT									16		16
RUBY-THR. HUM'NBD											
BELTED KINGFISHER											
YEL-SHAFTED FLICKER											
PILEATED WOODPECKER											
RED-BILLIED WOODP'R	1	1		2	3						7
RED-HD. WOODPECKER		1									1
HAIRY WOODPECKER											
DOWNY WOODPECKER		2			1						3
RED-COCKADED WDP'R											
E. KINGBIRD											
GT. CREST FLYCATCHER											
E. PHOEBE											
ACADIAN FLYCATCHER											
E. WOOD PEWEE											
HORNED LARK											
ROUGH-WG. SWALLOW											
BARN SWALLOW											
PURPLE MARTIN											
BLUE JAY	3	3	4	4	6	4				3	27
COMMON CROW	6	3				1	1		1	2	14

STOP NUMBER	11	12	13	14	15	16	17	18	19	20	TOTAL
FISH CROW			1								1
CAROLINA CHICKADEE		3							5		8
TUFTED TITMOUSE									2		2
WHITE-BR. NUTHATCH											
BROWN-HD. NUTHATCH		5							3		8
HOUSE WREN											
CAROLINA WREN		1	1		1				1		4
WREN											
MOCKINGBIRD	8	1	2			2					13
CATBIRD											
BROWN THRASHER	1		1								2
ROBIN											
WOOD THRUSH											
E. BLUEBIRD											
BL-GR. GNATCATCHER											
LOGGERHEAD SHRIKE	1	1		2	1	2					7
STARLING											
WHITE-EYED VIREO				2					1	1	4
YELLOW-THR. VIREO									1		1
RED-EYED VIREO											
BLK-&-WHT WARBLER											
PROTHONOTARY WARB											
WORM-EATING WARB											
BLUE-WG. WARBLER											
PARULA WARBLER									3		3
YELLOW WARBLER											
BLK-THR. GREEN WARB											
YELLOW-THR. WARB											
PINE WARBLER										2	2
PRAIRIE WARBLER											
OVENBIRD											
LA. WATERTHRUSH											
KENTUCKY WARBLER											
YELLOWTHROAT											
YELLOW-BR. CHAT											
HOODED WARBLER											
AM. REDSTART											
HOUSE SPARROW											
E. MEADOWLARK											
RED-WG. BLACKBIRD											
ORCHARD ORIOLE											
BALTIMORE ORIOLE											
BOAT-TAIL GRACKLE											
COMMON GRACKLE											
BROWN-HD. COWBIRD											
SCARLET TANAGER											
SUMMER TANAGER				1							1
CARDINAL	2		2	2	2		1		1	1	11
BLUE GROSBEAK											
INDIGO BUNTING											
PAINTED BUNTING											
DICKCISSEL											
AM. GOLDFINCH											
RUFOUS-SIDE TOWHEE			3	2	2	1					8
GRASSHOPPER SPARROW											
BACHMAN'S SPARROW											
CHIPPING SPARROW											
FIELD SPARROW											
SONG SPARROW											

Form 3-1a (1972)

1

TABLE 6.3-1 (Continued)

FIELD SHEET, BREEDING BIRD SURVEY

PROV. STATE: Fla. ROUTE NO.: ROUTE NAME: Caryville Plant Site DATE: 9 2 74 (Mo Day Year) PAGE: 3

Starting Time: : Ending Time: :

STOP NUMBER	21	22	23	24	25	26	27	28	29	30	total
TIME											
SPEEDOMETER											
PIED-BILLED GREBE											
BROWN PELICAN											
DBL-CR. CORMORANT											
ANHINGA											
GT. BLUE HERON											
GREEN HERON											
LITTLE BLUE HERON											
CATTLE EGRET					4	3					7
COMMON EGRET											
HERON											
WHITE IBIS											
DUCK											
TURKEY VULTURE											
BLACK VULTURE											
RED-TAILED HAWK											
RED-SHOULDER HAWK											
BROAD-WG. HAWK											
HAWK											
OSPREY											
BOBWHITE											
TURKEY											
SANDHILL CRANE											
RAIL											
GALLINULE											
KILLDEER											
WILLET											
LAUGHING GULL											
LEAST TERN											
ROYAL TERN											
ROCK DOVE											
MOURNING DOVE			1	1	2		3		1	2	10
GROUND DOVE						2	1				3
YEL-BILLED CUCKOO				2	1						3
GT. HORNED OWL											
BARRED OWL											
CHUCK-WILL'S-WIDOW											
WHIP-POOR-WILL											
COMMON NIGHTHAWK											
CHIMNEY SWIFT									1		1
RUBY-THR. HUM'NBD.											
BELTED KINGFISHER											
YEL-SHAFTED FLICKER											
PILEATED WOODPECKER											
RED-BILLIED WOODP'R											
RED-HD. WOODPECKER											
HAIRY WOODPECKER											
DOWNY WOODPECKER											
RED-COCKADED WDP'R											
E. KINGBIRD											
GT. CREST FLYCATCHER	1				1						2
E. PHOEBE											
ACADIAN FLYCATCHER											
E. WOOD PEWEE											
HORNED LARK											
ROUGH-WG. SWALLOW											
BARN SWALLOW											
PURPLE MARTIN											
BLUE JAY		6	2	3	2	1	3	3	2	1	23
COMMON CROW	1	3		6		1	3	2	2	2	20

STOP NUMBER	21	22	23	24	25	26	27	28	29	30	total
FISH CROW		2									2
CAROLINA CHICKADEE											
TUFTED TITMOUSE					1						1
WHITE-BR. NUTHATCH											
BROWN-HD. NUTHATCH						3					3
HOUSE WREN											
CAROLINA WREN		1		2		2					5
WREN											
MOCKINGBIRD						1	2	2			5
CATBIRD											
BROWN THRASHER											
ROBIN											
WOOD THRUSH											
E. BLUEBIRD											
BL-GR. GNATCATCHER											
LOGGERHEAD SHRIKE		1	1				1				3
STARLING											
WHITE-EYED VIREO	1		1	2	1				1		6
YELLOW-THR. VIREO											
RED-EYED VIREO											
BLK-&-WHT WARBLER											
PROTHONOTARY WARB											
WORM-EATING WARB											
BLUE-WG. WARBLER											
PARULA WARBLER	1			1							2
YELLOW WARBLER											
BLK-THR. GREEN WARB											
YELLOW-THR. WARB											
PINE WARBLER											
PRAIRIE WARBLER											
OVENBIRD											
LA. WATERTHRUSH											
KENTUCKY WARBLER											
YELLOWTHROAT											
YELLOW-BR. CHAT											
HOODED WARBLER	1										1
AM. REDSTART											
HOUSE SPARROW											
E. MEADOWLARK											
RED-WG. BLACKBIRD											
ORCHARD ORIOLE											
BALTIMORE ORIOLE											
BOAT-TAIL GRACKLE											
COMMON GRACKLE											
BROWN-HD. COWBIRD											
SCARLET TANAGER											
SUMMER TANAGER											
CARDINAL		2	1		3			4	3		13
BLUE GROSBEAK											
INDIGO BUNTING											
PAINTED BUNTING											
DICKCISSEL											
AM. GOLDFINCH											
RUFOUS-SIDE TOWHEE				2							2
GRASSHOPPER SPARROW											
BACHMAN'S SPARROW											
CHIPPING SPARROW											
FIELD SPARROW											
SONG SPARROW											

1

Form 3-3a (1972)

TABLE 6.3-1 (Continued)

FIELD SHEET, BREEDING BIRD SURVEY

PROV. STATE: Fla.   ROUTE NO.: ______   ROUTE NAME: Caryville Plant Site

DATE: 9 (Mo) 2 (Day) 74 (Year)   PAGE: 4

Starting Time: __ : __   Ending Time: __ : __

STOP NUMBER	31	32	33	34	35	36	37	38	39	40	TOTAL
TIME											
SPEEDOMETER											
PIED-BILLED GREBE											
BROWN PELICAN											
DBL-CR. CORMORANT											
ANHINGA											
GT. BLUE HERON											
GREEN HERON											
LITTLE BLUE HERON									8		8
CATTLE EGRET											
COMMON EGRET											
______ HERON											
WHITE IBIS											
______ DUCK											
TURKEY VULTURE				2			2				4
BLACK VULTURE											
RED-TAILED HAWK							2				3
RED-SHOULDER HAWK	1										
BROAD-WG. HAWK											
______ HAWK											
OSPREY					1						1
BOBWHITE											
TURKEY											
SANDHILL CRANE											
______ RAIL											
______ GALLINULE											
KILLDEER											
WILLET											
LAUGHING GULL											
LEAST TERN											
ROYAL TERN											
ROCK DOVE											
MOURNING DOVE			1				6				7
GROUND DOVE	1										1
YEL-BILLED CUCKOO											
GT. HORNED OWL											
BARRED OWL											
CHUCK-WILL'S-WIDOW											
WHIP-POOR-WILL											
COMMON NIGHTHAWK											
CHIMNEY SWIFT											
RUBY-THR. HUM'NBD											
BELTED KINGFISHER											
YEL-SHAFTED FLICKER											
PILEATED WOODPECKER			1		1		1		1		4
RED-BILLIED WOODP'R											
RED-HD. WOODPECKER											
HAIRY WOODPECKER											
DOWNY WOODPECKER											
RED-COCKADED WDP'R											
E. KINGBIRD											
GT. CREST FLYCATCHER											
E. PHOEBE											
ACADIAN FLYCATCHER											
E. WOOD PEWEE											
HORNED LARK											
ROUGH-WG. SWALLOW											
BARN SWALLOW											
PURPLE MARTIN	3		2		4	3	1		4		17
BLUE JAY	6	3	1	1		1		1	1		14
COMMON CROW											
______											
______											
______											

STOP NUMBER	31	32	33	34	35	36	37	38	39	40	total
FISH CROW	1					2					3
CAROLINA CHICKADEE	6										6
TUFTED TITMOUSE											
WHITE-BR. NUTHATCH											
BROWN-HD. NUTHATCH											
HOUSE WREN	1			3	1	3					8
CAROLINA WREN											
______ WREN					1	2	2		3	2	10
MOCKINGBIRD											
CATBIRD											
BROWN THRASHER											
ROBIN											
WOOD THRUSH											
E. BLUEBIRD											
BL-GR. GNATCATCHER											
LOGGERHEAD SHRIKE											
STARLING											1
WHITE-EYED VIREO	1										
YELLOW-THR. VIREO											
RED-EYED VIREO											
BLK-&-WHT WARBLER											
PROTHONOTARY WARB											
WORM-EATING WARB											
BLUE-WG. WARBLER											
PARULA WARBLER											
YELLOW WARBLER											
BLK-THR. GREEN WARB											
YELLOW-THR. WARB											
PINE WARBLER											
PRAIRIE WARBLER											
OVENBIRD											
LA. WATERTHRUSH											
KENTUCKY WARBLER											
YELLOWTHROAT											
YELLOW-BR. CHAT											
HOODED WARBLER											
AM. REDSTART											
HOUSE SPARROW											
E. MEADOWLARK											
RED-WG. BLACKBIRD											
ORCHARD ORIOLE											
BALTIMORE ORIOLE											
BOAT-TAIL GRACKLE					2						2
COMMON GRACKLE											
BROWN-HD. COWBIRD											
SCARLET TANAGER											
SUMMER TANAGER			3	2	1	1			3	1	11
CARDINAL											
BLUE GROSBEAK											
INDIGO BUNTING											
PAINTED BUNTING											
DICKCISSEL											
AM. GOLDFINCH					1			1			2
RUFOUS-SIDE TOWHEE											
GRASSHOPPER SPARROW											
BACHMAN'S SPARROW											
CHIPPING SPARROW											
FIELD SPARROW											
SONG SPARROW											
______											
______											
______											

1

Form 3-3a (1972)

TABLE 6.3-1 (Continued)

FIELD SHEET, BREEDING BIRD SURVEY

PROV. STATE: Fla. ROUTE NO.: ROUTE NAME: Caryville Plant Site DATE: 9 2 74 (Mo Day Year) PAGE: 5

Starting Time: : Ending Time: :

STOP NUMBER	41	42	43	44	45	46	47	48	49	50	TOTAL
TIME											
SPEEDOMETER											
PIED-BILLED GREBE											
BROWN PELICAN											
DBL-CR. CORMORANT											
ANHINGA											
GT. BLUE HERON											
GREEN HERON											
LITTLE BLUE HERON											
CATTLE EGRET					12						12
COMMON EGRET											
HERON											
WHITE IBIS											
DUCK											
TURKEY VULTURE	1		2								3
BLACK VULTURE											
RED-TAILED HAWK										2	2
RED-SHOULDER HAWK	1										1
BROAD-WG. HAWK		1									1
HAWK											
OSPREY											
BOBWHITE											
TURKEY											
SANDHILL CRANE											
RAIL											
GALLINULE											
KILLDEER											
WILLET											
LAUGHING GULL											
LEAST TERN											
ROYAL TERN											
ROCK DOVE											
MOURNING DOVE											
GROUND DOVE										1	1
YEL-BILLED CUCKOO											
GT. HORNED OWL											
BARRED OWL											
CHUCK-WILL'S-WIDOW											
WHIP-POOR-WILL											
COMMON NIGHTHAWK											
CHIMNEY SWIFT											
RUBY-THR. HUM'NBD										1	1
BELTED KINGFISHER											
YEL-SHAFTED FLICKER						1					1
PILEATED WOODPECKER											
RED-BILLED WOODP'R.		2									2
RED-HD. WOODPECKER	1										1
HAIRY WOODPECKER					1						1
DOWNY WOODPECKER											
RED-COCKADED WDP'R.											
E. KINGBIRD	4									1	5
GT. CREST FLYCATCHER											
E. PHOEBE											
ACADIAN FLYCATCHER											
E. WOOD PEWEE											
HORNED LARK											
ROUGH-WG. SWALLOW											
BARN SWALLOW											
PURPLE MARTIN											
BLUE JAY	3	1			2	1		2			9
COMMON CROW	3			1				1			5

STOP NUMBER	41	42	43	44	45	46	47	48	49	50	total
FISH CROW											
CAROLINA CHICKADEE											
TUFTED TITMOUSE											
WHITE-BR. NUTHATCH											
BROWN-HD. NUTHATCH											
HOUSE WREN											
CAROLINA WREN		1					1	1	1	3	7
WREN											
MOCKINGBIRD	2	2	1	2			1	1	1	2	12
CATBIRD											
BROWN THRASHER								1			1
ROBIN											
WOOD THRUSH											
E. BLUEBIRD											
BL-GR. GNATCATCHER											
LOGGERHEAD SHRIKE	2										2
STARLING											
WHITE-EYED VIREO								1	1		2
YELLOW-THR. VIREO											
RED-EYED VIREO											
BLK-&-WHT WARBLER											
PROTHONOTARY WARB											
WORM-EATING WARB											
BLUE-WG. WARBLER											
PARULA WARBLER											
YELLOW WARBLER											
BLK-THR. GREEN WARB											
YELLOW-THR. WARB											
PINE WARBLER					1						1
PRAIRIE WARBLER											
OVENBIRD											
LA. WATERTHRUSH											
KENTUCKY WARBLER											
YELLOWTHROAT											
YELLOW-BR. CHAT											
HOODED WARBLER											
AM. REDSTART											
HOUSE SPARROW											
E. MEADOWLARK											
RED-WG. BLACKBIRD											
ORCHARD ORIOLE											
BALTIMORE ORIOLE											
BOAT-TAIL GRACKLE											
COMMON GRACKLE											
BROWN-HD. COWBIRD											
SCARLET TANAGER											
SUMMER TANAGER											
CARDINAL		1				1					2
BLUE GROSBEAK											
INDIGO BUNTING											
PAINTED BUNTING											
DICKCISSEL											
AM. GOLDFINCH											
RUFOUS-SIDE TOWHEE	3							1	2		6
GRASSHOPPER SPARROW											
BACHMAN'S SPARROW											
CHIPPING SPARROW											
FIELD SPARROW											
SONG SPARROW											

Form 3-3a (1972)

BUREAU OF SPORT FISHERIES AND WILDLIFE
MIGRATORY BIRD POPULATIONS STATION
LAUREL, MARYLAND 20810

SUMMARY SHEET, BREEDING BIRD SURVEY

(1)	STATE-PROV.	FLA.
(3)	ROUTE NO.	
(6)	ROUTE NAME	CARYVILLE PLANT SITE
(16)	COORDINATES	
	STRATUM	(40)

		START	FINISH
(42)	TEMP. (F)	7 2	9 0
(46)	WIND SPEED	0	0-5
(48)	SKY	0	0

C ☐ (39)   (50) DATE 0 9 0 2 7 4 (MONTH DAY YEAR)

OBSERVER (PLEASE PRINT) (DR.) MR. (MRS.) MISS (CIRCLE ONE)

(27) D U S I — LAST NAME; JULIAN & ROSEMARY — FIRST; INITIAL

(56) TIME 0 6 1 6 — 1 1 5 0   (64) T

MAILING ADDRESS P.O. BOX 742 AUBURN, ALA.   ZIP CODE 36830

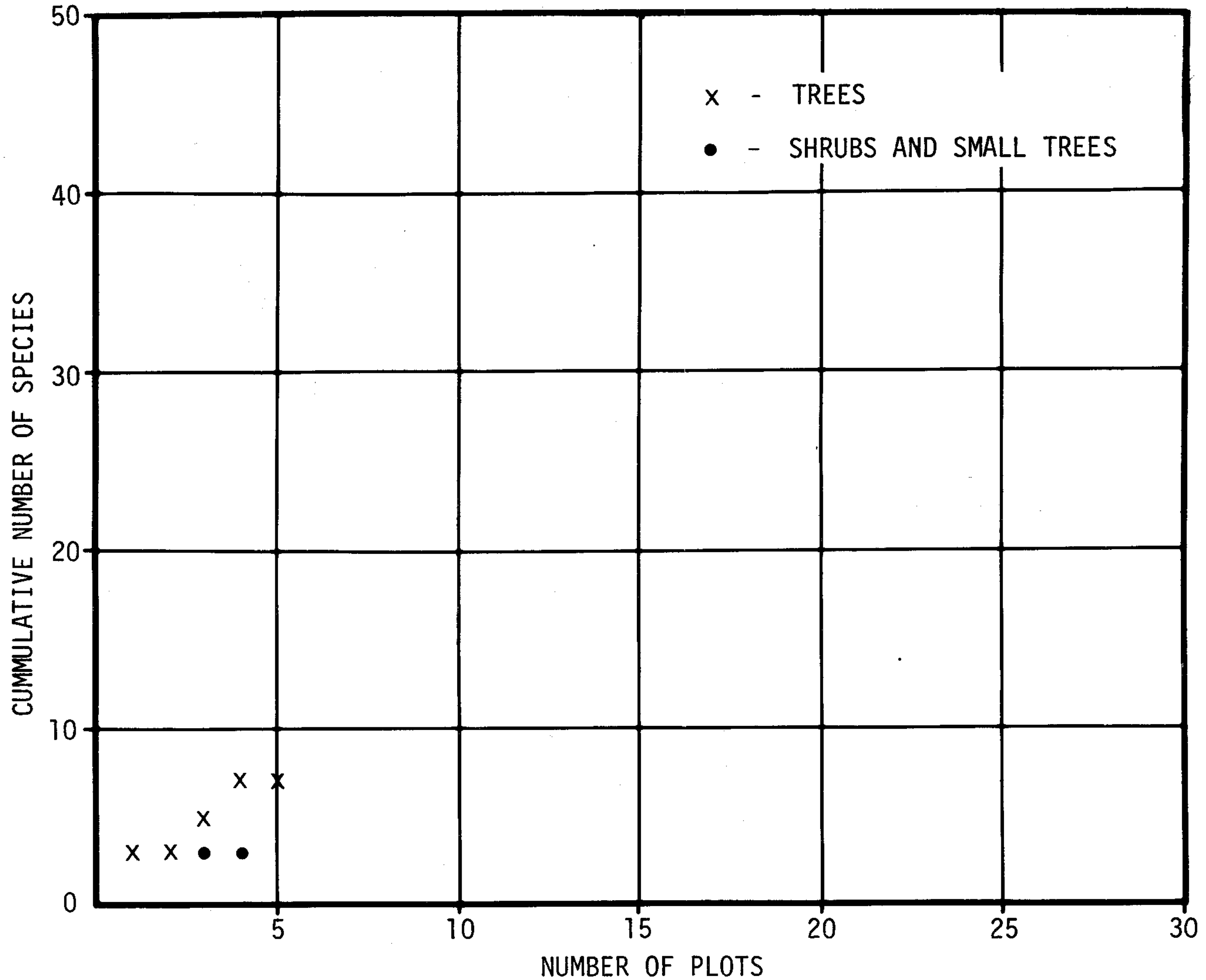
SPECIES	AOU (65)	PAGE TOTALS 1 (69)	2 (72)	3 (75)	4 (78)	5 (81)	TOTAL INDIV (84)	STOPS PER SPEC. (88)
BROWN PELICAN	126							
ANHINGA	118		1				1	1
GT. BLUE HERON	194		1				1	1
GREEN HERON	201							
LITTLE BLUE HERON	200							
CATTLE EGRET	2001	2	3	7	8	12	32	8
COMMON EGRET	196							
SNOWY EGRET	197							
LOUISIANA HERON	199							
BLACK-CR. NIGHT HERON	202							
YEL-CR. NIGHT HERON	203							
WHITE IBIS	184		5				5	1
WOOD DUCK	144							
TURKEY VULTURE	325				4	3	7	4
BLACK VULTURE	326							
COOPER'S HAWK	333							
RED-TAILED HAWK	337					2	2	1
RED-SHOULDERED HAWK	339	2			3	1	6	4
BROAD-WINGED HAWK	343					1	1	1
OSPREY	364							
SPARROW HAWK	360							
BOBWHITE	289	7	8		1		16	8
TURKEY	310							
SANDHILL CRANE	206							
CLAPPER RAIL	211							
COMMON GALLINULE	219							
AMERICAN COOT	221							
KILLDEER	273							
WILLET	258							
LAUGHING GULL	058							
LEAST TERN	074							
BLACK SKIMMER	080							
ROCK DOVE	3131							
MOURNING DOVE	316	21	10	10	7	1	49	23
GROUND DOVE	320	8	3	3	1		15	6
YELLOW-BILLED CUCKOO	387	1		3			4	3
SCREECH OWL	373							
GREAT HORNED OWL	375							
BARRED OWL	368							
CHUCK-WILL'S-WIDOW	416							
WHIP-POOR-WILL	417							
COMMON NIGHTHAWK	420							
CHIMNEY SWIFT	423	2	15	1		1	20	4
RUBY-THR. HUMMINGBIRD	428							
BELTED KINGFISHER	390							
YELLOW-SHAFTED FLICKER	412	6				1	7	7
PILEATED WOODPECKER	405	1					1	1
RED-BELLIED WOODPECKER	409	10	7		4	2	23	16
RED-HEADED WOODPECKER	406		1			1	2	2
HAIRY WOODPECKER	393					1	1	1
DOWNY WOODPECKER	394		3				3	2
RED-COCKADED WDPKR.	395							
E. KINGBIRD	444					5	5	2
GT. CRESTED FLYCATCHER	452			2			2	2
E. PHOEBE	456							
ACADIAN FLYCATCH	465							
E. WOOD PEWEE	461							
TREE SWALLOW	614							
ROUGHED-WINGED SWALLOW	617							
BARN SWALLOW	613	2					2	1
PURPLE MARTIN	611	1					1	1
BLUE JAY	477	36	27	23	17	9	112	36

SPECIES	AOU (65)	PAGE TOTALS 1 (69)	2 (72)	3 (75)	4 (78)	5 (81)	TOTAL INDIV (84)	STOPS PER SPEC. (88)
COMMON CROW	488	14	14	20	14	5	67	31
FISH CROW	490		1	2	3		6	4
CAROLINA CHICKADEE	736		8		6		14	3
TUFTED TITMOUSE	731	4	2	1			7	4
WHITE-BREASTEDNUTHATCH	727							
BROWN-HEADED NUTHATCH	729		8	3			11	3
HOUSE WREN	721							
BEWICK'S WREN	719							
CAROLINA WREN	718	19	4	5	8	7	43	25
MOCKINGBIRD	703	12	13	5	10	12	52	24
CATBIRD	704							
BROWN THRASHER	705	1	2			1	4	4
ROBIN	761	1					1	1
WOOD THRUSH	755							
E. BLUEBIRD	766							
BLUE-GRAY GNATCHER	751							
LOGGERHEAD SHRIKE	622	3	7	3		2	15	12
STARLING	493							
WHITE-EYED VIREO	631	1	4	6	1	2	14	12
YELLOW-THROATED VIREO	628		1				1	1
RED-EYED VIREO	624							
BLACK-AND-WHT. WARBLER	636							
PROTHONOTARY WARBLER	637							
WORM-EATING WARBLER	639							
BLUE-WINGED WARBLER	641							
PARULA WARBLER	648		3	2			5	3
YELLOW WARBLER	652							
BLK.-THR.-GRN. WARBLER	667							
CERULEAN WARBLER	658							
YELLOW-THR. WARBLER	663							
PINE WARBLER	671	2	2			1	5	4
PRAIRIE WARBLER	673							
OVENBIRD	674							
LA. WATERTHRUSH	676							
KENTUCKY WARBLER	677							
YELLOWTHROAT	681	1					1	1
YELLOW-BREASTED CHAT.	683							
HOODED WARBLER	684		1				1	1
AMERICAN REDSTART	687							
HOUSE SPARROW	6882							
E. MEADOWLARK	501							
RED-WINGED BLACKBIRD	498	2					2	1
ORCHARD ORIOLE	506							
BALTIMORE ORIOLE	507							
BOAT-TAILED GRACKLE	513							
COMMON GRACKLE	511	25			2		27	6
BROWN-HEADED COWBIRD	495							
SCARLET TANAGER	608							
SUMMER TANAGER	610		1				1	1
CARDINAL	593	7	11	13	11	2	44	24
BLUE GROSBEAK	597							
INDIGO BUNTING	598							
PAINTED BUNTING	601							
DICKCISSEL	604							
AMERICAN GOLDFINCH	529							
RUFOUS-SIDED TOWHEE	587	11	8	2	2	6	29	16
GRASSHOPPER SPARROW	546							
BACHMAN'S SPARROW	575							
CHIPPING SPARROW	560							
FIELD SPARROW	563							
SONG SPARROW	581							

TOTAL SPECIES = 45
TOTAL INDIVIDUALS = 668
DENSITY RATE = 267.2/Hr.

FORM 3-3
(1969)

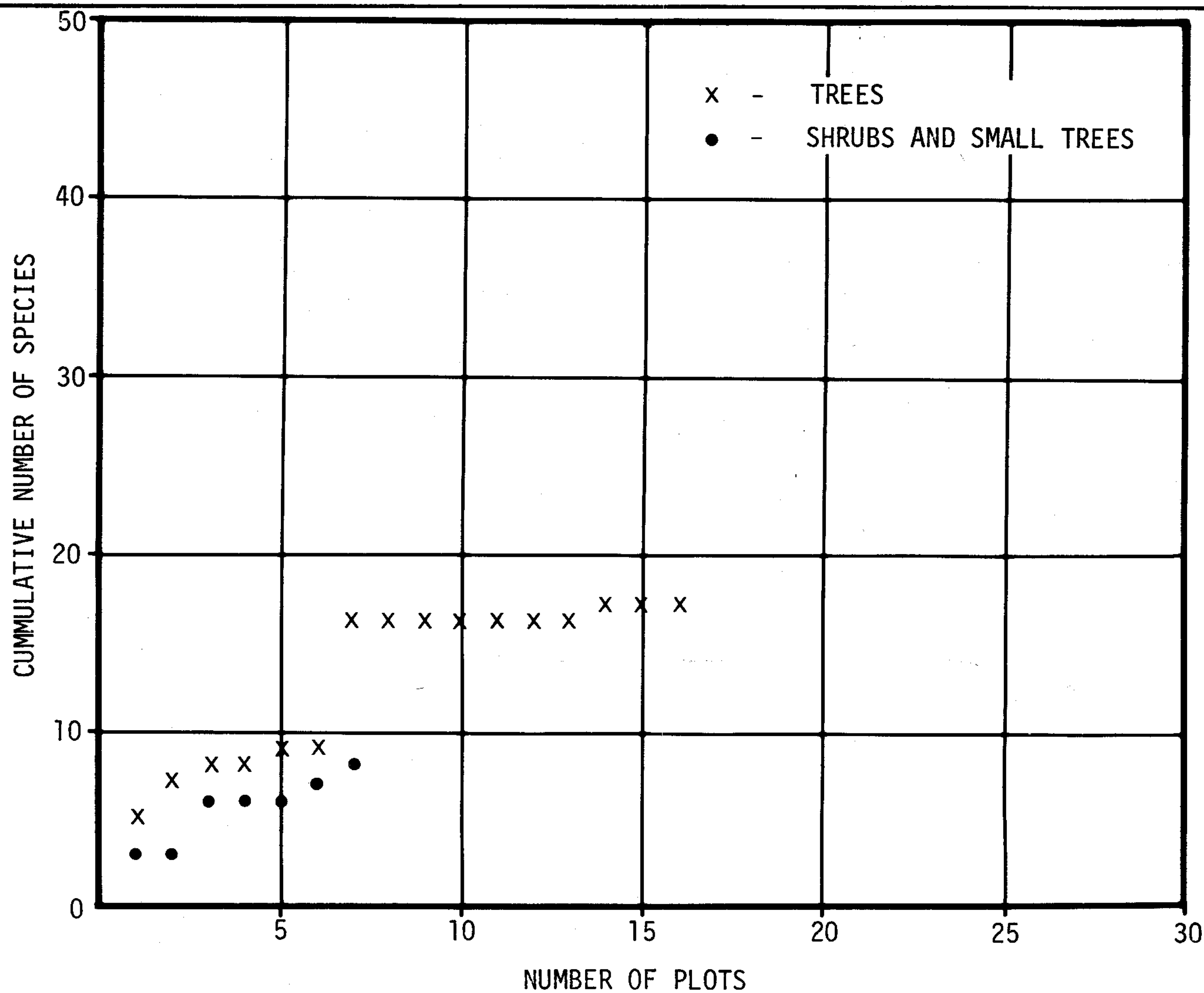
1 CSP-ER-6



GULF POWER CO.
CARYVILLE STEAM PLANT

SPECIES AREA CURVES
CYPRESS BAYHEAD COMMUNITY

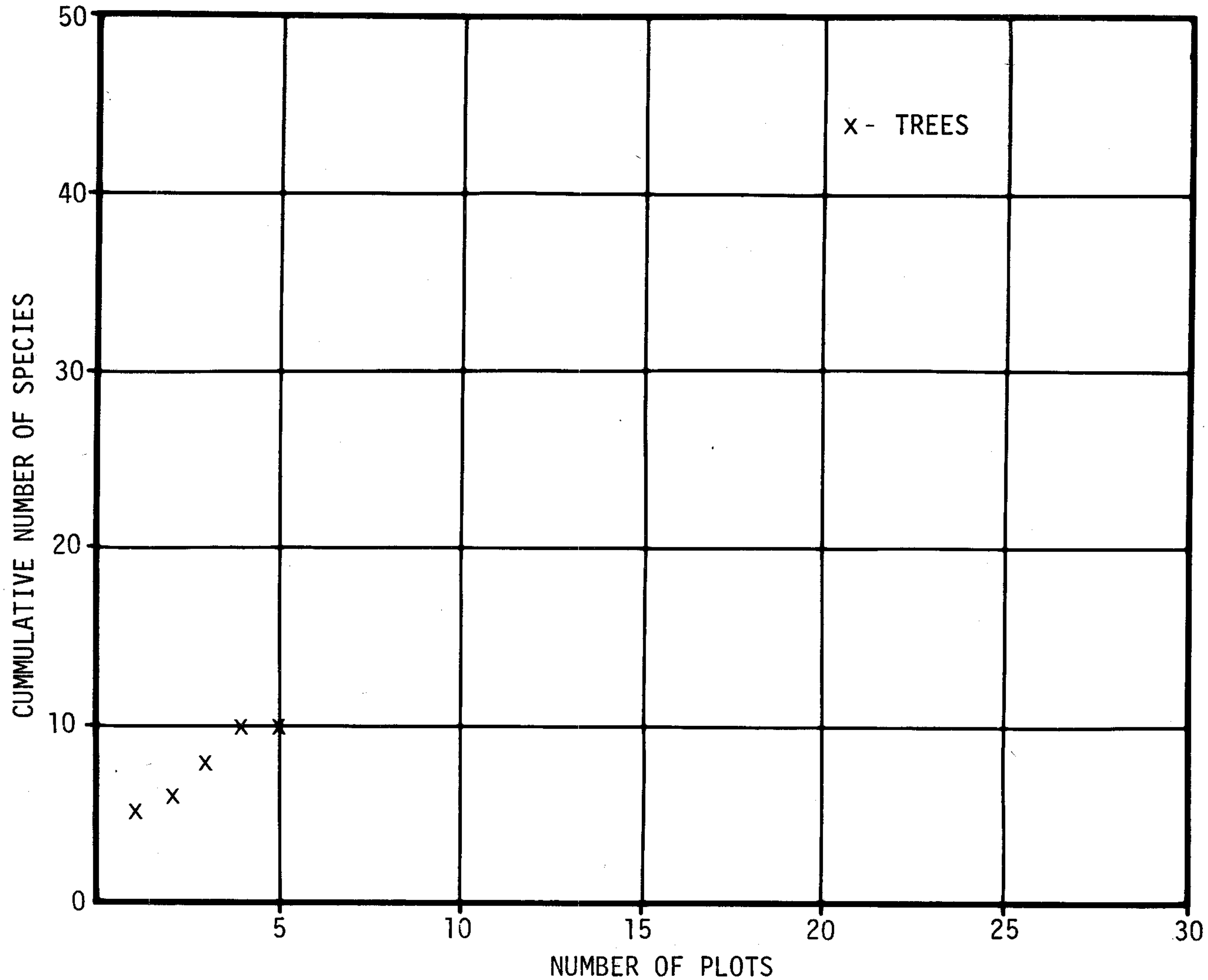
FIGURE 6.3-1



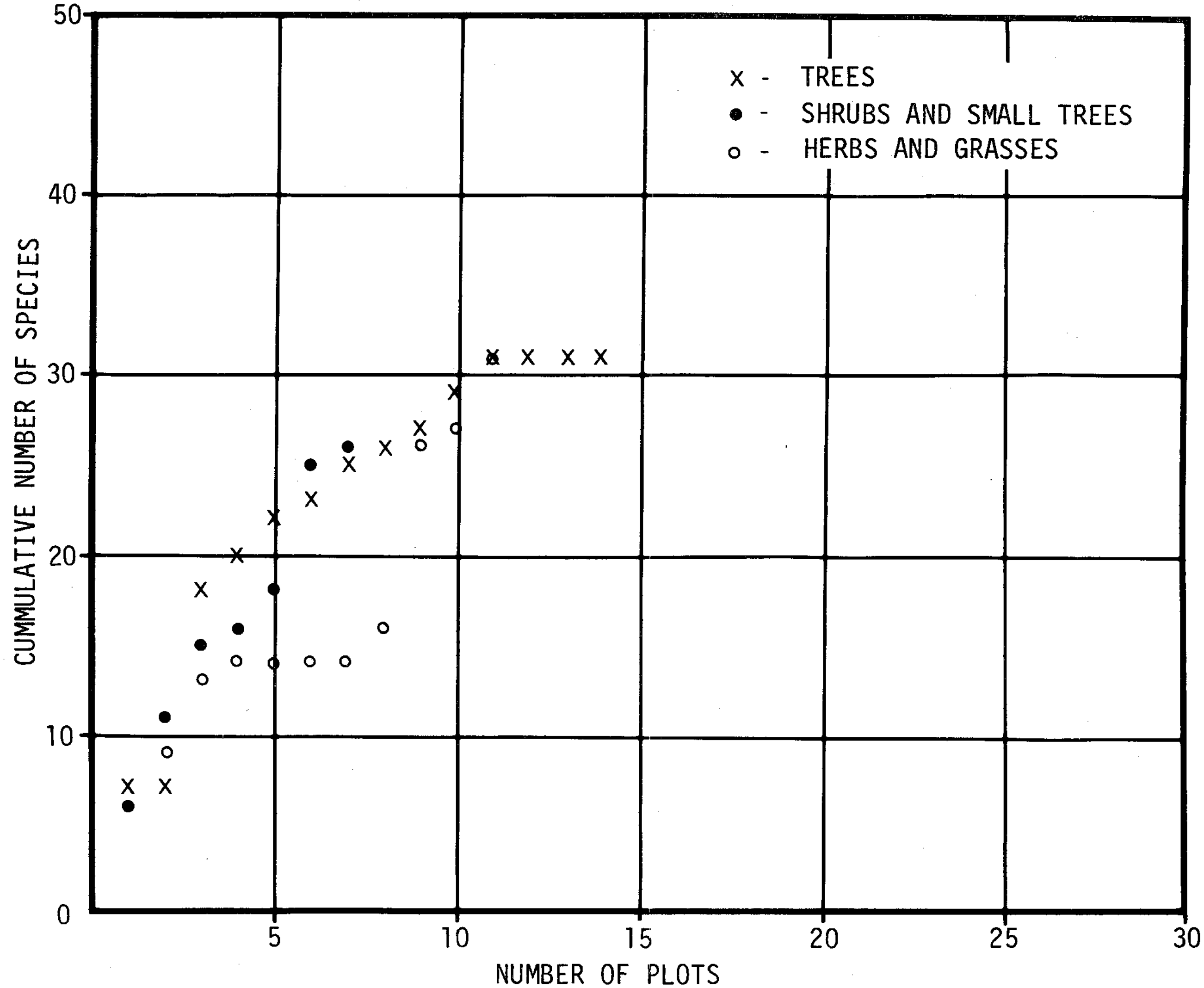
GULF POWER CO.
CARYVILLE STEAM PLANT

SPECIES AREA CURVES
BAYHEAD COMMUNITY

FIGURE 6.3-2



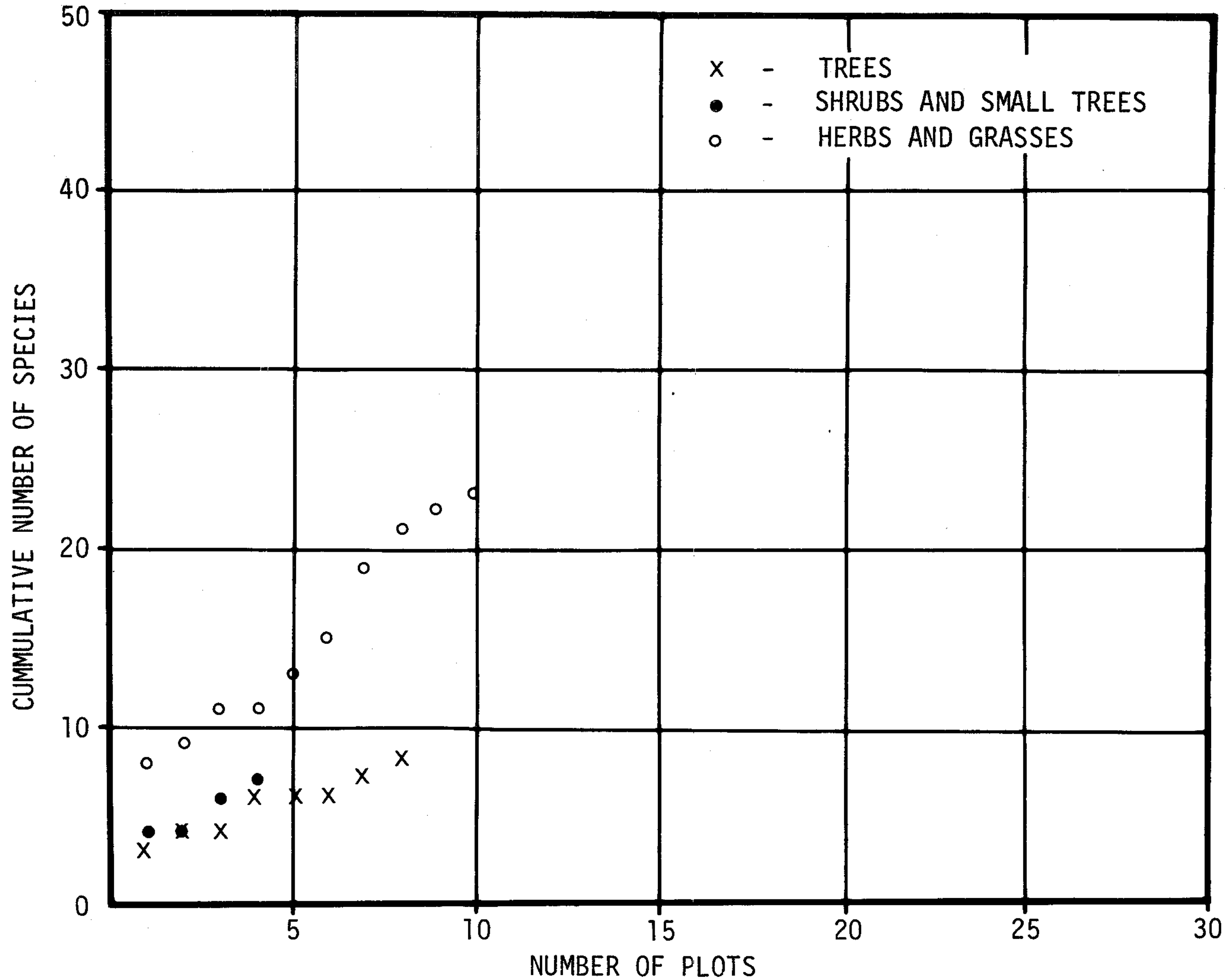
Gulf Power Company	GULF POWER CO. CARYVILLE STEAM PLANT	SPECIES AREA CURVES MIXED HARDWOOD SWAMP COMMUNITY
		FIGURE 6.3-3



GULF POWER CO.
CARYVILLE STEAM PLANT

SPECIES AREA CURVES
MIXED MESOPHYTIC HARDWOOD

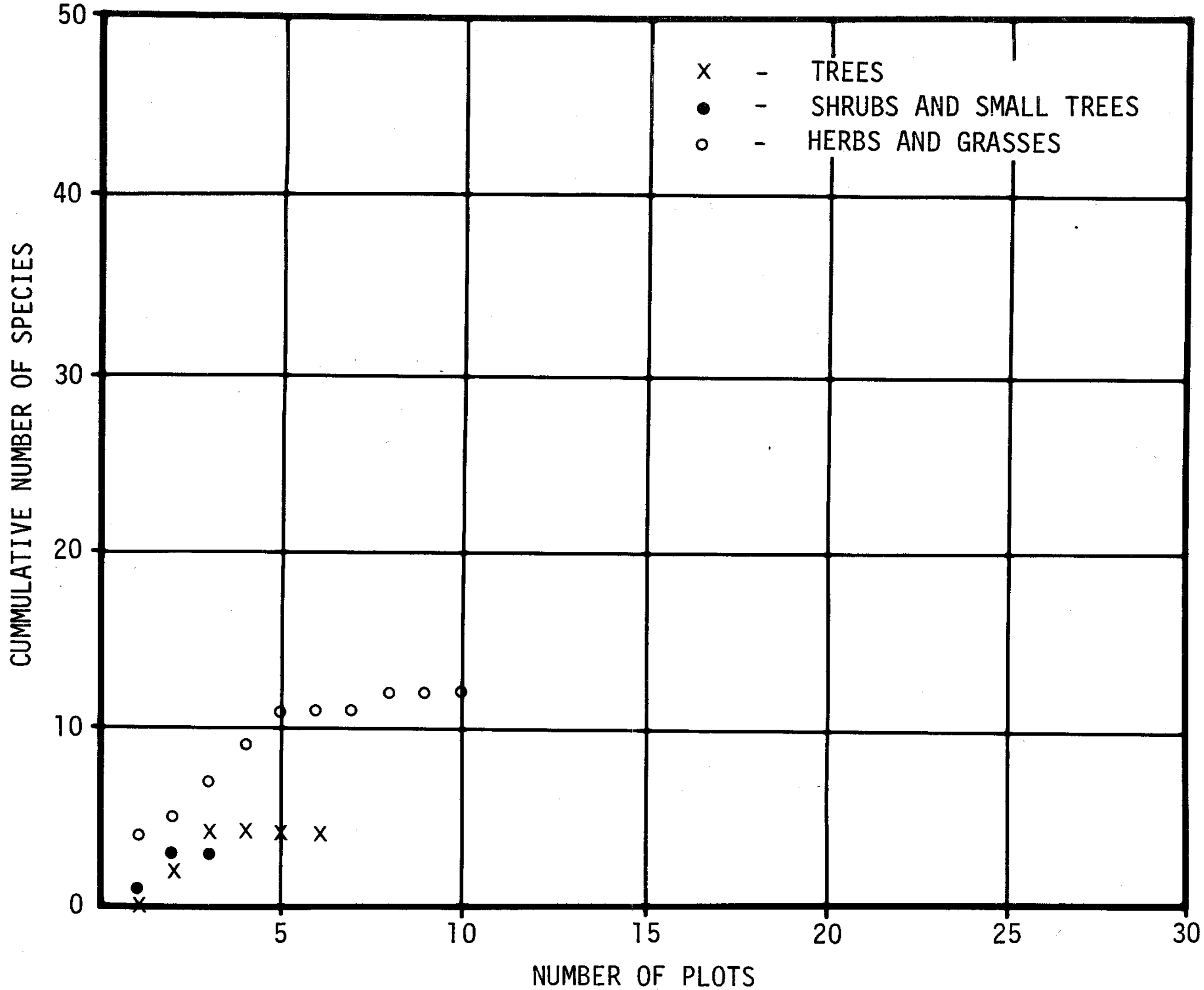
FIGURE 6.3-4



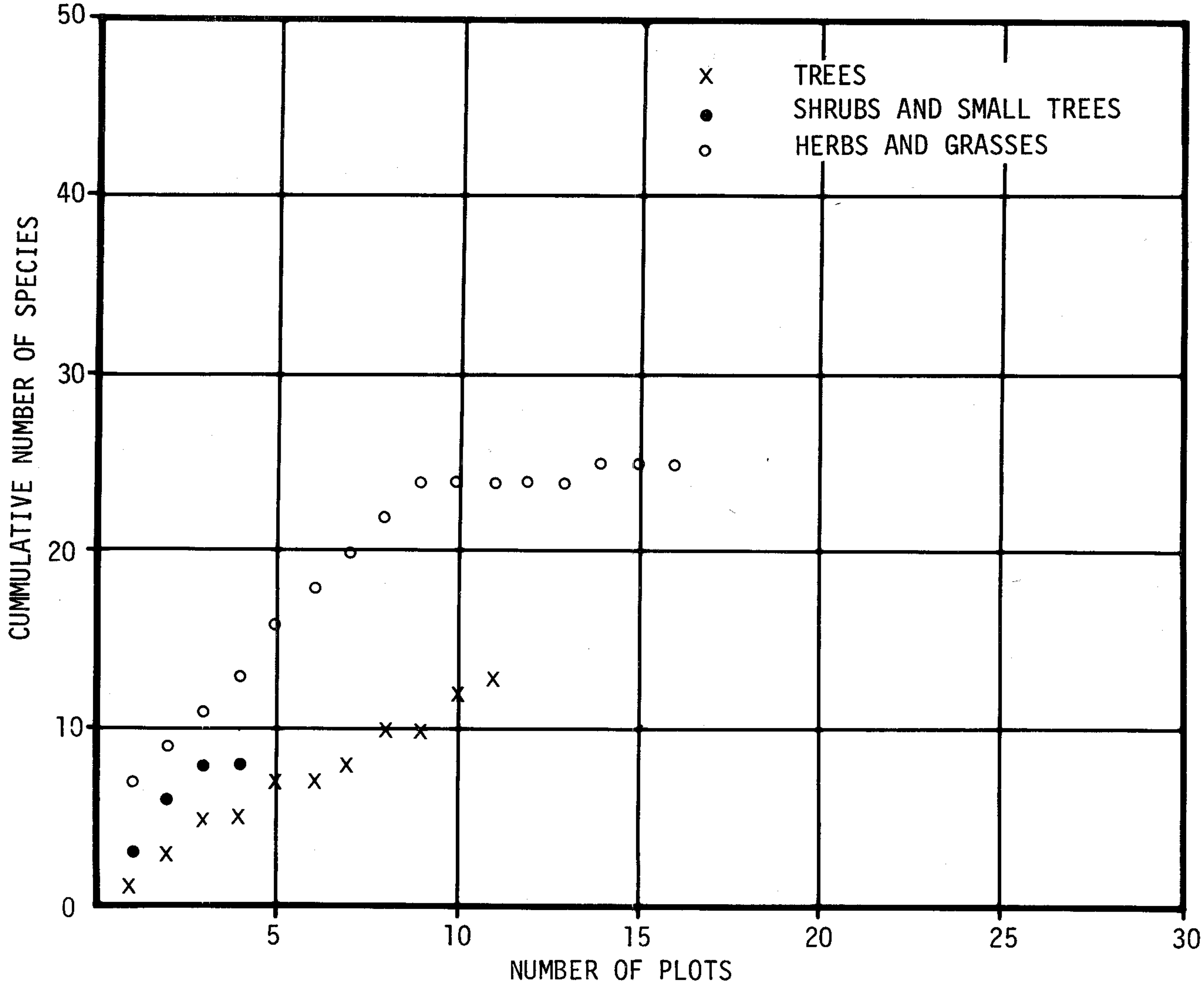
GULF POWER CO.
CARYVILLE STEAM PLANT

SPECIES AREA CURVES
MESOPHYTIC PINE PLANTATION (UNBURNED)

FIGURE 6.3-5



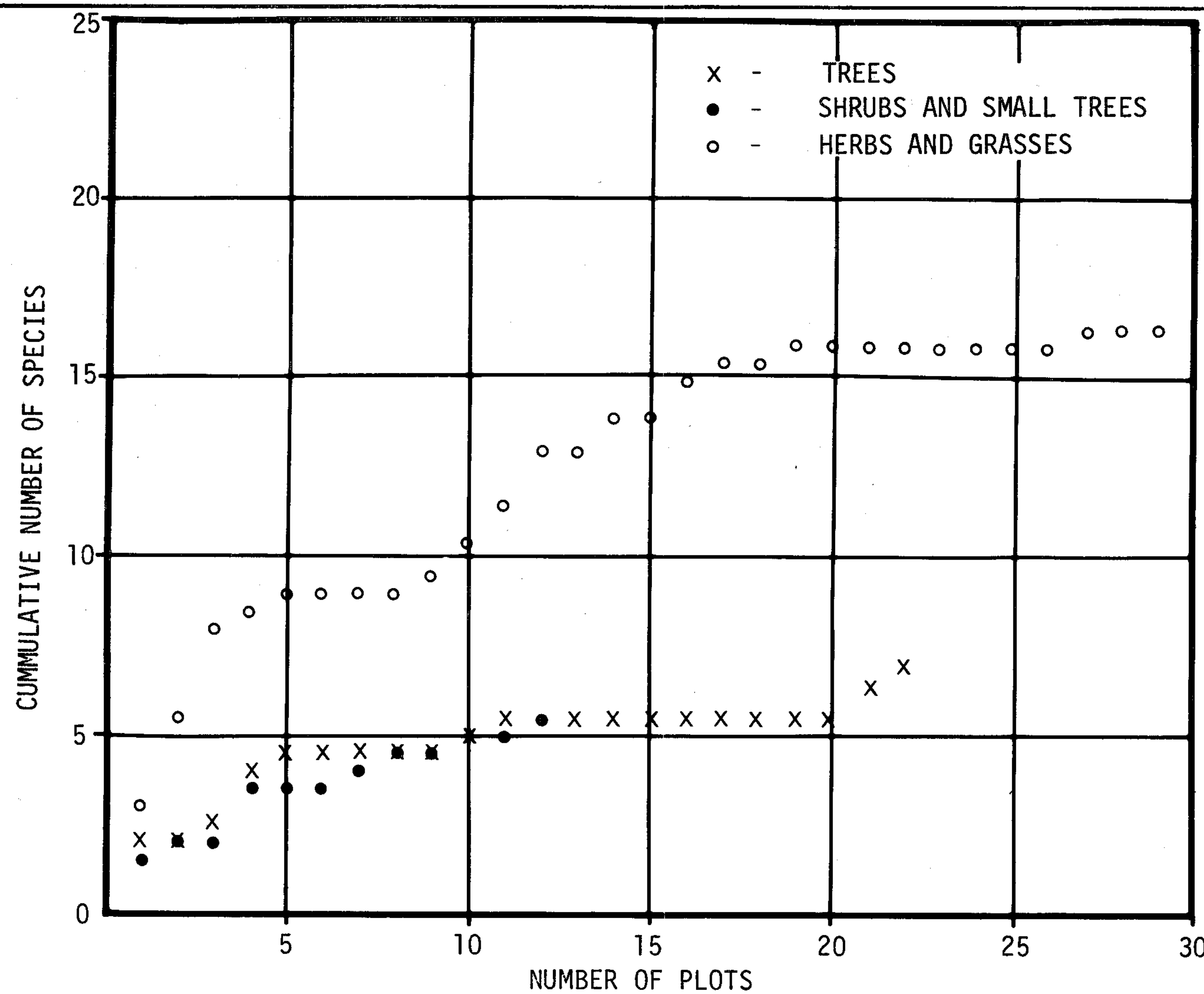
GULF POWER CO. CARYVILLE STEAM PLANT	SPECIES AREA CURVES MESOPHYTIC PINE PLANTATION (BURNED)
	FIGURE 6.3-6



GULF POWER CO.
CARYVILLE STEAM PLANT

SPECIES AREA CURVES
SANDHILL COMMUNITY

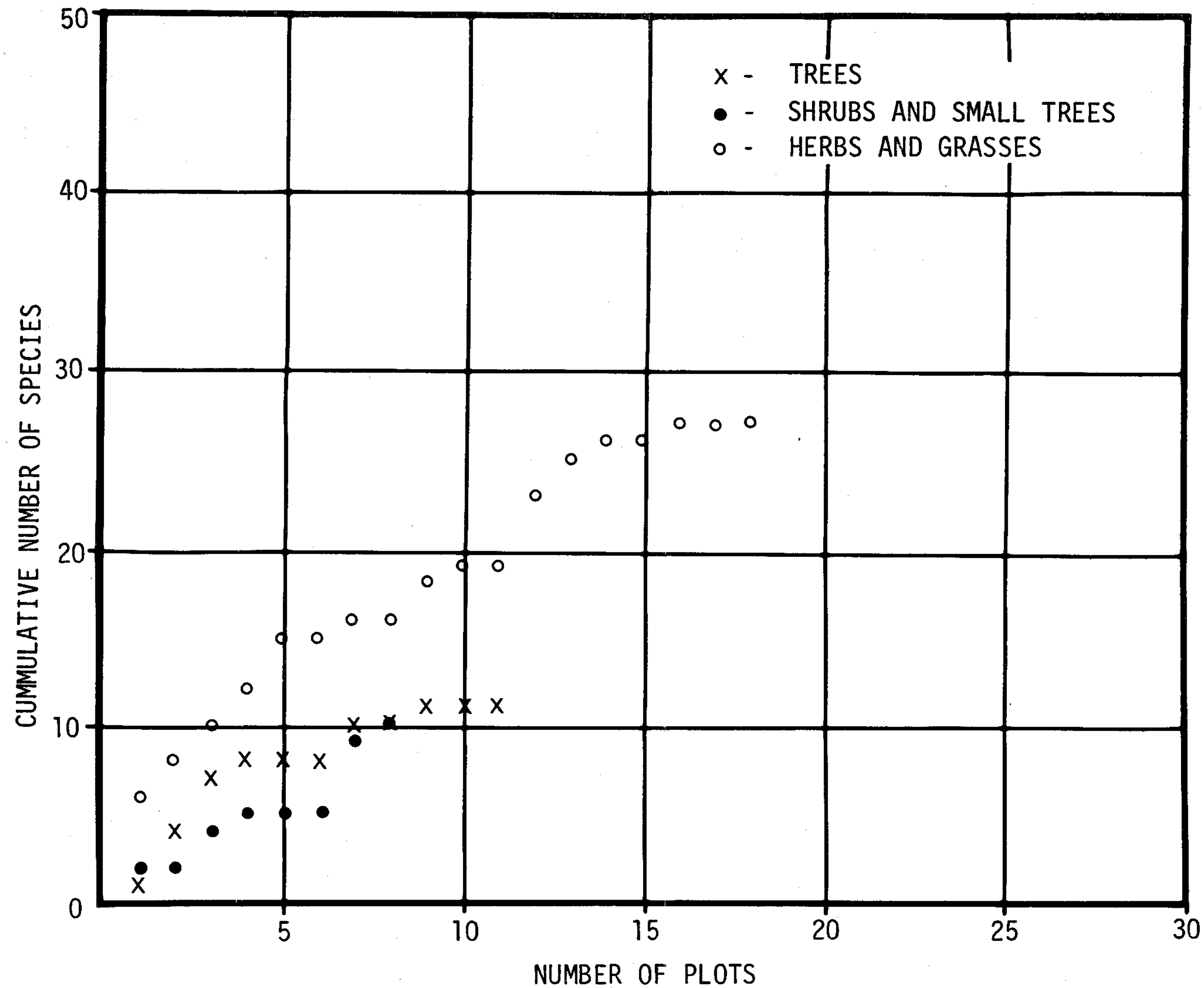
FIGURE 6.3-7



GULF POWER CO.
CARYVILLE STEAM PLANT

SPECIES AREA CURVES
XEROPHYTIC PINE PLANTATION
(UNBURNED)

FIGURE 6.3-8



GULF POWER CO.
CARYVILLE STEAM PLANT

SPECIES AREA CURVES
XEROPHYTIC PINE PLANTATION
(BURNED)

FIGURE 6.3-9

6.4

6.4 Ground-Water

6.4.1 Methods and Procedures for Ground-Water Data Collection

Gulf conducted a well inventory within a five-mile radius of the site to provide background data in the area of the proposed plant site. (See figure 6.4-1.) Selected data from the well inventory that are most pertinent to site preparation and construction of the plant are given in tables 2.5-2 through -6. This inventory consisted of a two-phase data gathering method: (a) a literature search from U. S. Geological Survey open files and publications of older wells and Northwest Florida Water Management District permit records for wells constructed after 1969, and (b) an actual field check of the area which verified published well data and which includes wells overlooked by previous studies.

Gulf's well inventory of the proposed plant site includes all wells of 100 gallons per minute (GPM) capacity or greater and includes selected dug wells and irrigation, domestic, industrial, and municipal wells. Where available, the well data include well number, coordinates, type of monitoring well, location, depth, diameter, casting, estimated yield, use, and important remarks that might affect the data such as water level measurements, pumping tests, log availability, etc. (Refer to subsection 2.5.1.1, "Sinks and Ponds.")

Data from the basic well inventory data that is keyed to figure 2.5-18 are contained in Section 1 of Appendix B. In addition, Gulf drilled a selected group of companion observation and monitoring wells which consisted of two observation wells at each inventory station: one developed in the shallow aquifer and the other in the underlying Floridan Aquifer. Four of these wells will be equipped with automatic recording water level gages; the other wells will be measured on a periodic basis. The ground-water monitoring program proposed for the Caryville steam plant is as follows:

A. Water Supply Wells - In conjunction with the construction of water supply wells, at least two observation wells will also be completed in the vicinity of each water supply well for the purpose of recording significant hydrologic information.

1. Recording gages will be installed on these wells to maintain a continuous record of the fluctuation of water levels before pumping begins. This will provide background data of the natural fluctuation of water levels in the area.

2. These recording gages will be maintained after installation of the production well or wells during site preparation and construction and after the plant begins operation.

3. Production wells will be equipped with recording meters to automatically record the discharge from each well until the first six months of plant operation is complete.

4. After six months of plant operation, an evaluation will be made to determine the necessity for the continuance of the monitoring program. If no adverse effects are noted, the program will be discontinued at that time.

B. <u>Ash Disposal Area</u> - Before construction of the ash disposal area, Gulf will install from three to five observation wells in the shallow aquifer within 200 feet from the perimeter of the pond. 2

1. These wells will be equipped with recording gages to maintain a continuous record of the fluctuation of water levels. These records will aid in the evaluation of the ash disposal operations. 2

2. Water samples will be collected at monthly intervals for chemical analysis.

3. After six months of plant operation, an evaluation will be made to determine the necessity for the continuance of the monitoring program. If no adverse effects are noted, the program will be discontinued at that time.

C. <u>Observation Well Network</u> - Gulf will collect samples of water from selected wells at monthly intervals prior to plant operation. Water levels will be measured at monthly intervals for six months after initial plant operation in selected observation well pairs (shallow and deep) within a five-mile radius of the plant site. 2

<u>6.4.1.1 Model to Predict Changes in Ground-Water Levels</u> - Gulf designed the pumping tests of the aquifer at the Caryville site to predict the maximum drawdown of water levels as a result of pumping from wells.

The problem is one of computing drawdowns of pumping levels for the steady-state conditions. This occurs when the rate of pumping has been balanced by an increase in the rate of recharge to the aquifer, a decrease in the rate of discharge from the aquifer, or, more probably, a combination of both (1).

When water is being pumped from an artesian aquifer, the potentiometric surface of the water in the aquifer is lowered throughout a circular 2

area that has the pumped well at its center. Because most confining beds are probably permeable to some extent, the lowering of the potentiometric surface results in a change in the rate of leakage through the confining bed. The change may consist of a decrease in the rate of leakage out of the aquifer or in an increase in the rate of leakage into the aquifer. In either event, the change results in a net increase to the supply of water in the aquifer.

The permeability of an effective confining bed is commonly small, and the change in the rate of leakage through a semi-permeable confining bed is generally only a small fraction of a gallon per day per square foot. A cone of depression, however, that has been created by large-scale pumping ordinarily encompasses many millions of square feet. Thus, leakage through a semi-permeable confining bed may result in the aquifer's capture of a considerable quantity of water. Situations in the area of the Caryville site where practically all the water being discharged from wells is balanced by such capture are not uncommon.

The limestone units comprising the Floridan Aquifer and underlying sands 2
in the Claiborne Group are permeable beds capable of producing water to wells. A long-term 72-hour pumping test of potable water supply well No. 2 near the plant site and a pumping test of the shallow aquifer in the ash disposal area were analyzed by using the Theis nonequilibrium method. The nonequilibrium method and the Cooper leaky aquifer method (1, 2) are briefly described in Section 1 of Appendix F.

It is desirable to introduce and define a few terms that will facilitate an understanding of the equations described in Appendix 1 to this section.

A. A ground-water reservoir may be precisely defined as an aquifer. An aquifer is defined as a geologic formation or group of formations that are water bearing.

B. The coefficient of permeability, P, of an aquifer is a measure of the aquifer's capacity to transmit water. It is defined as the rate of flow of water in gallons per day through a cross-sectional area of one square foot under a hydraulic gradient of 100 percent.

C. The coefficient of transmissibility, T, is expressed as the rate of flow of water in gallons per day through a vertical strip of the aquifer one foot wide extending the full saturated height of the aquifer under a hydraulic gradient of 100 percent.

D. A hydraulic gradient of 100 percent means a foot drop in water level in one foot of flow distance.

E. Thus, the coefficient of transmissibility, T, is equal to the coefficient of permeability, P, multiplied by the thickness of the aquifer.

> The amount of water available from storage as the water level declines depends upon the coefficient of storage of the aquifer. The coefficient of storage, S, is the volume of water that an aquifer releases from storage from a one square foot area of the aquifer as the water level declines one foot.

All pumping test methods are designed to yield information on aquifer performance and not on well performance. There are certain features common to all testing and analytical methods described in this report. Each method involves turning a pumped well on or off and observing what happens to the water levels in nearby observation wells. Each method takes into account the time that has elapsed since pumping began or pumping ceased. Finally, each method relates solely to those particular uses of the equations that consider variations in drawdown or recovery with the passing of time.

The coefficients of storage and transmissibility can thus be used to estimate the rate and amount of lowering in water levels to be expected at various rates and distribution of pumping, to determine optimum well yields, and to determine the proper spacing of wells.

6.4.1.2 Salt Water Encroachment - Throughout the Florida Peninsula, two aspects of salt water encroachment are present: (a) the principal of equilibrium between salt and fresh water, as applied to the hydrology of a seacoast, and (b) the coning effect of salt water encroaching upward into a fresh water aquifer.

A statement of the relationship between salt water and fresh water is frequently referred to as the theory of Ghyben and Herzberg. This theory states that because of the difference in specific gravities, fresh water "floats" on salt water and is expressed in the following formula:

$$H = h + t = hg$$

$$H = t/(g-1)$$

Where

g is the specific gravity of sea water,

1 is assumed to be the specific gravity of fresh water,

H is the total thickness of fresh water,

h is the depth of fresh water below sea level, and

t is the height of fresh water above mean sea level. (See figure 6.4-2.)

Therefore, under static nonartesian conditions, if the fresh ground water has a specific gravity of 1.0 and the sea water has a specific gravity of 1.025, the contact between the salt water and the overlying fresh water at any place is depressed 40 feet below sea level for every foot that the water table stands above sea level. For example, consider figure 6.4-3 where a lense of fresh water is surrounded on the sides and bottom by salt water. Under pre-pumping conditions, the fresh water/salt water interface lies at a depth of 40 feet below sea level. After pumping begins, a cone of depression forms in the water table and the fresh water/salt water interface begins to move upward as an inverted cone. If pumped at a rate large enough to cause the water table to drop to sea level, the cones would meet at that point. The well, however, would be producing salt water as soon as the interface rose as high as the bottom of the well. Under artesian conditions, the same general principal may hold. If the confining bed is completely impervious and the head of water in the aquifer is not large enough to push the salt water back to the submarine outcrop of the aquifer, the condition is one of equilibrium between two bodies of water of different densities. (See figure 6.4-4.) Under this condition, there is no discharge of fresh water into the sea. Hence, there is no hydraulic gradient, the head of the water in the aquifer is the same at all points, and the piezometric surface becomes an even surface at some height above sea level (3). If, however, the head of water is sufficiently great, a hydraulic gradient will be established in the aquifer, the salt water will be pushed back to the submarine outcrop, and fresh water will escape into the sea. (See figure 6.4-5.)

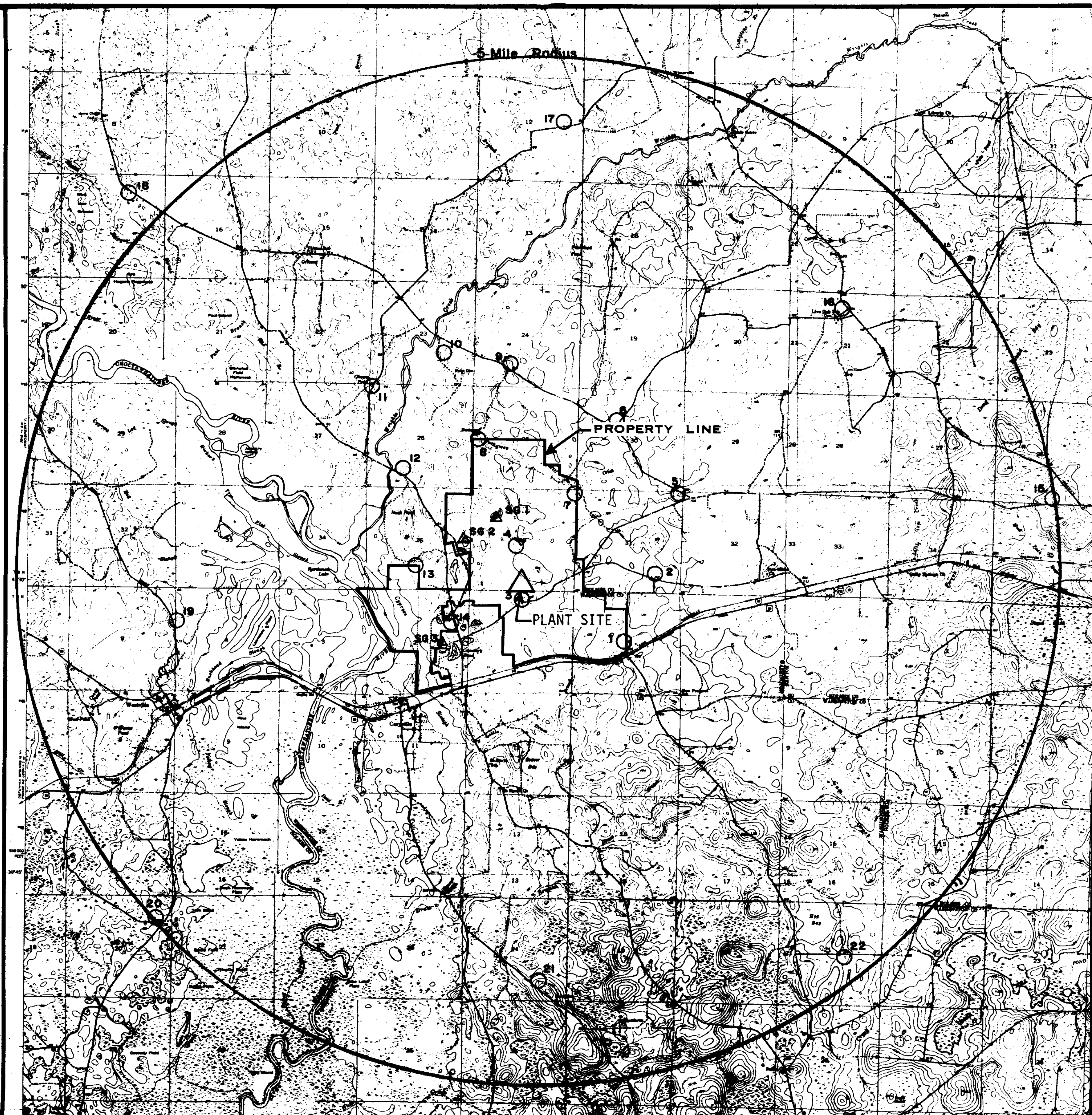
Relating the preceeding discussion to a basin, it can be seen in the Caryville area that if a large cone of depression were created in the potentiometric surface of the Floridan aquifer, there would be some upward warping of the salt water/fresh water interface provided there were no intervening impermeable strata between the part of the aquifer from which water was being withdrawn and the interface. It is not known whether an impermeable strata of this magnitude exists in the Caryville area. But, there will not be a serious upward movement of the salt water/fresh water interface for the following reasons: (a) The salt water/ fresh water interface under predevelopment conditions is estimated
to be between the depths of 840 to 890 feet. This is based on a concentration 2
of 1,000 parts per million of sodium chloride (NaCL). With these conditions, considerable drawdowns could be imposed on the system before salt water encroachment would become a problem. (b) Transmissibilities of the Floridan Aquifer are large; therefore, drawdowns in the potentiometric surface in the vicinity of the proposed production wells would be small. Gulf will use pumping test results to plan construction, spacing, and production of water supply wells to guard against salt water intrusion.
The ground water monitoring program described in subsection 2.5.1.1, 2
"Sinks and Ponds," includes analysis for chlorides.

6.4.2 References

(1) Cooper, H. H., "Type curves for nonsteady radial flow in an infinite leaky artesian aquifer." Shortcuts and special problems in aquifer tests: U. S. Geol. Survey Water-Supply Paper 1545-C, ed. by R. Bentall, pp. C48-C55, 1963.

(2) Hantush, M. S. and C. E. Jacob. "Non-steady radial flow in an infinite leaky aquifer." Am. Geophys. Union Trans., Vol. 36, No. 1, pp. 95-100, 1955.

(3) Stringfield, V. T. "Artesian water in Tertiary limestone in the southeastern states." U. S. Geol. Survey Prof. Paper 517, p. 226, 1966.



LEGEND

△ SG3 STAFF GAGE

○ 22 SITE OF PAIRED OBSERVATION WELLS IN THE SHALLOW AQUIFER AND THE FLORIDAN AQUIFER.

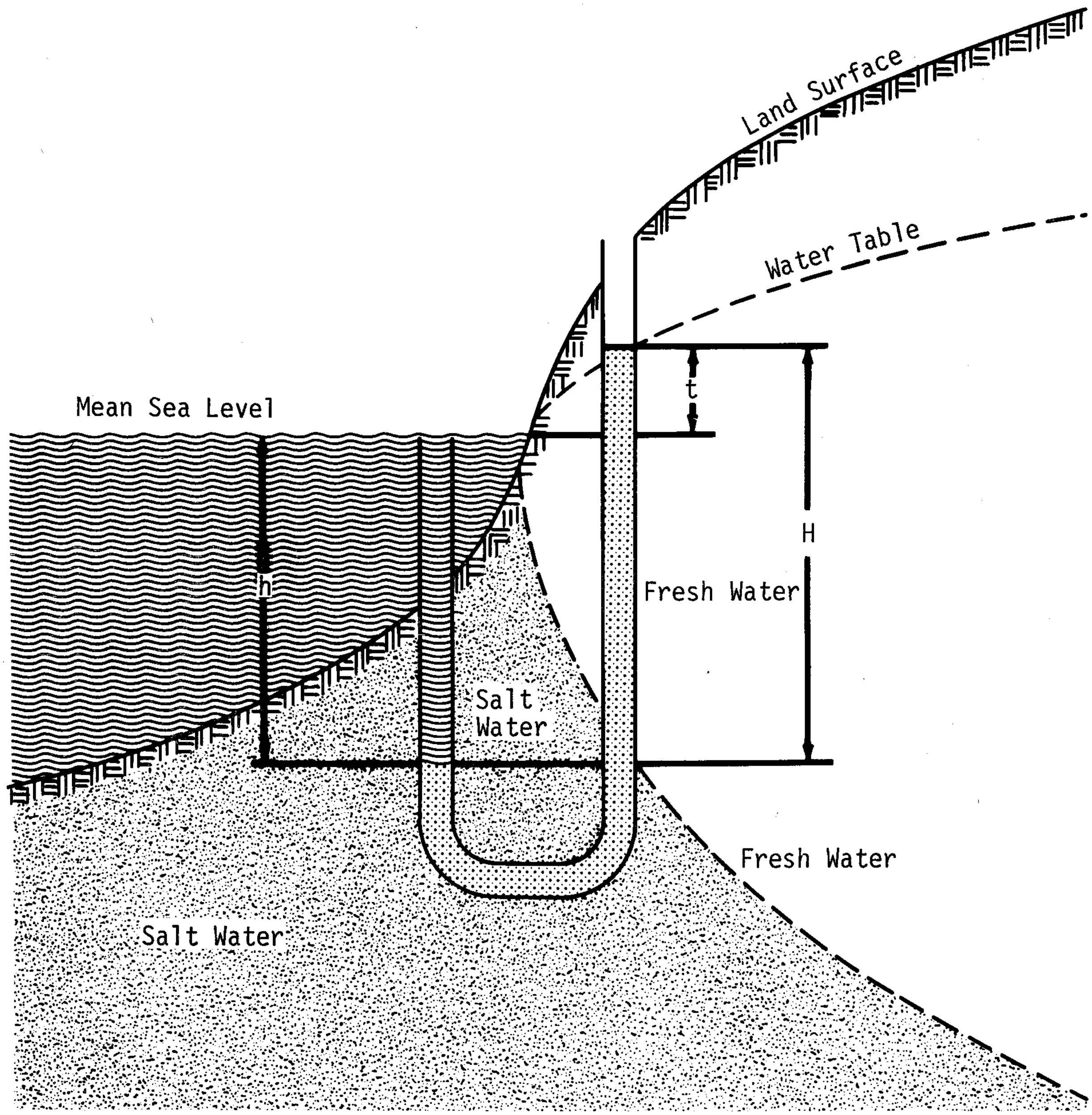
CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

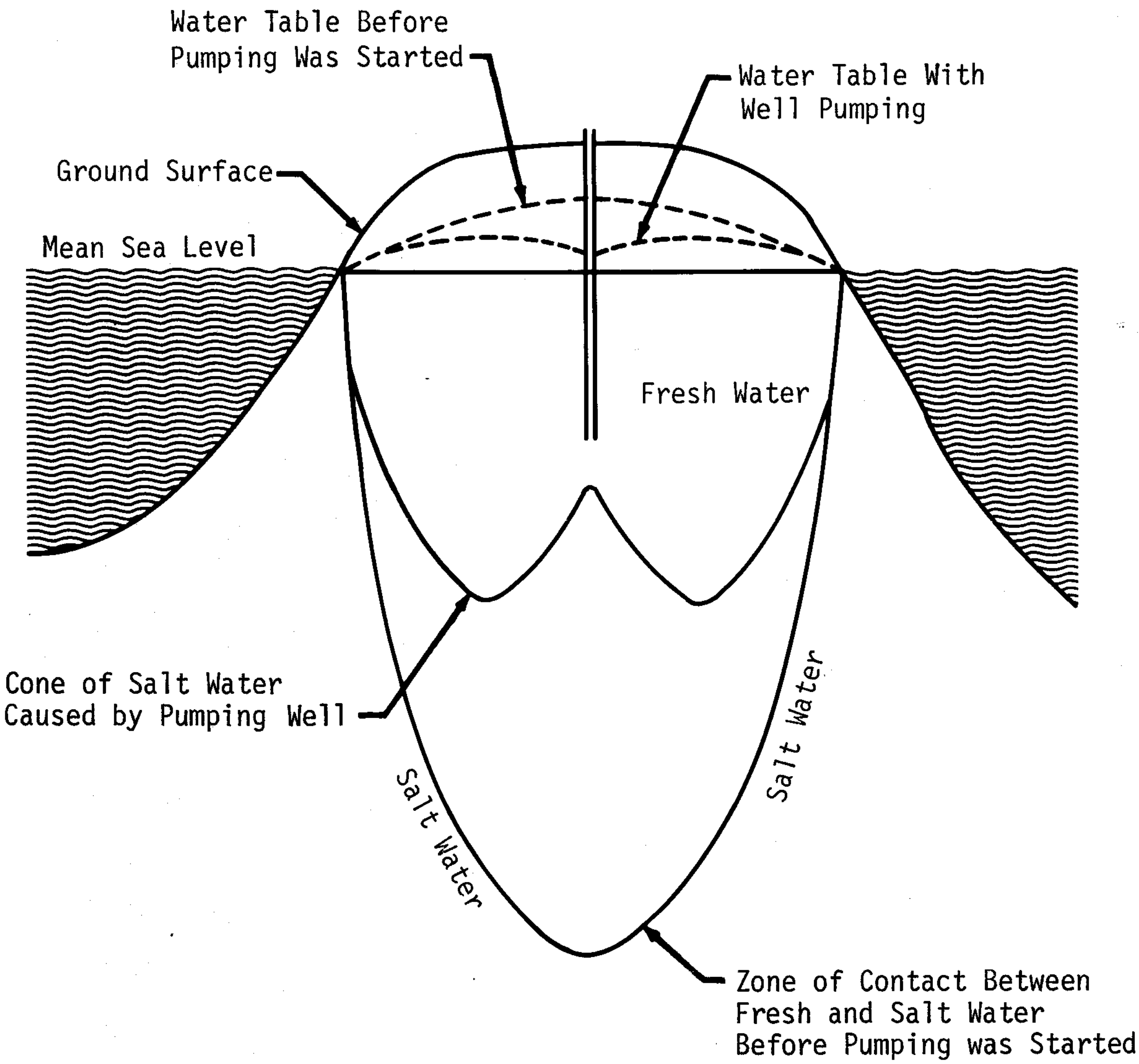
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT

STAFF GAGE AND OBSERVATION WELLS IN 5-MILE RADIUS

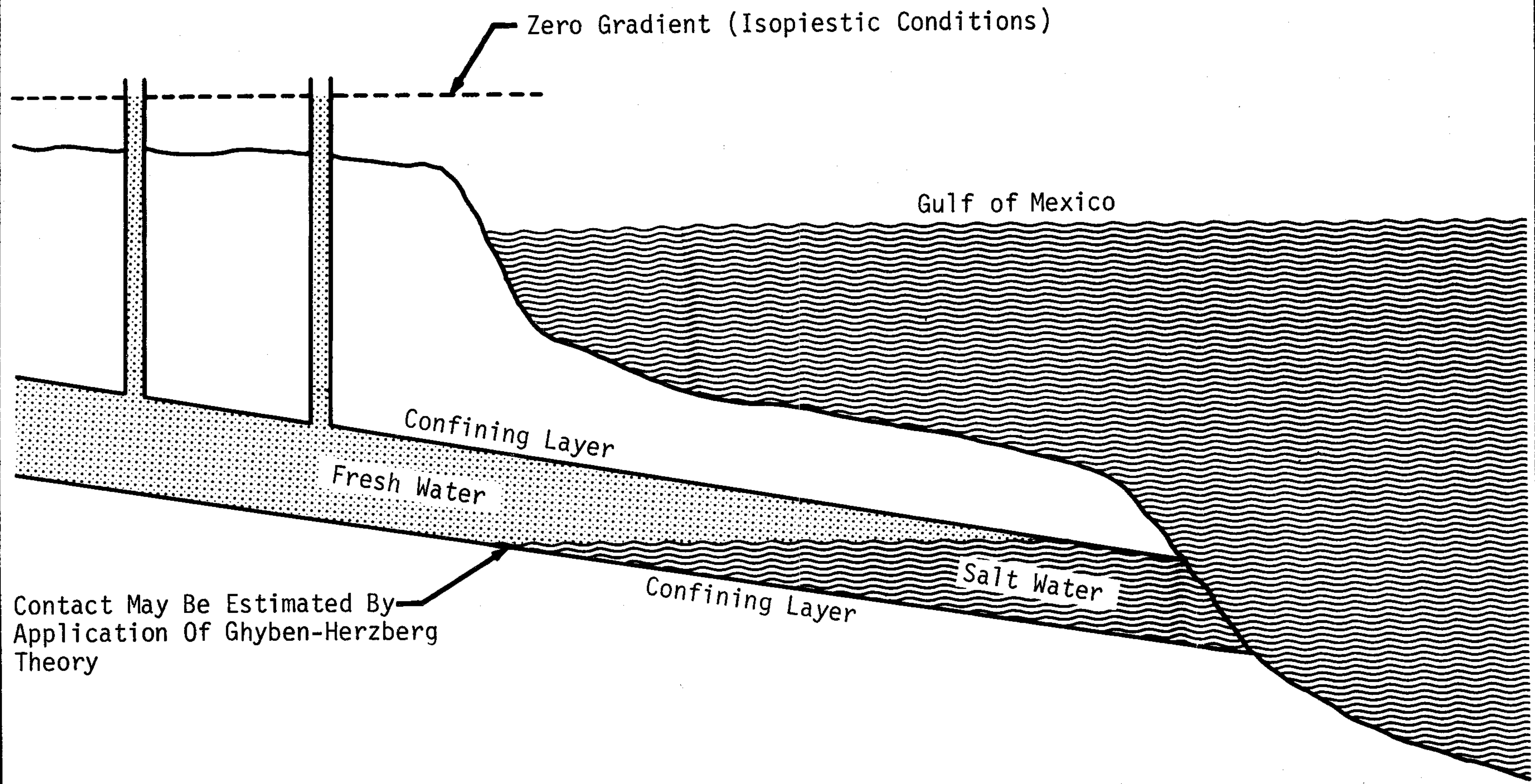
FIGURE 6.4-1



Gulf Power Company	GULF POWER CO. CARYVILLE STEAM PLANT	ILLUSTRATION OF GHYBEN-HERZBERG PRINCIPLE IN WHICH A COLUMN OF FRESH WATER BALANCES A COLUMN OF HEAVIER SEA WATER
		FIGURE 6.4-2



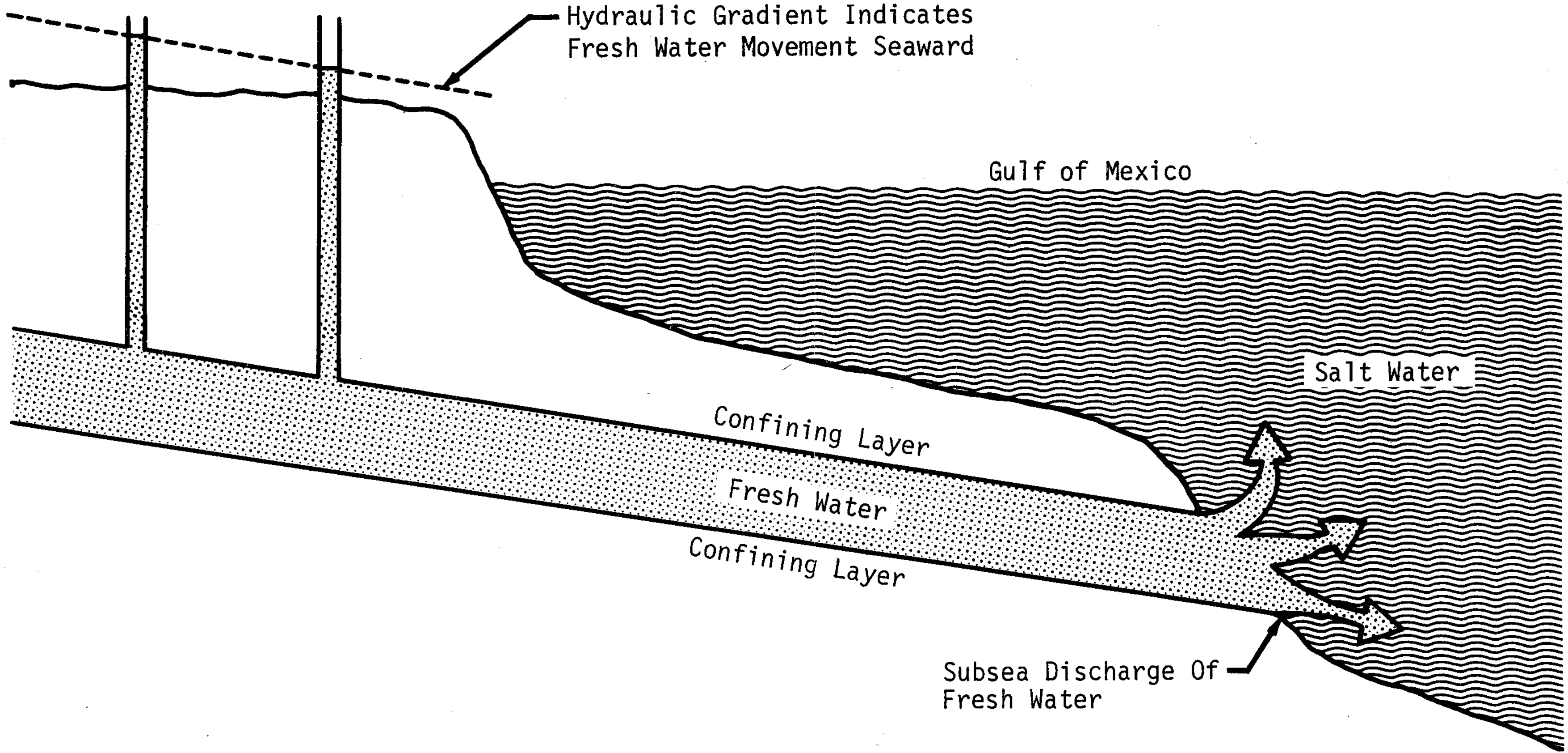
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	RELATIONSHIP OF SALT WATER TO FRESH WATER UNDER WATER-TABLE CONDITIONS FIGURE 6.4-3



GULF POWER CO.
CARYVILLE STEAM PLANT

SALT WATER/FRESH WATER RELATIONSHIP IN AN ARTESIAN AQUIFER UNDER ISOPIESTIC CONDITIONS (ZERO HYDRAULIC GRADIENT)

FIGURE 6.4-4



GULF POWER CO.
CARYVILLE STEAM PLANT

SALT WATER/FRESH WATER RELATIONSHIP UNDER ARTESIAN CONDITIONS WITH SUB-SEA DISCHARGE OF FRESH WATER

FIGURE 6.4-5

6.5 Air

6.5.1 Onsite Meteorological and Air Quality Measurement Program

Gulf has installed equipment for onsite meteorological measurements in a cleared area west of the plant location as shown in figure 6.5-1. Sensors for monitoring wind characteristics including wind speed and direction, temperature, and dew point are mounted on a 199-foot tower located near the center of the cleared area. There are no large structures near the tower that could affect meteorological measurements. Equipment for monitoring precipitation, solar radiation, and barometric pressure is located at ground level near the tower. The meteorological instrumentation is described in detail in table 6.5-1.

The system that will be used to monitor air quality in the vicinity of the plant is in the final stages of installation, and consists of two ambient air monitoring stations located north and south of the plant as shown in figure 6.5-1. Ambient air monitoring station No. M-4-B contains a Meloy SA-185-2 sulfur dioxide analyzer, a high-vol particulate sampler, and support equipment. Ambient air monitoring station No. M-2-A contains a Meloy SA-185-2 sulfur dioxide analyzer, a Thermo Electron 14D oxides-of-nitrogen analyzer, a high-vol particulate sampler, and support equipment. 2

Gulf will continuously record the data from meteorological and ambient air monitoring instruments on strip-chart recorders. The data will also be recorded at 10-second intervals in digital form by a computerized data aquisition system. These data will be checked for errors and stored on magnetic tape. The magnetic tapes will be processed to summarize the meteorological and air quality data.

6.5.2 Meteorological Data Sources

As presented in section 2.6, "Meteorology," the data source to describe trends in regional climatology of the Caryville site was Tallahassee, Florida. Tallahassee was chosen as the source of meteorological data because data required for air quality modeling were available for this location. Tallahassee is the nearest noncoastal station meeting this requirement.

Annual summaries of climatological conditions were obtained from the National Climatic Center in Ashville, N. C. Data included in the summaries were complied from measurements recorded at the Tallahassee Municipal Airport. The meteorological instrumentation from which the Tallahassee data were obtained is described in table 6.5-2.

6.5.3 Air Quality Models

This subsection describes the models Gulf used to derive estimates of basic air quality surrounding the proposed plant and discusses their application and acceptability.

Four air quality diffusion computer models were used to predict spatial distribution and ground level concentrations of sulfur dioxide (SO_2), nitrogen oxides (NO_x), and particulate matter resulting from operation of the Caryville plant. The four models are known as (a) the Air Quality Display Model (AQDM), (b) the Environmental Protection Agency (EPA) 24-Hour Power Plant Model (CRS1), (c) the Point Multiple (PTMTP), and (d) the Point Maximum (PTMAX). All the models use the Gaussian diffusion equation (1) and the most recent form of the Briggs Plume Rise Equation (2,3). They also employ the stability classes of Pasquill (4) and the diffusion parameters of Gifford (5).

6.5.3.1 The Air Quality Display Model (AQDM) - TRW Systems Groups of Washington, D.C., developed this general basic model (6,7) under contract to the National Air Pollution Control Administration, now called the Office of Air Programs, EPA. The AQDM calculates the annual average ground-level pollutant concentrations at many locations resulting from numerous area and point sources.

6.5.3.1.1 Methodology of AQDM Calculations - To run the AQDM, it is
necessary to input emissions data for all point and area sources which may
have an impact on the study area, to input meteorological data representa-
tive of the area in the form of a Pasquill stability windrose, and to
specify a grid of up to 237 receptor locations at which the pollutant con- 1
centrations are calculated. The model calculates the effect of each source
on each receptor for each observed combination of wind speed, wind direc-
tion, and stability class. The relative frequency of occurrence for each
combination of wind speed, wind direction, and stability class is then
included as a factor, and the resulting data are summed for each receptor
over all combinations and all sources. The plume is assumed to be nor-
mally distributed about its center line, i.e., a Gaussian-distribution
in the vertical direction, and distributed as a linear function of cross-
wind distance in the crosswind direction.

6.5.3.1.2 Meteorological Data Employed in the AQDM - The data represented by a Pasquill windrose are input into the AQDM. These data consist of a frequency distribution of wind speed and wind direction by Pasquill stability classes for a time period of one or more years, and should be obtained for the weather station which is the nearest to and most representative of the study site. A Pasquill windrose for Tallahassee, Florida, which is the most representative weather station for the Caryville site, was obtained for the period January 1969 through December 1973 (8). The annual average mid-afternoon mixing height of 1,200 meters from Holzworth (9) was input for limited mixing of the plume situations. The annual normal temperature for Tallahassee, Florida, 293°K (67.7°F), which is based on an average for the period 1941-1970 (10), was also input to the AQDM.

6.5.3.2 The EPA 24-Hour Power Plant Model (CRS1) - The Computer Techniques Group, Division of Meteorology, EPA, developed this model (11) to (a) determine the maximum 24-hour concentrations from individual point sources for one year, (b) to determine the meteorological conditions which

cause the maximum concentrations, and (c) to store concentration information on magnetic tape useful in determining calculated frequency distributions for various averaging times for receptors located near point sources. Because calculations of concentrations are made for each hour of a year and determined from midnight to midnight for each day, this model represents a comprehensive approach to the estimation of maximum concentrations in any given 24-hour period.

6.5.3.2.1 Methodology of CRS1 Calculations - Calculations are made for 180 receptors at 36 azimuths and five distances from the source. The single source can consist of from one to eight individual stacks. In this model, no consideration is given to the physical separation between stacks since all are assumed to be at the same geographical point. However, selection of the distances of the receptors from the source is of prime importance; and, in order to make this selection, another program, called PTMAX, is invoked. This latter program provides an analysis of maximum concentrations from each stack individually as a function of stability class and wind speed. Appropriate receptor locations for input to CRS1 can then be determined from the critical wind speed for each stability class and the distance of the corresponding maximum concentration. The distance of the maximum 24-hour concentration calculated by CRS1 is further refined after the main program has been run, by use of another program called PTMTP. This program calculates a 24-hour 1
concentration for up to 30 locations along the azimuth of maximum 24-hour concentration. When this program is used, the distance from the source of the location of maximum 24-hour concentration can be determined to the nearest 0.1 kilometer and the corresponding maximum concentration can be determined precisely.

6.5.3.2.2 Meteorological Data Employed in CRS1 - Calculations for this model are performed using surface meteorological data for (a) 1964, which is the only year that data is readily available from the National Weather Records Center in Ashville, North Carolina, (b) 24 hours a day, and (c) wind direction to 10's of degrees (36 points). The corresponding daily mixing height information for 1964, obtained from Mr. George Holzworth of the Climatic Analysis Branch of the EPA, is also input to CRS1. The model processes these data into the hourly surface and upper air data necessary to perform the calculations. Hourly surface weather data for Tallahassee, Florida, and daily mixing height data for Montgomery, Alabama, were used in the model as the most representative detailed meteorological data available for the Caryville site.

6.5.3.3 The Point Multiple Model (PTMTP) - PTMTP is a model (12) which calculates hourly pollutant concentrations at preselected locations resulting from several point sources. Up to 24 hours of hourly meteorological data may be input. Output for this model will include not only hourly concentrations, but also the average concentration over the time period considered.

6.5.3.3.1 Methodology of PTMTP Calculations - A set of up to 30 receptor locations and emission data for the source or sources are input

to the model, along with hourly meteorological data. This program is used in conjunction with both CRS1 and PTMAX. CRS1 provides hourly meteorological data for the 24 hours resulting in the highest ground level concentration calculated by that model. PTMTP uses these meteorological data and the same emission data used in CRS1, to calculate pollutant concentrations at receptors located along the azimuth of the maximum concentration. In this way, the distance to the 24-hour maximum ground level concentration can be refined to 0.1 kilometer, and the concentration at this location calculated. PTMAX interacts with PTMTP by providing the meteorological data for one hour which result in the maximum one-hour ground level concentration for a single stack. These meteorological data, along with complete emission data, are input to PTMTP, with receptors selected at downwind locations to determine the maximum one-hour pollutant concentration. This one-hour concentration can be converted to a three-hour concentration by multiplying by 0.8, a procedure used and recommended by Mr. Russell Lee, Meteorologist, Office of Air Quality and Standards, Source Receptor Analysis Branch, EPA.

6.5.3.3.2 Meteorological Data Employed in PTMTP - The meteorological data employed in PTMTP as used in this study consist of either actual hourly meteorology covering a 24 hour period, as supplied by CRS1, or one hour of hypothetical meteorological conditions supplied by PTMAX.
These data are used to calculate 24-hour and 3-hour pollutant concentrations, 1
respectively.

6.5.3.4 The Point Maximum Model (PTMAX) - PTMAX is a model (12) which performs an analysis of the maximum short-term pollutant concentration from a point source as a function of stability class and wind speed. A separate analysis is made for every stack.

6.5.3.4.1 Methodology of PTMAX Calculations - Emission data for a single stack are input with an ambient air temperature, and the model performs calculations to determine the short-term downwind maximum concentration for various combinations of stability class and wind speed. The results of the calculations are used in conjunction with CRS1 and with PTMTP. The distance to the maximum concentration for the critical windspeed of each stability class is used to determine the set of ranges for input to CRS1, thus providing that model with receptor locations at which the maximum pollutant concentrations are likely to occur. The stability class and wind speed combination which results in the maximum pollutant concentration calculated by PTMAX for a single stack are input to PTMTP with emission data for all stacks of the source. This procedure is followed in order to calculate the maximum ground-level pollutant concentration resulting from the entire source under these unfavorable meteorological conditions. A one-hour or three-hour maximum pollutant concentration can thereby be obtained.

6.5.3.4.2 Meteorological Data Employed in PTMAX - The calculations of this model are made for downwind locations, for a set of 49 different combinations of stability class and wind speed, which are generated internally

by the program. The only meteorological information input is the ambient air temperature to be used with the internally generated combinations of meteorological parameters to make the calculations. The annual normal temperature for Tallahassee, Florida, (10), 293°K (67.7°F), which is the same ambient air temperature input to AQDM, was used in PTMAX. 1

6.5.3.5 Acceptability of Air Quality Models AQDM, CRS1, PTMTP, and PTMAX were all obtained from the Region IV office of the EPA. The models and procedures described in this section are those used and recommended by Region IV, EPA, for their air quality modeling.

6.5.4 References

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(4) Pasquill, F. "The Estimation of the Dispersion of Windborne Material." Meteorology Magazine,, 90, 1063, pp. 33-49, 1961.

(5) Gifford, F. A., Jr. "Use of Routine Meteorological Observations for Estimating Atmospheric Depsersion." Nuclear Safety, 1961.

(6) Air Quality Display Model, TRW System Group, U. S. Department of Commerce, NTIS Clearinghouse No. PB 189 194, Washington, D. C. 1969. 1

(7) Martin, D. O., and J. A. Tikvart. "A General Atmospheric Diffusion Model for Estimating the Effect on Air Quality of One or More Sources." APCA Paper, pp. 68-148, June, 1968.

(8) Seasonal and Annual Wind Distribution by Pasquill Stability Classes, STAR Program, Station No. 93805, Tallahassee, Florida, Period 1/69-12/73, U. S. Department of Commerce, NOAA, Environmental Data Service, June 18, 1974.

(9) Holzworth, G. C. Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States, Environmental Protection Agency, Research Triangle Park, North Carolina, 1972.

(10) Local Climatological Data, Annual Summary With Comparative Data, 1974, Tallahassee, Florida, NOAA, Environmental Data Service, National Climatic Center, Ashville, N. C.

(11) Hrenko, J. B. Turner, and J. Zimmerman. Interim User's Guide to a Computation Technique to Estimate Maximum 24-Hour Concentrations from Single Sources, U. S. Department of Interior, Division of Meteorology, October 24, 1972.

(12) Turner, D. B., and A. D. Busse. User's Guides to the Interactive Versions of Three Point Source Dispersion Programs: PTMAX, PTDIS, and PTMTP, National Environmental Research Center, Office of Research and Monitoring, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, June, 1973.

TABLE 6.5-1

METEOROLOGICAL INSTRUMENTATION AT CARYVILLE SITE

Measured Parameter	Approximate Height Above Tower Base	Range	Accuracy
Wind Speed	195 feet & 33 feet	0-25, 50, 100 mph	±1 percent
Horizontal Wind Direction	195 feet & 33 feet	0 to 540°	±3°
Vertical Wind Direction	195 feet	±60°	±3°
Ambient Air Temperature	33 feet	-5 to +45°C	±0.5°C
Temperature Gradient	195 feet & 33 feet	-5 to +10°C	±0.1°C
Dewpoint Temperature	33 feet	-5 to +45°C	±0.3°C
Wind Direction Sigma	195 feet	0 to 40°	±1.2°C
Precipitation	Ground	0 to 1"	±0.01"
Solar Radiation	Ground	0 to 2gm-cal/cm^2/min	±1.5 percent
Barometric Pressure	Ground	28.0 to 32.0" Hg	±0.5 percent

1

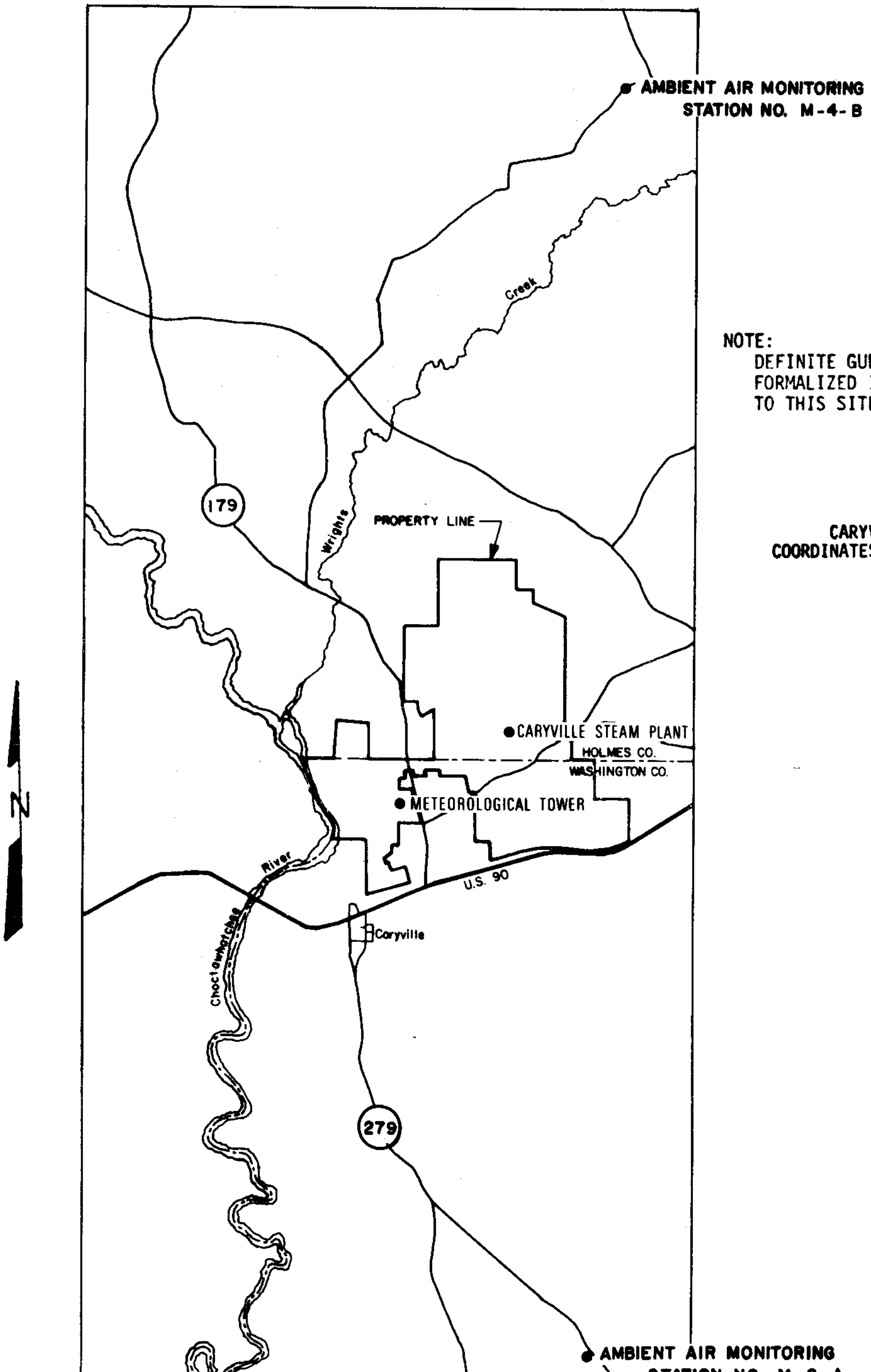
TABLE 6.5-2

METEOROLOGICAL INSTRUMENTATION AT TALLAHASSEE, FLORIDA

Location: Tallahassee Municipal Airport
Latitude: North 30° 23'
Longitude: West 84° 22'

Meteorological Instrument Description	Elevation Above Ground (feet)	Dates of Occupation
Wind Instruments	78	3/29/61 to 3/29/65
Wind Instruments	25	3/29/65 to Present
Extreme Thermometers	5	3/29/61 to Present
Psychrometer	5	3/29/61 to Present
Telepsychrometer	4	3/29/61 to Present
Weighing Rain Gage	5	3/29/61 to Present
8" Rain Gage	3	3/29/61 to Present
Hygrothermometer	5	10/12/65 to Present
Pyranometer	70	10/04/68 to Present

1



NOTE:
DEFINITE GULF PROPERTY LINES WILL BE FORMALIZED IN A SUBSEQUENT AMENDMENT TO THIS SITE CERTIFICATION APPLICATION

CARYVILLE PLANT SITE
COORDINATES N-654,000; E-1,594,000

1 ½ 0 1 MILE

Amendment 2 8/75
Amendment 1 6/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	LOCATION OF METEOROLOGICAL AND AIR QUALITY MEASUREMENT STATIONS FIGURE 6.5-1

6.6 Geology

6.6.1 Observation Wells

Gulf drilled wells in the shallow aquifer and the Floridan Aquifer at each of 26 sites at distances up to five miles from the plant site. (See figure 6.4-1.) Studies of the drill cutting samples are being made to determine the lithologies present and the structural geologic conditions that relate to site stability, land use, and the occurrence and movement of ground water. The locations of the observation wells have been selected to monitor hydrologic conditions prior to and during construction and after the plant is in operation. The wells can be used as sampling points to monitor water quality and to monitor the piezometric effects of water use from wells at the plant site. Gulf has collected water samples for chemical analysis from each well to provide background for the water quality monitoring program in the area. 2

6.6.2 Storage and Disposal Areas

Test borings at six locations in or in the vicinity of Ash Disposal Area "A," figure 2.1-1, were made to determine the thickness and lithology of overburden, the depth to limestone, and the general condition of the limestone bedrock. Electrical logs were run in the test holes when possible for purposes of correlation and to provide additional definition of clay lenses that occur sporadically beneath the disposal site. A shortterm pumping test of the water table aquifer in one of the test holes was run to determine the coefficients of storage and transmissibility and to provide information on the underflow. Geologists and drillers logs of the test borings are contained in Sections 1 and 2, respectively, of Appendix B. 2

6.6.2.1 Results of Test Borings and Pumping Test in Ash Disposal Area "A" The overburden on bedrock limestone beneath the proposed Ash Disposal Area "A" consists of lenticular sand, clay, and gravel. The clay beds are not continuous and the overburden in the area acts as a single water bearing unit with a shallow water table under water table conditions.

6.6.2.2 Ash Disposal Area "A" Fence Diagram - A Fence diagram of Ash Disposal Area "A" is shown in figure 2.4-19. The information was obtained from drillings and test borings in Ash Disposal Area "A" as contained in Sections 2 and 3, respectively, of Appendix B.

6.6.3 Remote Sensing Studies

Remotely sensed data in a carbonate terrain are known to be helpful in locating soil moisture anomalies, subsurface voids, areas of potential collapse, and zones of fracturing. However, because of the extensive cover of alluvial terrace deposits, Gulf could obtain only limited information concerning the bedrock limestone geology of the area by conventional field methods. Gulf therefore employed remote sensing techniques to aid in the study of the Caryville site. To provide remotely

sensed data, Gulf conducted studies using the Caryville 7 and 1/2-minute topographic quadrangle map, color infrared photography, a thermal infrared mosaic, and ERTS-1 (Earth Resources Technology Satellite) imagery.

6.6.3.1 Caryville 7 and 1/2-Minute Topographic Quadrangle - The ponds, swampy undrained depressions, and shallow dry depressions that dot the landscape of the Caryville area are related to solution which has occurred in the limestone underlying the thin veneer of alluvial terrace deposits in the area. Gulf measured the orientation of these surface features in a 35 square mile area surrounding the plant site directly from the Caryville 7 and 1/2-minute topographic quadrangle. The orientation of each lake and depression area shown within the study intervals on a rose diagram for analysis and comparison. (See figure 2.4-9.) One hundred sixteen orientations occurred within 146 recorded features. Orientation values were not assigned to equidimensional features.

6.6.3.2 Color Infrared Photography - Color infrared photographs of the Caryville area at a scale of 1:48,000 were studied under stereoscopic view for subtle differences in vegetative vigor suggestive of variations in soil moisture content which could represent subsurface geologic or hydrologic conditions. Initial analysis revealed a rectilinear character of many of the ponds, drainages, swamps, and zones of high soil moisture. Such short straight segments on aerial photographs have been called "fracture traces" provided they are less than one mile in length. Gulf evaluated an area of approximately 7.3 square miles in the vicinity of the proposed plant site and plotted the locations of 243 separate fracture traces. (See figure 2.4-10.) Their orientation are plotted at 10° intervals on a rose diagram for analysis and comparison. (See figure 2.4-11.)

Black and white prints of color infrared photographs were used to plot long linear alignments which were not possible to delineate on the color infrared transparencies. These alignments are difficult to see through conventional viewing; therefore, rather than viewing the print with the eye essentially perpendicular to the picture, the photographs were viewed with the eye at a low angle. This technique allows delineation of subtle long-linear features which, when longer than one mile in length, are termed "lineaments." Lineaments may represent a variety of geologic, topographic, and soils phenomena described in subsection 2.4.1, "Remote Sensing Studies."

Gulf studied an area of approximately nine square miles in the vicinity of the proposed plant site and plotted the traces of 47 major lineaments. (See figure 2.4-12 and -13.) Their orientations are plotted at a 10° interval on a rose diagram for analysis and comparison.

6.6.3.3 Thermal Infrared Mosaic - Gulf made studies of a thermal infrared mosaic of the Caryville area that was prepared at a scale of 1:12,000. Thermal signatures for differential soil moisture in the area show very subtle changes in thermal characteristics along linear alignments

and were plotted as lineaments. Gulf evaluated an area of 4.7 square miles in the vicinity of the proposed plant site and located 137 lineament traces. Their orientations are plotted at a 10° interval on a rose diagram for analysis and comparison. (See figure 2.4-15.)

6.6.3.4 ERTS-1 Imagery - Gulf also used data collected by ERTS-1 to evaluate the regional lineament orientations in Walton, Holmes, and Washington Counties, Florida. Lineaments were plotted on a band 5 (red spectral band) image of a part of northwest Florida at a scale of approximately 1:1,000,000. Lineaments so delineated were drawn on a clear overlay. One-hundred-sixteen separate lineaments were plotted for the three-county area. (See figure 2.4-16.) Their orientations are measured, recorded, and plotted on a 10° interval rose diagram. (See figure 2.4-17.)

6.6.4 Summary and Conclusion - The studies described in subsection 6.6.3 above did show a number of alignments, fracture traces, and lineaments suggestive of fracturing which may be related to subsurface karstic development in the underlying limestone. However, the results of these studies showed no evidence of collapse within the alluvial terrace deposits in the immediate area of the plant site.

Refer to subsection 2.4.1.6, "Remote Sensing Studies," for more information.

APPENDICES

APPENDICES

The information contained in the following appendices explains in greater detail the material to which it applies, or it lists in tabular form detailed findings from field investigations, or it presents the formulas used in gathering and presenting data. In all cases, the appendix material supplements one or more sections in the Site Certification Application. Reference is made in the narrative portion of a section to a particular appendix.

The following appendices are located behind the index tab shown:

SECTION NUMBER TO SUBJECT	INDEX TAB TITLE
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APPENDIX A

SECTION 1 OF APPENDIX A

This space is reserved for appendix material to section 2.3, "Regional Historic, Scenic, Cultural, and Natural Landmarks." This material will be added by a subsequent amendment to this Site Certification Application. 2

APPENDIX B

SECTION 1 OF APPENDIX B

This Section contains Geologist's Logs of the subsurface investigations performed at the proposed plant site. All logs are identified by either Observation Well Number or Ash Disposal Area "A" Test Hole Number. These numbers are located in the upper left of each page.

The following Subsurface Investigation Index, cross-referenced by page number, is offered to aid in locating a specific Observation Well or Test Hole Number.

SUBSURFACE INVESTIGATION INDEX

2

Observation Well 1-1
SE1/4NW1/4 sec. 6, T. 4 N., R. 15 W.
Washington County, Florida
Elevation: 92.85'LSD
Total Depth: 260 feet

Coordinates: 1,598,558.767 E.
650,753.092 N.

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet

0 to 10:	Sand, clayey, pale yellowish-orange and light-gray fine to very coarse, subangular to subrounded, grains clear and frosted, quartzose, with clay, white to moderate-pink, mottled in part, fine sandy; trace humate.
10 to 20:	Sand, very light gray and moderate pink, medium to very coarse, poorly sorted, subangular to subrounded, grains clear and frosted, quartzose with pink clay coating; clay, white to moderate-pink, sandy.
20 to 30:	Sand, clayey, light-pink, fine to coarse, poorly sorted, subangular to subrounded, grains clear and frosted, quartzose with minor amounts of pink clay.
30 to 40:	Sand, gravelly, very light-gray, fine to very coarse, poorly sorted, subangular to subrounded, grains clear and frosted, quartzose; gravel, fine, mostly rounded, frosted, quartz pebble.
40 to 50:	Gravelly sand, same, with trace of garnet.
50 to 60:	Gravelly sand, same.
60 to 70:	Gravelly sand, same, with kyanite grain noted.
70 to 80:	Gravelly sand, very light-gray; sand is medium to very coarse, subangular to subrounded, grains clear and frosted, quartzose; gravel, fine, mostly rounded, frosted, quartz pebble.
80 to 90:	Gravelly sand, same.
90 to 100:	Gravelly sand, same.
100 to 110:	Gravel, very light-gray to white, fine, mostly rounded, frosted, quartz pebble with coarse to very coarse, frosted, quartzose sand.
110 to 120:	Gravel, very light-gray to white, same, with moderate reddish-orange, fine to medium sandy clay.
120 to 130:	Gravelly sand; sand is very light-gray, fine to very coarse, poorly sorted, subangular to subrounded, grains clear and frosted, quartzose; gravel, very light-gray to white, fine, mostly rounded, frosted, quartz pebble, trace limonite cemented sand aggregates.
130 to 140:	Clayey sand, moderate-pink; sand is fine to coarse, subangular to subrounded, grains clear and frosted, quartzose; clay is moderate-pink, fine to coarse sandy; gravel from above.

Observation Well 1-1 - Cont.

Depth in Feet

140 to 150:	Gravelly sand; sand is very light-gray, fine to very coarse, poorly sorted, subangular to subrounded, grains clear and frosted, quartzose; gravel, very light gray to white, fine, mostly rounded, frosted, quartz pebble; trace humate.
150 to 160:	Gravelly sand, same, with trace of moderate-pink sandy clay, trace humate.
160 to 170:	Sand, very light-gray and grayish-yellow, iron stained in part, fine to very coarse, poorly sorted, angular to subrounded, frosted in part, quartzose.
170 to 180:	Sand, same, with trace of limonite cemented sand aggregates.
180 to 190:	Sand, very light-gray and grayish-yellow, iron stained in part, fine to very coarse, poorly sorted, angular to subrounded, frosted in part, quartzose.
190 to 200:	Sand, same, with fine gravels from above.
200 to 210:	Sand, same, with fine gravels from above.

Williston Formation at 210.5 Feet 2

210 to 220:	Sandstone (weathered limestone), yellowish-orange fine to medium grained, subangular, grains clear, quartzose, calcareous; with traces of dusky red sandy clay.
220 to 230:	Sandstone (weathered limestone), yellowish-orange, fine grained, subangular, quartzose, calcareous, slightly glauconitic.
230 to 240:	Limestone, yellowish-orange, fine sandy, glauconitic, weathered.
240 to 250:	Limestone, yellowish-orange, fine sandy, fossiliferous, weathered, glauconitic in part; *Nummulites* and bryozoans.
250 to 260:	No sample, cuttings not returned to surface because of drill hole conditions.

Observation Well 2-1
SE1/4SE1/4 sec. 31, T. 5 N., R. 15 W.
Holmes County, Florida
Elevation: 116.09' LSD
Total Depth: 220 feet

Coordinates: 1,600,089.519 E. and 654,096.285 N.

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet

0 to 10: Sand, pale yellowish-orange, fine to medium, subangular, quartzose and minor amounts of white to light-pink mottled, fine sandy clay.

10 to 20: Sand, pale yellowish-orange and moderate-pink, fine to very coarse poorly sorted with fine gravel, subangular to subrounded, quartzose, frosted in part and; clay, moderate-pink and pale greenish-yellow, fine sandy, mottled.

20 to 30: Clayey sand, grayish-red purple, pale yellowish-orange and pale greenish-yellow mottled; sand is fine, subangular, quartzose with mica trace.

30 to 40: Clayey sand, same.

40 to 50: Clayey sand, grayish-red purple and pale yellowish-orange; sand is fine to very coarse, poorly sorted with a few fine gravels, subangular to subrounded, frosted in part, quartzose; clay is grayish-red purple, fine sandy, slightly micaceous.

50 to 60: Clay, pale yellowish-orange and yellowish-gray mottled, stiff, blocky, very fine sandy and silty.

60 to 70: Clay, pale yellowish-orange and grayish-red purple, fine sandy, silty, slightly micaceous.

Crystal River Formation (Top of limestone at 78 feet)

70 to 80: No sample. Circulation was lost at 78 feet, drill cuttings not returned to surface.

80 to 90: Limestone, yellowish-gray, coquinoidal, porous, fossiliferous, hard; abundant *Nummulites* with a few byrozoa and pelecypod fragments.

90 to 100: No sample. Well drilled through broken rock. Circulation was difficult to maintain.

Observation Well 2-1 - Cont.

Depth in Feet

100 to 110:	Limestone, yellowish-gray, fine grained, dolomitic in part and coquinoidal, soft, fossiliferous in part.
110 to 120:	Limestone, yellowish-gray, fine grained dolomitic (split spoon sample).
120 to 130:	Limestone, yellowish-gray, coquinoidal, porous in part, fossiliferous; bryozoans, *Nummulites* and a few *Lepidocyclina*.
130 to 220:	No samples. Circulation not maintained due to broken rock conditions. See driller's log.

Observation Well 3-1
NW1/4NE1/4 sec. 1, T. 4 N., R. 16 W. Coordinates: 1,593,403.638 E.
Washington County, Florida 652,883.327 N.
Elevation: 79'LSD (topo)
Total Depth: 150 feet

Geologist's Log

Quaternary Alluvium

Depth in Feet

0 to 10:	Clayey sand; sand is very light-gray to pale yellowish-orange, fine to very coarse, poorly sorted, subangular to subrounded, grains clear and frosted, quartzose; clay is pale yellowish-orange silty and fine sandy.
10 to 20:	Clayey sand; sand is very light-gray to moderate-pink, fine to coarse, subangular to subrounded, grains clear and frosted quartzose; clay is moderate-pink, fine to coarse sandy, silty with mica trace.
20 to 30:	Clayey sand, moderate-pink, same.
30 to 40:	Gravelly sand, very light-gray to white; sand is fine to very coarse, poorly sorted, angular to subrounded grains clear and frosted, quartzose; gravel is fine, rounded, frosted, quartz pebble.
40 to 50:	Sandy clay, pale blue-green, fine to coarse sandy with sand, very light-gray, coarse and very coarse, subrounded, grains frosted, quartzose and pale yellowish-orange sandy clay.
50 to 60:	Ironstone or hardpan, black in color with pale yellowish-orange sandy clay and very light-gray limestone fragments.
60 to 70:	Sandy clay, white to very pale-orange, fine to coarse sandy with trace of ironstone and dark-gray (manganiferous?) clay.

Crystal River Formation

70 to 80:	Limestone, very pale-orange, hard, porous, bioclastic, fossiliferous; fossils highly weathered, mostly bryozoans, pelecypod shell fragments and Nummulites. (Top of limestone at 72 feet.)
80 to 90:	Limestone, same; fossil content mainly bryozoans, Nummulites and a few Lepidocyclina.
90 to 100:	Limestone, very pale-orange, same with abundant Nummulites.
100 to 110:	Limestone, pale yellowish-orange, hard, porous, bioclastic, fossiliferous; abundant bryozoans, Nummulites and pelecypod shell fragments; small echinoid noted.

Observation Well 3-1 - Cont.

110 to 120:	Limestone, same; sample contains fossils as above plus a few small *Lepidocyclina* and *Sphaerogypsina*.
120 to 140:	Limestone, very pale-orange, hard, porous, bioclastic, fossiliferous; abundant bryozoans, *Nummulites*, and a few pelecypod and echinoid fragments and a few small *Nummulites*.
140 to 150:	Limestone, same but more weathered, fossils poorly preserved; coarse sand from above?.

Observation Well 5-1
NE1/4NE1/4 sec. 31, T. 5 N., R. 15 W.   Coordinates: 1,601,257.886 E.
658,513.785 N.
Holmes County, Florida
Elevation: 102.66'LSD
Total Depth: 265 feet

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet

0 to 10:	Sand, very light-gray to very pale-orange, medium to very coarse, subangular to subrounded, grains partially frosted, quartzose with white clay coating.
10 to 20:	Gravelly sand, very light gray to white; sand is medium to very coarse, subangular to subrounded, grains clear and frosted, quartzose; gravel is fine, frosted, quartz pebble.
20 to 30:	Gravelly sand, same.
30 to 40:	Gravelly sand, same with yellowish-gray clay coating on grains and trace of dark mineral grains.
40 to 50:	Gravelly sand, very light-gray to white; sand is medium to very coarse, subangular to subrounded, grains clear and frosted, quartzose, gravel is fine, frosted, quartz pebble.
50 to 60:	Gravelly sand, same with slight increase in gravel size; sand grains coated in part with light-pink clay.
60 to 70:	Gravelly sand, same with decrease in gravel size and pale yellowish-orange, fine to corase grained clayey sand.
70 to 80:	Gravelly sand, very light-gray to white; sand is medium to very coarse, subangular to subrounded, grains mostly clear, quartzose, gravel is fine, frosted, rounded, quartz pebble; clayey sand, pale yellowish-orange, medium to very coarse, quartzose.
80 to 100:	Gravelly sand, very light-gray to white, same.
100 to 110:	Gravelly sand, very light-gray to very pale-orange; sand is coarse to very coarse, subangular to subrounded, grains clear and frosted, quartzose; gravel is fine, frosted, rounded, quartz pebble; minor amounts of moderate-red clayey sand.
110 to 120:	Clayey gravelly sand, dark yellowish-orange; sand is medium to very coarse, subangular to rounded, clay coated, quartzose; gravel is fine, frosted, rounded, quartz pebble.
120 to 140:	Clayey sand, light-red; sand is fine to very coarse, poorly sorted, subangular to subrounded, quartzose, with mica trace.
140 to 160:	Gravelly sand, very light-gray to light-pink; sand is coarse and very coarse, subangular to subrounded, grains clear and frosted, quartzose; gravel is fine, rounded, frosted, quartz pebble.

Observation Well 5-1 - Cont.

Depth in Feet

160 to 170:	Gravelly sand, same with grayish-red sandy clay.
170 to 180:	Gravelly sand, same with dark yellowish-orange and white speckled clay and clayey sand (limestone residuum?).
180 to 200:	Gravelly sand, very light-gray to very pale-orange; sand is coarse and very coarse, subangular to subrounded, grains frosted and clear, quartzose; gravel is fine, rounded, frosted, quartz pebble.
200 to 210:	Gravelly sand same with pale yellowish-orange clayey sand.

Williston Formation 2

210 to 220:	Limestone, grayish-orange, abundantly fine sandy, containing sparse glauconite with light-gray calcareous fine grained quartzose, glauconitic sandstone.
220 to 230:	Sandstone, light-gray, very fine grained, subangular quartzose, glauconitic, calcareous.
230 to 240:	Limestone, very pale-orange, weathered, hard, conquinoidal containing altered glauconite and weathered fragmental miliolid foraminifers; sandstone, light-gray, very fine grained as above.
240 to 250:	Limestone, same, but limestone is less weathered, yellowish-gray, and contains abundant foraminifera 2
250 to 260:	Limestone, yellowish-gray, same with subangular to subrounded, coarse grained quartz sand.
260 to 265:	Sandstone, pale yellowish-brown, very fine grained, subangular, quartzose, calcareous, glauconitic.

Observation Well 6-1
SE1/4NW1/4 sec. 30, T. 5 N., R. 15 W. Coordinates: 1,598,253.401 E.
Holmes County, Florida 662,108.679 N.
Elevation: 118.30' LSD
Total Depth: 265 feet

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet	
0 to 10:	Clay, moderate-pink and light greenish-gray, mottled in part, fine to coarse sandy.
10 to 20:	Sand, grayish-orange-pink, medium to very coarse, subangular to subrounded, grains mostly clear, quartzose with light clay coating.
20 to 30:	Sand, grayish-orange-pink, same with clay, grayish-pink, fine sandy.
30 to 50:	Clayey sand, grayish-pink; sand is very fine to coarse, poorly sorted, subangular to subrounded, quartzose with trace of dark mineral grains.
50 to 60:	Clay, medium dark-gray, silty, contains minor amounts of organic material; sand from above.
60 to 70:	Clay, olive-gray, fine sandy, stiff.
70 to 80:	Clay, olive-gray, fine sandy, stiff, with minor amounts of coarse sand.
80 to 90:	Clay, olive-gray, same with pink clayey sand from above.
90 to 100:	Clay, olive-gray, same with humate and sand, light-gray, coarse and very coarse, frosted in part, subrounded, quartzose.
100 to 110:	Gravelly sand, very light-gray; sand is coarse and very coarse, subrounded, partially frosted, quartzose; gravel is very fine, subrounded, frosted, quartz pebble with clay and humate from above.
110 to 120:	Gravelly sand, same with humate and brownish-gray clay.
120 to 130:	Gravelly sand, very light-gray to white; gravel is fine, rounded, frosted, quartz and quartzite pebble; sand is medium to very coarse, subangular to subrounded, quartzose.
130 to 140:	Gravelly sand, same with minor amounts of dark yellowish-orange clay and yellowish-gray fine sandy clay.
140 to 150:	Gravelly sand, very light-gray; gravel is fine, rounded, frosted, quartz and quartzite pebble; sand is fine to very coarse, subangular to subrounded, quartzose.
150 to 160:	Gravelly sand, same with moderate-pink sandy clay.
160 to 170:	Sand, grayish-orange, fine to very coarse, poorly sorted, subangular to subrounded, quartzose with residual clays of weathered limestone and limonitized fossil fragment
170 to 180:	Sand, dark yellowish-orange, fine to very coarse, poorly sorted, subangular to subrounded, quartzose with residual clays of weathered limestone fragments.

Observation Well 6-1 - Cont.

Depth in Feet

180 to 190:	Sand, very pale-orange, mainly coarse and very coarse, subrounded, quartzose, partially frosted.
190 to 200:	Sand, very light-gray, medium to very coarse, subrounded, slightly frosted in part, quartzose with humate trace.

Williston Formation 2

200 to 210:	Limestone, pale yellowish-orange, abundantly fine sandy with sparse glauconite and sand as above.
210 to 215:	No sample.
215 to 220:	Limestone, pale yellowish-orange, very fine sandy, glauconitic or sandstone, very fine grained, subangular, quartzose, calcareous, glauconitic.
220 to 230:	Sandstone, pale yellowish-orange, very fine grained, subangular, quartzose, calcareous, glauconitic.
230 to 240:	Limestone, pale yellowish-orange, hard, coquinoidal containing altered glauconite and weathered fragmental miliolid foraminifera; with sand, very light-gray, medium to very coarse, subrounded, partially frosted, quartzose.
240 to 250:	Limestone, very pale-orange, hard, coquinoidal, sparsely glauconitic, containing weathered miliolid foraminifera and other small foraminifera; sand as above.
250 to 260:	Limestone, yellowish-gray to light bluish-gray, fine to coarse sandy, abundantly glauconitic, fossiliferous (miliolids); sandstone, greenish-gray to light-gray very fine grained, quartzose, abundantly glauconitic.
260 to 265:	Limestone and sandstone, same with fine to very coarse, subangular to subrounded quartz sand. 2

Observation Well 7-1
NW1/4NW1/4 sec. 31, T. 5 N., R. 15 W.   Coordinates: 1,596,124.007 E.
Holmes County, Florida   658,642.349 N.
Elevation: 89.95'LSD
Total Depth: 151 feet

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet

0 to 10:	Sand and gravel, very light-gray; sand is fine to very coarse, poorly sorted, clayey, grains clear and frosted, subangular to subrounded, quartzose with kyanite trace; gravel, fine, rounded, quartz pebble.
10 to 20:	Sand and gravel, very light-gray; sand is medium to very coarse, poorly sorted, clayey, grains mostly frosted, subangular to subrounded, quartzose; gravel fine rounded, quartz pebble.
20 to 30:	Sand, medium to very coarse, subangular to subrounded, grains frosted, quartzose with minor amounts of medium dark-gray clay and lignite or humate.

Marianna Formation 2

30 to 35:	Clay, greenish-gray, sandy, glauconitic with sand from above and weathered yellowish-gray limestone fragments. Limestone at 34 feet on driller's log.
35 to 40:	Limestone, yellowish-gray, hard, with trace of glauconite, porous, bioclastic, with abundant Lepidocyclina and bryozoans, some smaller foraminifera.
40 to 42:	Limestone, yellowish-orange, weathered in appearance, iron stained, hard with abundant Lepidocyclina and bryozoans.
42 to 151:	No samples, circulation was lost, drill cuttings not returned to surface.

Observation Well 8-1
Near SW/cor. of SW1/4NW1/4 sec. 25, T. 5 N., R. 16 W.
Holmes County, Florida
Elevation: 68.82' LSD
Total Depth: 110.5 feet

Coordinates: 1,591,029.797 E.
661,495.471 N.

Geologist's Log

Quarternary Alluvium at Surface

Depth in Feet

0 to 10:	Sand, very pale-orange, fine to coarse, subangular to subrounded, frosted in part, quartzose with slight amount of light-brown clay.
10 to 20:	Sand, pale yellowish-orange, fine to very coarse, poorly sorted, subangular to subrounded, partly frosted, quartzose.
20 to 30:	Pale yellowish-orange sand, same.

Crystal River Formation (Top of limestone at 39 feet)

30 to 40:	Sand, pale yellowish-orange, same with highly weathered limestone in the form of yellowish-gray clay.
40 to 50:	Limestone, yellowish-gray, dense to fine grained fossiliferous; limestone, grayish-orange, fine grained, very hard, silty.
50 to 60:	Limestone, yellowish-gray, dense to coquinoidal, fossiliferous, porous in part; bryozoans, large foraminifera including *Lepidocyclina* and *Nummulites*.
60 to 70:	Limestone, yellowish-gray, coquinoidal, porous, abundantly fossiliferous; abundant *Nummulites* and bryozoans, few *Terebratulina* and assorted shell fragments.
70 to 80:	Limestone, yellowish-gray to pale-orange, same, slightly weathered.
80 to 90:	Limestone, pale yellowish-orange, weathered, coquinoidal, abundantly fossiliferous; bryozoans and *Nummulites*.
90 to 100:	No sample. Circulation lost in well.
100 to 101.5:	Split spoon sample: Limestone, yellowish-gray to pale yellowish-orange, dense to coquinoidal, soft, fossiliferous; bryozoans mainly.
109 to 110.5:	Split spoon sample. Limestone, yellowish-orange, soft, dense to coquinoidal, fossiliferous; abundant bryozoans and *Nummulites*.

Observation Well 12-1
SE1/4SW1/4 sec. 26, T. 5 N., R. 16 W.   Coordinates: 1,587,269.331 E.
Holmes County, Florida   653,470.175 N.
Elevation: 68.71' LSD
Total Depth: 190 feet

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet

0 to 10:	Clay, moderate-red and dark yellowish-orange, mottled, fine to medium sandy, slightly micaceous.
10 to 20:	Clay, moderate-red and dark yellowish-orange, same with slight increase in sand content.
20 to 30:	Clayey sand, moderate-red, slightly micaceous; sand is medium to coarse, subangular to subrounded, quartzose with heavy mineral trace.
30 to 40:	Clay, grayish-yellow-green, very fine sandy with mica trace.
40 to 50:	Clay, grayish-yellow-green, very fine sandy, same with medium to coarse subrounded quartz sand.
50 to 70:	Sand, very light gray, medium to very coarse, subangular to subrounded, grains mostly clear, quartzose with a few fine rounded, frosted quartz pebble gravels.
70 to 80:	Sand, medium to very coarse, same with yellowish-orange clay coating on grains and soft, very pale-orange, fine grained, micaceous, quartzose sandstone. Micas are mostly green.
80 to 90:	Gravelly sand, very light-gray to pale yellowish-orange; sand is mostly coarse and very coarse, subangular to subrounded, grains mostly clear, quartzose; gravel is fine, rounded, frosted, quartz pebble; sample contains trace of yellowish-orange clayey sand from above.
90 to 100:	Gravelly sand, same with weathered white feldspar crystals.
100 to 110:	Gravelly sand with feldspar crystals, same, and grayish-yellow-green, fine sandy waxy appearing clay.
110 to 120:	No sample due to loss of circulation.

Crystal River Formation at 123 Feet

120 to 130:	Sample consists mainly to very light-gray, medium to coarse, subrounded quartz sand with glauconite and yellowish-gray limestone trace (casing was set from 124' to 128'; see driller's log for lithologies in this interval).
130 to 150:	Sand, same with yellowish-gray to pale yellowish-orange fine sandy, glauconitic limestone fragments.
150 to 160:	Sand, very light-gray to yellowish gray, medium to coarse, subrounded, quartoze with glauconite trace. 2

Observation Well 12-1 - Cont.

Depth in Feet

Williston Formation ?

160 to 170: Sand, very light-gray, fine to medium, subangular, quartzose with glauconite trace and with yellowish-gray, fine grained, glauconitic dolomite fragments and carbonate (dolomite) sand. 2

170 to 180: Sand and dolomite fragments, same with abundant, very fine grained, carbonate sand.

180 to 190: No sample, circulation was lost.

Observation Well 13-1
SE1/4SW1/4 sec. 35, T. 5 N., R. 16 W. Coordinates: 1,587,766.710 E.
Holmes County, Florida 654,614.966 N.
Elevation: 59.33' LSD 2
Total Depth: 150 feet

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet

0 to 10:	Sand, very light-gray, subangular, grains clear, quartzose with clay, yelllowish-orange, silty and very fine sandy.
10 to 20:	Clay, very pale-orange, silty and very fine sandy with mica trace; sand, very light-gray, same and clay, yellowish-orange, same.

Crystal River Formation (Top limestone at 19 feet)

20 to 22: and 26 to 30:	Limestone, yellowish-gray to white, hard, bioclastic, very fossiliferous with medium to very coarse, subangular to subrounded, quartzose, grains clear; limestone not visibly affected by solution; fossils include bryozoans, shell fragments, *Nummulites* sp. and other small foraminifera including *Sphaerogypsina* and several species of *Globigerina*.
30 to 60:	Gap in samples due to drill hole conditions.
60 to 70:	Limestone, yellowish-gray, hard, porous, fossiliferous, fine sandy; abundant bryozoans and *Nummulites*.
70 to 90:	Limestone, yellowish-gray same with decrease in sand content.
90 to 100:	Limestone, yellowish-gray, hard, bioclastic, porous, fossiliferous with abundant bryozoans, *Nummulites* and a few small *Lepidocyclina*; *Sphaerogypsina* noted.
100 to 120:	Limestone, same, fossils as above with shell fragments.
120 to 130:	Limestone, yellowish-gray, hard, bioclastic, fossiliferous, with abundant bryozoans and *Nummulites* and medium grained, subangular quartz sand.
130 to 140:	Sand, very light-gray, medium to coarse, even grained, subangular to subrounded, grains clear, quartzose, slightly glauconitic with a few smaller foraminifera.
140 to 150:	Sand, same with minor amounts of yellowish-gray, soft glauconitic, very fine sandy siltstone.

CSP-ER-2

Observation Well 14-1
SE1/4NE1/4 sec. 2, T. 4 N., R. 16 W.   Coordinates: 1,589,661.261 E.
Washington County, Florida   651,525.676 N.
Elevation: 70.66' LSD
Total Depth: 100 feet

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet

0 to 10:	Sand and gravel, very light-gray to pale yellowish-orange; sand is medium to very coarse, poorly sorted, subangular to rounded, frosted, quartzose, clayey; gravels are fine, mostly rounded quartz pebbles.
10 to 20:	Sand, very light-gray, fine to very coarse, poorly sorted, grains clear and frosted, subangular to subrounded, quartzose, clayey, slightly iron stained in part.
20 to 30:	Sand, very light gray, fine to very coarse, mostly medium to coarse, grains clear and frosted, subangular to subrounded, quartzose, clayey.
30 to 40:	Sand, very light-gray, fine to medium mostly, with some coarse; grains mostly clear, subangular, quartzose; limonite trace.
40 to 43:	Sand, very light-gray, fine to medium mostly, with some coarse and very coarse; grains mostly clear, subangular to subrounded, quartzose with orangish-brown clay (residual limestone).
43 to	Lost circulation.

Cyrstal River Formation at 44 Feet

44.0 to 44.3:	Limestone, brownish-gray to light-gray, hard, bioclastic, fine to medium sandy, fossiliferous, frosted.
44.3 to 45:	Sand, very light-gray, medium to very coarse, subangular to subrounded, quartzose; grains clear, coated with small amount of light-brown clay.
45 to 47:	No sample.
47 to 50:	Limestone, yellowish-gray to yellowish-orange, weathered in appearance, fossiliferous, porous; shell fragments.
50 to 60:	Limestone, yellowish-gray, porous, hard, abundantly fossiliferous; abundant small brachiopods, Nummulites, bryozoans, pelecypod shell fragments and a few smaller foraminifera.
60 to 70:	Limestone, same.
70 to 80:	Limestone, more weathered in appearance, fewer recognizable fossil remains.
80 to 90:	Limestone, yellowish-gray, porous, hard, bioclastic, abundantly fossiliferous; Nummulites, bryozoans, Sphaerogypsina, few echinoids, and Lepidocyclina, and shell fragments.
90 to 100:	Limestone, same with abundant Nummulites, bryozoans, one Terebratulina observed.

Observation Well 18-1
NW¼NE¼ sec. 17, T. 5 N., R. 16 W.
Holmes County, Florida
Elevation: 63.03' LSD
Total Depth: 100 feet

Coordinates: 1,573,499.464 E.
674,032.737 N.

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet

0 to 10:	Clayey sand, yellowish-gray, pale yellowish-orange and moderate-pink; sand is very fine to fine grained, subangular, quartzose.
10 to 20:	Clayey sand, same with sand, light-gray, medium to coarse, subangular to subrounded, quartzose.
20 to 30:	Sand, light-gray and pale yellowish-orange, medium to very coarse, subangular to subrounded, frosted in part quartzose with trace of gray clay.
30 to 37:	Sand, light-gray and pale yellowish-orange, very fine to very coarse, poorly sorted, subangular to subrounded, quartzose, frosted in part; kyanite, garnet, and rose quartz noted.
37 to 42:	Circulation was lost, cuttings not returned to surface; 4-inch casing set to 42 feet.

Crystal River Formation (Top of limestone at 37 feet)

42 to 50:	Limestone, white to yellowish-gray, coquinoidal, porous, abundantly fossiliferous with bryozoans, larger foraminifera (mainly *Nummulites*), corals, and smaller foraminifera; *Terebratulina* noted.
50 to 60:	Limestone, white to yellowish-gray, coquinoidal, porous, abundantly fossiliferous as above with more numerous *Lepidocyclina* sp.
60 to 70:	Limestone, same with minor amount of medium grained subangular quartz sand.
70 to 80:	Limestone with sand trace, same; *Nummulites*, more abundant than *Lepidocyclina*.
80 to 90:	Limestone, white to yellowish-gray, coquinoidal, porous, abundantly fossiliferous with bryozoans and *Nummulites*; sand, very light gray, fine to medium, subangular, quartzose.
90 to 100:	Limestone, white to yellowish-gray, coquinoidal in part, dense in part, abundantly fossiliferous with bryozoans, foraminifera and fossil fragments with minor amounts of sand, very light-gray, fine to medium, subangular, quartzose.

Observation Well 19-1
SE¼NE¼ sec. 5, T. 4 N., R. 16 W.
Holmes County, Florida
Elevation: 69.15' LSD
Total Depth: 100 feet

Coordinates: 1,575,890.167 E.
652,058.888 N.

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet

0 to 10:	Sand, very light-gray and pale yellowish-orange, medium to coarse, subangular to subrounded, quartzose with weathered bryozoan fragments.
10 to 20:	Clayey sand, light brownish-gray, fine to medium grained, subangular to subrounded, quartzose.
20 to 30:	Sand, very light-gray and pale yellowish-orange, medium to coarse, subangular to subrounded, quartzose with a few weathered bryozoan fragments.

Crystal River Formation (Top of limestone at 36')

30 to 36:	Sand, same and limestone, yellowish-gray, weathered, fine grained, slightly glauconitic and dolomitic.
36 to 37:	Circulation was lost, cuttings not returned to surface. Steel casing was set to 37 feet.
37 to 50:	Limestone, white to yellowish-gray, coquinoidal, porous, abundantly fossiliferous with bryozoans, large and small foraminifera and shell fragments; sand, pale yellowish-orange, medium to coarse, subangular to subrounded, quartzose.
50 to 60:	Limestone, same; Nummulites more abundant than Lepidocyclina.
60 to 70:	Limestone, white to yellowish-gray, coquinoidal in part, dense in part, abundantly fossiliferous with bryozoans, large and small foraminifera and a few shell fragments.
70 to 80:	Limestone, white to yellowish-gray, same.
80 to 90:	Limestone, same with medium grained subangular quartz sand.
90 to 100:	Limestone, same with sand trace.

Observation Well 20-1
NE¼NE¼ sec. 20, T. 4 N., R. 16 W.
Holmes County, Florida
Elevation: 57.31' LSD
Total Depth: 100 feet

Coordinates: 1,575,244.691 E.
636,268.559 N.

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet

0 to 10:	Clayey sand, yellowish-orange and moderate-pink; sand is very fine to medium grained, subangular, quartzose, silty; limestone, yellowish-gray, glauconitic, medium sandy, occurring as fragments.
10 to 20:	Sand, pale yellowish-orange, medium to coarse, subangular to subrounded, frosted in part, quartzose.
20 to 30:	Sand, pale yellowish-orange, same.
30 to 40:	Sand, very light-gray and very pale-orange, medium to very coarse, subangular to rounded, frosted in part, quartzose with fragments of weathered yellowish-gray fine sandy residual limestone.

Crystal River Formation (Top of limestone at 45 feet)

40 to 50:	Limestone, yellowish-gray to pale yellowish-orange, slightly weathered, coquinoidal, porous, abundantly fossiliferous with bryozoans, Nummulites and Lepidocyclina; minor amounts of dense, glauconitic limestone; sand, medium to very coarse as above.
50 to 60:	Limestone, yellowish-gray to very pale-orange, fine grained, fossiliferous with fine glauconite; fossils include abundant Lepidocyclina, bryozoa, a few shell fragments and foraminifera.
60 to 70:	Limestone, yellowish-gray, dense and fine grained to coquinoidal, fossiliferous; fossils include abundant Lepidocyclina.
70 to 80:	Limestone, yellowish-gray, dense and fine grained to coquinoidal, same.
80 to 90:	Limestone, white to yellowish-gray, coquinoidal, fossiliferous with abundant Nummulites, bryozoans and small foraminifera; Terebratulina noted.
90 to 100:	Limestone, white to yellowish-gray, same with fossils as above.

Observation Well 22-1
NW¼SE¼ sec. 21, T. 4 N., R. 15 W. Coordinates: 1,609,533.366 E.
Washington County, Florida 634,280.478 N.
Elevation: 98.00' LSD
Total Depth: 320 feet

Geologist's Log

Quaternary Alluvium at Surface

Depth in Feet	
0 to 10:	Clayey sand, pale yellowish-orange and moderate-pink; sand is fine to very coarse, poorly sorted, subangular to subrounded, quartzose.
10 to 20:	Clayey sand, very pale-orange and grayish-pink; sand is fine to very coarse, poorly sorted, subangular to subrounded, quartzose.
20 to 30:	Clayey sand and clay, very pale-orange and grayish-pink; sand is fine to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose; clay is very light-gray, very fine sandy in part.
30 to 40:	Clayey sand and clay, same.
40 to 50:	Clayey sand, white to grayish-pink; sand is very fine to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose with fine rounded, frosted quartz pebble gravels.
50 to 60:	Clayey sand, same with fine, rounded, frosted, quartz pebble gravels.
60 to 70:	Gravel, very light-gray, fine, rounded, frosted, quartz and quartzite pebble with sand, fine to very coarse, same.
70 to 80:	Clay, very light gray, fine sandy with fine to very coarse sand and fine gravel.
80 to 90:	Clay, medium-gray, silty and fine sandy with a trace of cabonaceous material.
90 to 100:	Gray clay, same with light-brown and very pale-orange clay (residual limestone) and fine to very coarse sand and fine gravel.
100 to 110:	Sand and gravel, very light-gray; sand is very coarse, subrounded, frosted, quartzose; gravel is fine, rounded, frosted, quartz and quartzite pebble.
110 to 120:	Sand and gravel, same with medium-gray, light-brown, and pale-orange clay (residual limestone).
120 to 130:	Sand, light-gray, coarse and very coarse, subrounded, frosted in part, quartzose.
130 to 140:	Sand, same with fine quartz and quartzite pebble gravel.
140 to 150:	Sand and gravel, same.

Observation Well 22-1 - Cont.

Depth in Feet

150 to 160:	Sand and gravel, same with moderate-red, silty, very fine sandy, slightly micaceous clay.
160 to 170:	Clay, pale yellowish-brown, fine sandy, slightly micaceous.
170 to 180:	Clayey sand, moderate-red; clay is sandy and slightly micaceous; sand is fine to very coarse, subangular to subrounded, frosted in part, quartzose.
180 to 190:	Sand, moderate-yellow, very fine to medium with some coarse, subangular, quartzose with trace of moderate-red and yellow sandy clay.
190 to 200:	Sand, grayish-yellow, fine to very coarse, poorly sorted, subangular to subrounded, quartzose with minor amounts of yellowish-orange sandy clay.
200 to 210:	Sandy clay, moderate-red and yellowish-orange with trace of grayish-green; sand is fine to very coarse, subangular to subrounded quartzose.
210 to 220:	Sand, grayish-yellow, medium to very coarse, subangular to subrounded, frosted in part, quartzose with small amounts of light-gray residual clay.
220 to 230:	Sand, same with fine quartz and quartzite pebble gravel.
230 to 240:	Sand and gravel, same with moderate-red and green clays and yellowish-orange limestone residuum clay.
240 to 250:	Sand, pale yellowish-orange, medium to very coarse, subangular to subrounded, frosted in part, quartzose with yellowish-orange limestone residuum clay.
250 to 260:	Sand, very pale orange, medium to coarse, subangular to subrounded quartzose.

Williston Formation (Top of limestone at 262 feet) 2

260 to 270:	Sand, same with limestone, grayish-yellow, weathered, fine to medium sandy, glauconitic.
270 to 280:	Limestone, dark yellowish-orange, hard, medium to coarse sandy, glauconitic.
280 to 290:	Limestone, dark yellowish-orange, very fine grained, dolomitic, glauconitic with medium to coarse sand and sandy limestone.
290 to 300:	Limestone, greenish-gray, very fine grained, glauconitic, fossiliferous, dolomitic in part; abundant *Nummulites*, probably *N. moodybranchensis* and a few pelecypod shell fragments.
300 to 310:	Limestone, yellowish-gray, dense, fossiliferous, argillaceous and glauconitic in part with medium to coarse quartzose sand; *Nummulites* sp., echinoid fragments and bryozoans.
310 to 320:	Limestone, yellowish-gray, dense, fossiliferous, argillaceous and partly glauconitic; glauconitic altered to pale-orange color; sand, medium to coarse quartzose; Nummulites sp., echinoid fragments, shell fragments, and bryozoans. 2

Ash Disposal Area "A"
Test Hole 1
NW1/4NE1/4 sec. 1, T. 4 N., R. 16 W.
Washington County, Florida
Elevation: 90.35' LSD
Total Depth: 260.0'

Coordinates: 1,594,337.971 E. and 652,129.493 N.

Geologist's Log

Quaternary Alluvium at surface

0-5:	Gravelly sand, pale red; sand is fine to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose, with minor amount of clay; gravel is fine, rounded, frosted, quartz and quartzite pebble.
5-10:	Clayey sand and gravel, moderate reddish-orange; sand is fine to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose; gravel is fine, rounded, frosted, quartz and quartzite pebble.
10-15:	Clayey sand and gravel, same; clay is pale yellowish-orange, fine to medium sandy.
15-20:	Gravelly sand, moderate reddish-orange; sand is fine to very coarse, subangular to subrounded, frosted in part, quartzose; gravel is fine, rounded, frosted, quartz and quartzite pebble.
20-25:	Gravelly sand as above with minor amounts of intermixed clay; sand is mainly medium to coarse in size.
25-50:	Gravelly sand, pale reddish-orange, medium to very coarse, subangular to subrounded, frosted in part, quartzose; gravel is very fine, rounded, quartz and quartzite pebble.
50-60:	Gravelly sand, pale reddish-orange, fine to coarse mainly with some very coarse, subangular to subrounded, frosted in part, quartzose; gravel is very fine, mostly rounded, frosted, quartz pebble.
60-65:	Gravelly sand, same with minor amounts of very light-gray, silty clay; few kyanite crystals.
65-70:	Sand, pale orange, coarse and very coarse with some very fine gravel, subangular to subrounded, frosted in part, quartzose.
70-80:	Sand and very fine gravel, very light-gray to pale yellowish-orange, same.

2

Ash Disposal Area "A", Test Hole 1 - Cont.

80-100: Gravelly sand, very light-gray; sand is mainly coarse and very coarse, subangular to subrounded, frosted in part, quartzose; gravel is very fine, rounded, frosted, quartz and quartzite pebble.

100-105: Gravelly sand, same, color is light reddish-orange; minor amount of moderate red sandy clay.

105-110: Gravelly, same, yellowish-orange as above with light-brown residual clay derived from weathered limestone.

110-115: Gravelly sand as above, moderate reddish-orange in color, with minor amounts of moderate-red fine sandy clay.

115-120: Gravelly sand, yellowish-orange to moderate-red, sand is mainly coarse and very coarse, subangular to subrounded, frosted in part, quartzose; gravel is very fine, rounded, frosted, quartz and quartzite pebble; sample also contains grayish-red and moderate-red clay.

120-130: Gravelly sand as above with trace amounts of clay. 2

Crystal River Formation (Residual clay, Elev. - 40')

130-135: Clay, brownish-gray, fine to medium sandy, with irregular manganese staining; gravelly sand, yellowish-orange to moderate-red, quartzose as above.

135-145: Clay, brownish-gray, fine to medium sandy, same mixed with gravelly sand from above.

145-160: Clay, brownish-gray, silty with fine leached fossil debris and impressions and gravelly sand from above.

160-180: Clay, brownish-gray and yellowish-brown mottled, silty and fine sandy with highly weathered fossil debris and irregular manganese staining; samples also contain gravel from above.

180-185: Clay, brownish-gray and yellowish-brown mottled, silty and fine to medium sandy containing highly weathered and leached fossil debris with brownish-gray, fine to medium, clayey, quartzose sand; trace grayish-purple clay.

185-205: Clay, brownish-gray, silty and fine to medium sandy containing highly weathered and leached fossil debris with gravel and coarse sand from above.

Ash Disposal Area "A", Test Hole 1- Cont.

Crystal River Formation (Unweathered limestone at 209.6', Elev. -119.2')

205-210: Gravel as above with limestone, yellowish-gray, fine grained, glauconitic, dolomitic, fine to medium sandy.

210-220: No sample. 2

220-255: Limestone, yellowish-gray, fine grained, glauconitic, dolomitic in part, fine to medium sandy in part.

255-260: Circulation was lost at 257 feet. Drill cuttings were not returned to the surface.

Ash Disposal Area "A"
Test Hole 2
NE1/4NE1/4 sec. 1, T. 4 N., R. 16 W.
Washington County, Florida
Elevation: 124.78' LSD
Total Depth: 290.0'

Coordinates: 1,595,870.040 E. and 653,084.233 N.

Geologist's Log

Quaternary Alluvium at surface

0-20: Clayey sand, dark yellowish orange, fine to very coarse grained, subangular to subrounded, frosted in part, quartzose.

20-25: Clayey sand, pale-red, fine to very coarse, subangular to subrounded, frosted in part, quartzose with brownish-gray very fine quartzose sand; trace humate.

25-40: Clayey sand, yellowish-orange and pale-red, fine to very coarse, subangular to subrounded, frosted in part, quartzose with trace humate.

40-45: Sand, moderated orange pink, medium to very coarse, subangular to subrounded, frosted in part, quartzose, with clay trace. 2

45-50: Sand as above with a few very fine quartz pebble gravels.

50-55: Sand, very light-gray, mainly coarse and very coarse, subangular to subrounded, frosted in part, quartzose with a few very fine quartz pebble gravels.

55-65: Sand and gravel same with trace of light-pink sandy clay.

65-95: Gravelly sand, very light-gray to very pale-orange; sand is coarse and very coarse, subangular to subrounded, frosted in part, quartzose, gravel is very fine, rounded, quartz pebble.

95-110: Gravelly sand, very light-gray to pale-orange; sand is coarse and very coarse, subangular to subrounded, frosted in part, quartzose; gravel is very fine, rounded, quartz pebble; samples contain minor amounts of intermixed clays.

110-190: Gravelly sand, very light-gray to pale-orange, same with minor amounts of white very fine sandy clay.

Ash Disposal Area "A", Test Hole 2 - Cont.

Crystal River Formation (Residual clays, Elev. -65.0')

190-195: Gravelly sand, dark yellowish-orange, sand is coarse and very coarse, subangular to subrounded, frosted in part, quartzose; gravel is very fine, rounded, quartz pebble; clay, light-brown, residuum from weathering of limestone.

195-205: Clay, light-brown to moderate-brown, silty, sandy in part (clay is limestone residuum) with coarse to very coarse, subangular to subrounded quartzose sand.

205-215: Limestone residuum, grayish-orange to moderate yellowish-brown consisting of highly weathered limestone fragments and light to medium-brown silty clay; brownish-gray, coarse to very coarse quartzose sand.

215-225: Clay, yellowish-orange brown, silty, fine sandy in part containing highly weathered fossil remains with light-brown medium to very coarse, subangular to subrounded quartzose clayey sand; trace weathered limestone fragments.

225-240: Clay, moderate-brown, silty and fine sandy with light-brown medium to very coarse, subangular to subrounded quartz sand, and weathered limestone fragments. 2

Crystal River Formation (Unweathered limestone at 244 feet, Elev. -119')

240-245: Limestone residuum, moderate-brown, consisting of highly weathered limestone fragments and brownish-spongy appearing clay; sand and gravel from above.

245-255: Limestone residuum, same with yellowish-orange fine sandy, glauconitic limestone and fine to medium quartz sand.

255-260: Limestone, yellowish-gray, fine grained, dolomitic, glauconitic with fine to coarse quartzose sand.

260-278: Limestone, yellowish-gray, fine grained, dolomitic, glauconitic, very fine sand in part with fine to coarse quartzose sand.

278-290: 100% loss in circulation occurred at 278 feet. Drill cutting samples from 278 feet to 290 feet (total depth) were not returned to surface.

Ash Disposal Area "A"
Test Hole 3
NW1/4NW1/4 sec. 6, T. 4 N., R. 15 W.
Washington County, Florida
Elevation: 112.57' LSD
Total Depth: 265.0'

Coordinates: 1,597,243.656 E. and 652,010.070 N.

Geologist's Log

Quaternary Alluvium at surface.

0-10:	Clayey sand, very pale-orange, fine to medium, subangular, quartzose with minor amounts of organic matter.
10-30:	Clayey sand, very pale-orange, fine to coarse, mostly fine to medium, subangular, quartzose.
30-50:	Sand, very light-gray to very pale-orange, medium to coarse, subangular to subrounded, quartzose.
50-60:	Sand, very light-gray to very pale-orange, medium to very coarse, subangular to subrounded, frosted in part, quartzose.
60-80:	Sand, same with very fine, frosted, rounded, quartz pebble gravel. 2
80-100:	Sand, very light-gray to very pale-orange, medium to very coarse, subangular to subrounded, frosted in part, quartzose.
100-110:	Sand, very light-gray to very pale-orange, medium to very coarse, subangular to subrounded, frosted in part, quartzose with a few very fine quartz pebble gravels.
110-135:	Gravelly sand, very light-gray to light-pink, sand is medium to very coarse, subangular to subrounded, frosted in part, quartzose with minor amounts of light-pink clayey sand; gravel is very fine, rounded, quartz pebble.
135-140:	Sand, very light-gray to very light-pink, medium to very coarse, subangular to subrounded, frosted in part, quartzose.
140-150:	Sand, same with a few very fine gravels.
150-160:	Gravelly sand, brownish-gray, sand is medium to very coarse, subangular to subrounded, frosted in part, quartzose, with minor amounts of brownish-gray clay; gravel in very fine, rounded, frosted, quartz pebble.
160-165:	Gravelly sand, same with moderate-pink sandy clay trace and trace of light-brown residual clay.

Ash Disposal Area "A", Test Hole 3 - <u>Cont.</u>

165-180: Gravelly sand, grayish-orange to grayish-pink; sand is medium to very coarse; gravel is very fine quartz pebble; trace of grayish-pink clay.

180-200: Gravelly sand, very pale-orange; sand is fine to very coarse, mainly coarse and very coarse, subrounded, frosted in part, quartzose; gravel is very fine, rounded, frosted, quartzose; clay, light-pink, sandy. Note: Electric log indicates clay in the interval from 180 feet to 222 feet. Samples apparently are not representative.

200-205: Gravelly sand, very pale-orange, same.

205-210: Gravelly sand, same with minor amounts of sandy pink clay. 2

210-225: Gravelly sand, very pale-orange, same; trace of grayish-orange residual limestone.

<u>Crystal River Formation</u> (Top of limestone at 226 feet, Elev. -113.4')

225-230: Sand, very light-gray, medium to coarse, subangular to subrounded, sparsely glauconitic, quartzose with fragments of light-brown to yellowish-gray sandy weathered, glauconitic, limestone.

230-260: Sand and weathered limestone, same.

260-265: Sand, very light gray, medium to coarse, subangular to subrounded, sparsely glauconitic, quartzose and limestone, yellowish-gray, fine grained, dolomitic, glauconitic. 50% loss of circulation at 260 feet and complete loss of circulation at 265 feet.

Ash Disposal Area "A"
Test Hole 4
NW1/4SW1/4 sec. 6, T. 4 N., R. 15 W.
Washington County, Florida
Elevation: 88.92' LSD
Total Depth: 166.5'

Coordinates: 1,596,169.396 E. and 649,980.208 N.

Geologist's Log

Quaternary Alluvium at surface.

0-10:	Clayey sand and gravel, grayish-orange to moderate-red; sand is fine to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose; gravel is very fine, rounded, frosted, quartz pebble.
10-15:	Clayey sand and gravel, moderate reddish-orange, very fine to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose; gravel is very fine, rounded, frosted, quartz pebble; clay is moderate reddish-orange silty.
15-20:	Clayey sand and gravel, same with pale greenish-yellow and moderate reddish-orange silty clay. 2
20-40:	Clayey sand and gravel, same with yellowish-gray to moderate reddish-orange silty clay.
40-60:	Clayes sand and gravel, grayish-orange to moderate-red; sand is fine to very coarse mostly coarse and very coarse, subangular to subrounded, frosted in part, quartzose; gravel, very fine, rounded, frosted, quartz pebble; clay is grayish-orange to pale yellowish-orange, silty.
60-75:	Clayey sand and gravel, moderate reddish-orange; sand is medium to coarse, subangular, frosted in part, quartzose; gravel is very fine, subangular to subrounded, frosted, quartzose; clay is light-red, silty; trace ferruginous grains.
75-80:	Clayey sand and gravel, grayish-yellow to pale-red; sand is medium to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose; gravel is very fine, subangular to subrounded, frosted, quartzose; clay is yellow, purple, and grayish-red, blocky, fine sandy.
80-90:	Clayey and gravel, same; clay is more evenly disseminated, grayish-red, purple, and yellow, fine sandy.
90-100:	Clayey sand, grayish-yellow; sand is medium to coarse, some very coarse, subangular to subrounded, frosted in part, quartzose; clay is pale greenish-yellow to pale purple, fine sandy.

Ash Disposal Area "A", Test Hole 4 - Cont.

100-110: Clayey sand, pale yellowish-orange; sand is medium to very coarse, subangular to subrounded, grains mainly clear quartz; clays are pale greenish-yellow to pale-purple, fine to medium sandy, with trace of dark mineral grains.

110-120: Sand, pale yellowish-orange, coarse and very coarse, subangular to subrounded, grains clear and frosted in part, quartzose.

120-130: Sand, same with minor amounts of brownish-gray clay and limonite cemented sand aggregates.

130-140: Clayey sand and gravel, grayish-red; sand is medium to very coarse, subangular to subrounded, grains mostly frosted, quartzose; clay is pale-purple, silty, blocky; gravel is very fine, rounded, frosted, quartz pebble. 2

140-150: Clayey sand and gravel; sand as above; gravel is fine, rounded, frosted, quartz and quartzite pebble; clay is grayish-red purple and yellow mottled, fine to medium sandy.

150-160: Clayey sand and gravel, moderate reddish-orange; sand is mostly coarse and very coarse, subangular to subrounded, mostly frosted, quartzose; gravel very fine, quartz pebble; clay is reddish-orange, silty; trace limonitic sand aggregates.

160-165: Void. Complete loss of circulation.

165-166.5: Split spoon sample, blows 3-3-4. Possible top of Crystal River Formation. Sample consists of fine to coarse (4 mm to 30 mm) quartz and quartzite pebble gravels and yellow-gray, fine grained, porous, dolomitic limestone.

Ash Disposal Area "A"
Test Hole 4-A
NE1/4SE1/4 sec. 1, T. 4 N., R. 16 W.
Washington County, Florida

Coordinates:

Elevation: 107.02' LSD
Total Depth: 248.0 feet

Geologist's Log

Quaternary Alluvium at surface

Depth in Feet

0 to 10: Gravelly clayey sand, moderate-orange pink, sand is medium to very corase, subangular to subrounded, frosted in part, quartzose; gravel is very fine and fine, subrounded to rounded, frosted, quartz pebble; clay is orange pink, medium sandy; trace of humate.

10 to 20: Gravelly, clayey sand, dark yellowish-orange, same.

20 to 40: Clayey gravelly sand, pale yellowish-orange to dark yellowish-
orange; sand is medium to very coarse, subangular to subrounded, 2
frosted in part, quartzose; gravel is very fine and fine,
rounded, frosted, quartz pebble; clay is pale yellowish-orange,
silty.

40 to 50: Clay, light-red to pale reddish-orange, medium to very coarse sandy; minor amounts of medium to very coarse sand and very fine gravel.

50 to 60: Gravelly, clayey sand, light-red to medium light-gray; sand is medium to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose; gravel is very fine, subrounded to rounded, quartz pebble; clay is light-red and medium light-gray, sandy with humate (gray material may be from surface).

60 to 70: Gravelly, clayey sand, grayish-pink to very pale-orange; sand is fine to very coarse, very poorly sorted, angular to subrounded, frosted in part, quartzose; gravel is fine, subangular to subrounded, frosted, quartz pebble; clay is light-pink and yellowish-gray; trace garnet and dark mineral grains.

70 to 80: Gravelly clayey sand, grayish-pink to reddish-brown; sand is coarse and very coarse, subangular to subrounded, only partially frosted, quartzose; gravel is fine, rounded, quartz pebble; clay is reddish-brown fine sandy.

80 to 90: Gravelly sand, very pale-orange, same as above.

Ash Disposal Area "A", Test Hole 4-A - <u>Cont.</u>

90 to 100: Gravelly sand, same with dark yellowish-orange residual clay formed from the weathering of limestone.

100 to 120: Gravelly sand, very light-gray to pale yellowish-orange; sand is very fine to very coarse, very poorly sorted, angular to subrounded, frosted in part, quartzose; gravel is fine, rounded, quartz pebble; sample contains trace of pale yellowish-orange sandy clay.

120 to 140: Gravelly sand, same with trace of pale-purple fine to coarse sandy clay.

140 to 150: Gravelly sand, same; sand is medium to very coarse in size, subangular to subrounded, frosted in part, quartzose; gravel is very fine, subrounded to rounded, frosted, quartz pebble; pale-purple sandy clay trace.

150 to 160: Gravelly sand, same with moderate red caly.

160 to 190: Gravelly sand, same with brownish-gray limestone residuum 2
(silty and sandy clay).

190 to 210: Gravelly sand, grayish-orange; sand is coarse and very coarse, subangular to subrounded, frosted in part, quartzose; gravel is very fine, subrounded to rounded, frosted, quartz pebble.

210 to 220: Gravelly sand, same with yellowish-brown sandy residual clay of weathered limestone of Crystal River Formation.

<u>Crystal River Formation</u> (Top of limestone at 227 feet)

220 to 230: Gravelly sand, same with weathered yellowish-gray, medium sandy limestone fragments.

230 to 240: Limestone, yellowish-gray, medium sandy, with trace of glauconite; gravelly sand from above.

240 to 248: Yellowish-gray sandy glauconitic limestone and yellowish-gray fine grained dolomitic limestone. Circulation was lost at 248 feet and boring was terminated.

Ash Disposal Area "A"
Test Hole 5
NE1/4NE1/4 sec. 1, T. 4 N., R. 16 W.
Washington County, Florida
Elevation: 86.09'
Total Depth: 220.0 feet

Coordinates: 1,595,178.377 E. and 652,355.272 N.

Geologist's Log

Quaternary Alluvium at surface

Depth in Feet

0 to 10: Clayey sand, pale yellowish-brown and pale yellowish-orange; medium to very coarse, subangular to subrounded, partially frosted, quartzose with small amounts of humate.

10 to 20: Gravelly sand, pale yellowish-orange; sand is coarse and very coarse, subangular to subrounded, frosted in part, quartzose; gravel is fine, frosted, subrounded, quartz pebble; sample also contains fragments of fine grained, glauconitic limestone.

20 to 30: Gravelly clayey sand, pale yellowish-orange and moderate-pink, 2
medium to very coarse, subangular to subrounded, frosted in part, quartzose; gravel is fine, subrounded to rounded, quartz pebble; sample contains a few fragments of limestone as above.

30 to 40: Gravelly clayey sand, pale yellowish-orange and moderate-pink, same.

40 to 50: Gravelly, clayey sand; sand is fine to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose; gravel is fine, rounded, quartz pebble; clay is moderate pink, silty; sample also contains limestone fragments.

50 to 60: Gravelly clayey sand, same; clay is silty and fine sandy.

60 to 70: Gravelly sand, pale yellowish-orange; sand is coarse and very coarse, subangular to subrounded, frosted in part, quartzose; gravel is very fine and fine, rounded, frosted, quartz pebble; sample contains fragments of fine grained glauconitic and fine to medium sandy limestone.

70 to 80: Gravelly sand, same with humate trace.

80 to 90: Gravelly clayey sand, moderate reddish-orange; sand is medium to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose; gravel is very fine, subrounded to rounded, frosted, quartz pebble; clay is silty.

Ash Disposal Area "A", Test Hole 5 - Cont.

90 to 100: Gravelly sand, grayish-orange; sand is medium to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose; gravel is very fine and fine, subrounded to rounded, frosted, quartz pebble.

100 to 110: Gravelly clayey sand, moderate-pink; sand and gravel as above; clay is silty and very fine sandy.

110 to 160: Gravelly sand, moderate-orange pink; sand is coarse and very coarse, subangular to subrounded, frosted in part, quartzose;
gravel is very fine and fine, subrounded to rounded, frosted, 2
quartz pebble.

160 to 190: Gravelly sand, same with trace of moderate yellowish-brown fine to medium sandy residual clay (Residual clay of Crystal River Formation).

190 to 210: Gravelly clayey sand, moderate yellowish-orange; sand is medium to very coarse, poorly sorted, subangular to subrounded, frosted in part, quartzose; gravel is very fine and fine, subrounded to rounded, quartz pebble.

Crystal River Formation (Top of limestone at 210 feet)

210 to 220: Limestone, yellowish-gray and pale yellowish-orange, weathered, fine to medium sandy, glauconitic; gravelly sand from above.

SECTION 2 OF APPENDIX B

This Section contains Driller's Logs of the subsurface investigation performed at the proposed plant site. All logs are identified by either Observation Well Number or Ash Disposal Area "A" Test Hole Number. These numbers are located in the upper left of each page.

The following Subsurface Investigation Index, cross-referenced by page number, is offered to aid in locating a specific Observation Well or Test Hole Number.

SUBSURFACE INVESTIGATION INDEX

Observation Well 1-1
SE1/4NW1/4 sec. 6, T. 4 N., R. 15 W.
Washington County, Florida
Elevation: 92.85'LSD
Total Depth: 260 feet

Coordinates: 1,598,558.767 E.
650,753.092 N.

Driller's Log

Depth in Feet

0	to	1.5:	Top soil, brown sand.
1.5	to	6:	Stiff tan clay.
6	to	9:	Stiff grayish-tan clay.
9	to	13:	Stiff reddish-tan clayey sand.
13	to	26:	Stiff tan clayey sand.
26	to	32:	Firm coarse gray sand.
32	to	54.5:	Firm coarse sand with clay lenses.
54.5	to	66.5:	Stiff tan clay.
66.5	to	96:	Stiff tan clay.
96	to	109:	Stiff pure clay.
109	to	175:	Firm tan gray sand with clay lenses.
175	to	183:	Firm tan gray sand.
183	to	200:	Dense sand.
200	to	210.5:	Dense sand with clay lenses.
210.5	to	214:	Hard limestone.
214	to	216:	Hard with soft broken streaks (lost about 15% water).
216	to	219:	Hard.
219	to	248:	Hard with broken soft streaks.
248	to	260:	Soft broken limestone (lost 50%).

Water Level 23' at T.O.B.
Water Level 33' at 24 hours.
Casing: size - 6 5/8"OD; length - 211'

Observation Well 1-2
SE1/4NW1/4 sec. 6, T. 4 N., R. 15 W. Coordinates: 1,598,562.101 E.
Washington County, Florida 650,763.080 N.
Elevation: 92.85'LSD
Total Depth: 53 feet

Driller's Log

Depth in Feet

0 to 1.5	Firm brown sand.
1.5 to 13:	Stiff tan clayey sand.
13 to 53:	Firm grayish-tan sand.

Wash 2 loads of water through hole.
Put gravel around p.v.c.

Water Level 9' at T.O.B.
Casing: size - 4"; length - 53' P.V.C.

Observation Well 2-1
SE1/4SE1/4 sec. 31, T. 5N., R. 15 W.
Holmes County, Florida
Elevation: 116.09' LSD
Total Depth: 220 feet

Coordinates: 1,600,089.519 E. and 654,096.285 N.

Driller's Log

Depth in Feet	
0 to 3:	Brown sand, top soil.
3 to 11:	Tan sandy clay.
11 to 15:	Sand.
15 to 34:	Clay, tan.
34 to 47:	Pure clay.
47 to 52:	Sand.
52 to 54:	Sandy clay.
54 to 73:	Stiff gray clay.
73 to 78:	Sandy clay.
78 to 84:	Lost all. mud. Hard broken limestone. 11-14-74 - Ream with 6" bit 0 to 84' pull out Ream - with 10" bit 0 to 60' 11-15-74 - Ream 60 to 84' - set casing to 87.8
84 to 110:	Drill hard broken limestone
110	Hard broken limestone. Ream to 96' - 6" bit 11-19-74 - Ream 96 to 104. Set 22' 4" pipe inside of 6" pipe from 84 to 104 drill - 110 to TD Drove 6" casing from 87.7 to 91' 11-20-74 - Drill - 3 hr. Rain out. 5 hrs. Fix tire on water truck Work on motor mount - black water 11-21-74
170 to 180:	Drill hard limestone, broken.
180 to 206:	Sand with limestone.
206 to 220:	Dense gray sand. Casing: size 4' length 118' 4" Black pipe in side of 91' 6" pipe.

Observation Well 2-2
SE1/4SE1/4 sec. 31, T. 5 N., R. 15 W.
Holmes County, Florida
Elevation: 115.49' LSD
Total Depth: 75 feet

Coordinates: 1,600,082.356 E.
654,097.628 N.

Driller's Log

Depth in Feet

0 to 3:	Brown sand.
3 to 14:	Brownish-tan clayey sand.
14 to 31:	Tan clay.
31 to 65:	Gray clay with little sand lenses.
65 to 75:	Sand - 3 7/8 hole.
0 to 75:	Ream - 6" hole

Screen - 65 to 75'
Put gravel around casing

Put air comp. Blew for 45 minutes

Casing: size - 4" length 75' p.v.c.

Observation Well 3-1
NW1/4NE1/4 sec. 1, T. 4 N., R. 16 W. Coordinates: 1,593,403.638 E.
Washington County, Florida 652,883.327 N.
Elevation: 79'LSD (topo)
Total Depth: 150 feet

Driller's Log

Depth in Feet

0 to 2:	Brown sand.
2 to 22:	Brownish-tan sandy clay.
22 to 29:	Tan sand with clay.
29 to 43:	Tan sand with clay and gravel.
43 to 49:	Brownish-tan sand with clay.
49 to 50:	Brown sandstone.
50 to 72:	Dense sand.
72 to 73:	Limestone.
73 to 75:	Cave - Lost - mud - 73'.
75 to 77:	Broken limestone.
77 to 78:	Drove casing 75 to 78' (regain circulation after driving casing).
78 to 86:	Hard gray limestone.
86 to 145:	Medium hard gray limestone - losing about 15% water.
145 to 150:	Broken limestone - lost all water.

Water Level 14' at T.O.B.
Water Level 14'10" at 24 hours
Water Losses 100% 145 to 150'
Casing: size - 4" length 78'
Notes: 78 & 145' water loss - 15%

Observation Well 3-2
NW1/4NE1/4 sec. 1, T. 4 N., R. 16 W. Coordinates: 1,593,406.744 E.
Washington County, Florida 652,863.463 N.
Elevation: 79.52' LSD
Total Depth: 42 feet

Driller's Log

Depth in Feet

0 to 3:	Brown sand.
3 to 36:	Tan sandy clay; dense sand with clay - 3 7/8" hole.
36 to 42:	Coarse sand.

Ream hole - 6" 0 to 42'
Set - 42' of 4" p.v.c. - pipe
Wash - hole out with clear water
Put gravel around p.v.c. pipe.

Water Level 12' at T.O.B.
Casing: size - 4' length 42' p.v.c.

Observation Well 5-1
NE1/4NE1/4 sec. 31, T. 5 N., R. 15 W. Coordinates: 1,601,257.886 E.
Holmes County, Florida 658,513.785 N.
Elevation: 102.66'LSD
Total Depth: 270 feet

Driller's Log

Depth in Feet

0 to 5:	Top soil, brown sand.
5 to 14:	Gray clay and sand.
14 to 19:	Tan and gray sand.
19 to 25:	Sand with claystone.
25 to 30:	Clay and sand.
30 to 87:	Tan and red sand with clay.
87 to 106:	Sand.
106 to 110:	Sand and clay, pure.
110 to 117:	Stiff clay.
117 to 142:	Brown clay with sand.
142 to 148:	Sand.
148 to 167:	Hard sand.
167 to 170:	Clay.
170 to 210:	Sand.
210:	Limestone, very hard.

0-212: Ream - 6" bit
212-215.2: Drove 4" pipe in
Casing: size - 4"; length - 215'

215 to 218:	Drill 3 7/8" bit; very hard.
218 to 219:	Broken limestone.
219 to 221:	Hard.
221 to 228:	Dense gray sand.
228 to 236:	Hard.
236 to 244:	Dense gray sand with limestone.
244 to 251:	Hard limestone with sand streaks.
251 to 260:	Lose a little water - hard, 60%.
260 to 265:	Dense gray sand.
265:	TD

Water Level 9.4 at T.O.B.
Water Losses 60%
Casing: size - 4"; Length - 215'

Observation Well 5-2
NE1/4NE1/4 sec. 31, T. 5 N., R. 15 W.   Coordinates: 1,601,246.760 E.
Holmes County, Florida   658,491.813 N.
Elevation: 103.66'LSD
Total Depth: 51 feet

Driller's Log

Depth in Feet

0 to 3:	Sand, brown.
3 to 13:	Sand and clay.
13 to 18:	Sand.
18 to 37:	Sand and clay.
37 to 51:	Sand; set 50' 4" p.v.c.; wash 1 load water.
10-29-74	Wash 1 load water through #2 part. Gravel around pipe - broke down - move to site #2.

Casing: size - 4"; length 50'

Observation Well 6-1
SE1/4NW1/4 sec. 30, T. 5 N., R. 15 W.
Holmes County, Florida
Elevation: 118.30' LSD
Total Depth: 265 feet

Coordinates: 1,598,253.401 E.
662,108.679 N.

Driller's Log

Depth in Feet	
0 to 4:	Brown sand.
4 to 7:	Reddish-tan clay.
7 to 9:	Red sandy clay.
9 to 19:	Tan sand.
19 to 20:	Clay.
20 to 34:	Sand.
34 to 35:	Clay.
35 to 38:	Sandy clay streaks.
38 to 46:	Clay.
46 to 54:	Clayey sand streaks.
54 to 95:	Brown clay.
95 to 115:	Dense sand with clay.
115 to 130:	Fine sand with clay.
130 to 151:	Sand and clay.
151 to 210:	Coarse sand with clay.
210 to 214:	Hard sandstone - limestone.
0 to 50:	Ream.
50 to 212:	Ream - 6" hole. set 215' 4" casing.
212 to 215:	Drove casing.
212 to 220:	Drill hard gray limestone.
220 to 231:	Hard sandstone; limestone streaks.
231 to 232:	Sand.
232 to 238:	Hard.
238 to 239:	Sand.
238 to 247:	Hard.
247 to 241:	Dense sand.
241 to 245:	Hard.
245 to 255:	Hard sandy limestone.
	Water Level 33 at T.O.B. Casing: size - 4" length - 215'
245 to 265:	Hard sandy limestone.
	Wash - 1 load - water through Broken down - move to site 1 - set up - put 1" pipe in hole - blew with air for 6 hours.

Observation Well 6-2
SE1/4NW1/4 sec. 30, T. 5 N., R. 15 W.
Holmes County Florida
Elevation: 117.92' LSD
Total Depth: 40 feet

Coordinates: 1,598,271.256 E.
662,090.007 N.

Driller's Log

Depth in Feet

0 to 3:	Brown sand.
3 to 13:	Tan sandy clay.
13 to 26:	Tan clay with sand streaks.
26 to 40:	Fine tan sand. 3 7/8" hole.
	Ream.
0 to 40:	Set 40' 4" p.v.c. Set up on O.W. #1 - Blew from 12:30 pm to

Water Level - 27' at t.o.b.
Casing: size - 4" length - 40' p.v.c.

Observation Well 7-1
NW1/4NW1/4 sec. 31, T. 5 N., R. 15 W. Coordinates: 1,596,124.007 E.
658,642.349 N.
Holmes County, Florida
Elevation: 89.95'LSD
Total Depth: 150 feet

Driller's Log

Depth in Feet

0 to 3:	Brown sand.
3 to 16:	Stiff sand and clay with gravel.
16 to 26:	Firm gray sand with gravel.
26 to 34:	Stiff gray clay.
34 to 35:	Limestone

Ream hole to 34'
Set 35' casing

35 to 42: Hard limestone. 3 7/8" hole.

Casing: size - 6" length 35'

42 to 43:	Hard limestone - lost all water at 43'
43 to 51:	Hard broken limestone - no return on water.

10-16-74 Move back on site no. 7 O.W. #1 - drill 3 7/8" hole - 51 to Roller cone.

51 to 90:	Hard broken limestone - with boulder.
90 to 132:	Medium hard limestone.
132 to 135:	Rod drop - 2' cave.
135 to 151:	Broken limestone, hard.

Used 10 load of water
7:00 a.m. to 4:30 p.m. - pull out of hole
Broke down - moved to site no. 13
4:30 to 5:30 - 10 hours.

Water Level 10' at T.O.B.
Casing: size - 6" Length 35'

Observation Well 7-2
NW1/4NW1/4 sec. 31, T. 5 N., R. 15 W.   Coordinates; 1,596,138.631 E.
Holmes County, Florida   658,620.427 N.
Elevation: 89.76'LSD
Total Depth: 25 feet

Driller's log

Depth in Feet

1 to 3:	Brown sand.
3 to 16:	Stiff sand and clay with gravel.
16 to 19:	Gray sand.
19 to 20:	Tan clay.
20 to 25:	Gray sand with gravel and clay; brown gray clay.
	4" - 25' p.v.c.

Casing: size - 4" length - 25' p.v.c.

Observation Well 8-1
Near SW/cor. of SW1/4NW1/4 sec. 25, T. 5 N., R. 16 W.
Holmes County, Florida — Coordinates: 1,591,029.797 E.
Elevation: 68.82' LSD — 661,495.471 N.
Total Depth: 110.5 feet

Driller's Log

Depth in Feet	
0 to 6:	Sand.
6 to 8:	Gray sandy clay.
8 to 28:	Loose sand.
28 to 29:	Clay.
29 to 37.6:	Sand.
37.6 to 39:	Clay.
39 to 42:	Lost mud. 100% Soft weathered limestone.
42 to 45:	Hard broken limestone - 50'.
45 to 50:	
0 to 45:	Ream 6" bit. Drove 50' casing in.
45 to 50:	Drill. 3 7/8 hole.
50 to 55:	Pink broken limestone, lost.
55 to 56:	Mud.
56 to 60:	Hard limestone.
60 to 77:	Drove casing from 50 to 60'.
77 to 80:	Drill - lost water - 77'
80 to 81.5:	Spoon Sample - soft gray limestone.
81.5 to 90:	Soft gray limestone
90 to 91.5:	Spoon Sample - soft gray limestone.
91.5 to 100:	Soft gray limestone.
100 to 101.5:	Spoon Sample - soft limestone.

Observation Well 8-2
SW/cor. of SW¼NW¼ sec. 25, T. 5 N., R. 16W.
Holmes County, Florida
Elevation: 69.52' LSD
Total Depth: 25 feet

Coordinates: 1,591,004.274 E.
661,486.273 N.

Driller's Log

Depth in Feet

0 to 6:	Sand.
6 to 8:	Sandy clay.
8 to 25:	Sand.
0 to 25:	Ream set 25 feet, p.v.c. pipe.

Casing: size - 4" length - 25' p.v.c.

Observation Well 12-1
SE1/4SW1/4 sec. 26, T. 5 N., R. 16 W.   Coordinates: 1,587,269.331 E.
653,470.175 N.
Holmes County, Florida
Elevation: 68.71' LSD
Total Depth: 190 feet

Driller's Log

Depth in Feet

0 to 3:	Top soils.
3 to 20:	Clay.
20 to 35:	Sand and clay.
35 to 37:	Yellow clay.
37 to 46:	Gray clay.
46 to 68:	Sand.
68 to 79:	Sand and clay with gravel.
79 to 101:	Sand.
101 to 123:	Sand and clay.
123 to 125:	Limestone.
	Ream - 0 to 80' 6" bit
80 to 124:	Ream.
124 to 128:	Drove casing - drill out with 3 7/8" bit.
128 to 129:	Limestone.
129 to 130:	Sand.
130 to 132:	Limestone, hard; sandstone.
132 to 134:	Dense greenish-gray sand.
134 to 135:	Hard sandstone.
135 to 138:	Hard cement sand.
138 to 146:	Dense greenish-gray sand, hard.
146 to 188:	Dense greenish-gray sand; lost all water.
188 to 190:	Hard sand.
190:	T.D.

Water Level 25' at T.O.B.
Water Losses 100% - 188'
Casing: size - 4"; length 128' block

Observation Well 12-2
SE1/4SW1/4 sec. 26, T. 5 N., R. 16 W. Coordinates: 1,587,251.811 E.
Holmes County, Florida 653,485.863 N.
Elevation: 67.75' LSD
Total Depth: 61 feet

Driller's Log

Depth in Feet

0 to 4:	Top soil - 3 7/8" bit.
4 to 7:	Sand and clay.
7 to 15:	Stiff clay.
15 to 25:	Tan clay.
25 to 37:	Sand and clay.
37 to 43:	Sand with a little clay with gravel.
43 to 46:	Tan clay with sand and gravel.
46 to 61:	Sand.
0 to 60:	Ream - 6" bit
	Set - 60' 4" p.v.c. - pipe
	Slot - last 10'
	Put gravel around pipe
	Wash 2 load water through p.v.c. pipe
	Broke down - move to site #6

Water Level 24' at T.O.B.
Water Losses 90%
Casing: size - 4"; Length 60' p.v.c.

Observation Well 13-1
SE1/4SW1/4 sec. 35, T. 5 N., R. 16 W.   Coordinates: 1,587,766,710 E.
Holmes County, Florida   654,614.966 N.
Elevation: 59.33'LSD
Total Depth: 150 feet

Driller's Log

Depth in Feet

0 to 2:	Brown sand silt.
2 to 11:	Brownish-tan sand and clay.
11 to 18:	Tan sand.
18 to 22:	Variegated tan sand.
22 to 28:	Broken limestone - lost mud - 100% .
28 to 30:	Limestone.
30 to 32:	Limestone.
32 to 40:	Rod drop - cave.
40 to 42:	Hard limestone.

Ream from 0 to 24' - 10" bit.
Drove 24' to 26' - 6" casing.

Water Level 10' at T.O.B.
Water Losses 100%
Casing: size 6" length 26'

42 to 70:	Drill with 3 7/8" hole; Hard limestone.
70 to 80:	Could not work out hole - had rods stuck in hole - 2 hours getting them out.
10-21-74	pick up load of mud in Mobile, Alabama; 1:00 p.m. back on site; set 4" casing to 54'.
70 to 129:	Medium hard limestone.
129 to 131:	Loss of water - 20% - Hard limestone streaks; dense medium coarse sand.
131 to 142:	Tan sand with limestone; hard limestone, sandstone streaks 6" thick.
142 to 150:	Dense gray medium coarse sand.

Casing: size - 4" Length 54'

Observation Well 13-2
SE1/4SW1/4 sec. 35, T. 5 N., R. 16 W.   Coordinates: 1,587,763.886 E.
654,638.712 N.
Holmes County, Florida
Elevation: 59.53'LSD
Total Depth: 18 feet

Driller's Log

Depth in Feet

0 to 2:	Brown sand.
2 to 18:	Sand.
	Put gravel around p.v.c.

Water Level 2' at T.O.B.
Water Level 10' at 24 hours
Casing: size - 4" Length 20' p.v.c.

Observation Well 14-1
SE1/4NE1/4 sec. 2, T. 4 N., R. 16 W.   Coordinates: 1,589,661.261 E.
Washington County, Florida   651,525.676 N.
Total Depth: 100 feet
Elevation: 70.66' LSD

Driller's Log

Depth in Feet

0 to 3:	Brownish-tan sand.
3 to 12:	Tan sand.
12 to 16:	Gray clay.
16 to 22:	Gray clayey sand.
22 to 32:	Gray coarse sand.
32 to 38:	Gray clay with sand streaks.
38 to 40:	
40 to 43:	Limestone (lost mud at 42').
43 to 44:	
0 to 44:	Ream with 10" rock bit.
44 to 47:	Set 47' casing - drove in 3' - wash hole out - drill with 4" bit - Roller came.
47:	Hard broken limestone - recover - water.
47 to 49:	Hard limestone.
49 to 55:	Hard with soft streaks.
55 to 84:	Soft limestone.
84 to 100:	Hard limestone with soft limestone streaks.
100:	T. D.

Casing: size - 6" length - 47'
Notes: Lost all water mud at 42'. Set casing 47'.
Regain circulation - water - from 47 to 100'
Water loss about 15%

Observation Well 14-2
SE1/4NE1/4 sec. 2, T. 4 N., R. 16 W.
Washington County, Florida
Total Depth: 30 feet
Elevation: 70.66' LSD

Coordinates: 1,589,686.251 E.
651,522.330 N.

Driller's Log

Depth in Feet

0 to 3:	Brown sand.
3 to 12:	Brownish-tan sandy clay.
12 to 22:	Sand and clay streaks.
22 to 28:	Sand.
28 to 30:	Stiff sandy clay.

Drill - 3 7/8" hole - 0 to 30'
Ream - 5 7/8" hole - 0 to 30'

Water Level 5' at T.O.B.
Casing: size - 4" length - 30' P.V.C.

Observation Well 18-1
NW¼NE¼ sec. 17, T. 5 N., R. 16 W.
Holmes County, Florida
Elevation: 63.03' LSD
Total Depth: 100 feet

Coordinates: 1,573,499.464 E.
674,032.737 N.

Driller's Log

Depth in Feet

0 to 6:	Top soil.
6 to 15:	Stiff tan clay.
15 to 37:	Loose sand with clay.
37	Lost water.
	Reamed.
	Set 42' 4" black pipe.
37 to 100:	Drill. 3 7/8 hole. Hard gray limestone with soft streaks.

Water Level - 7 at t.o.b.
Water Level - 7 at 24 hours
Casing: size 4" length - 42' black pipe

Observation Well 18-2
NW¼NE¼ sec. 17, T. 5 N., R. 16 W.
Holmes County, Florida
Elevation: 63.08' LSD
Total Depth: 26 feet

Coordinates: 1,573,514.162 E.
674,052.472 N.

Driller's Log

Depth in Feet

0 to 6:	Porous sand.
6 to 11:	Clayey sand.
11 to 26:	Sand.
26	Tan clay.

26' 4" p.v.c. - pipe.

Water Level - 7 at t.o.b.
Casing: size - 4" length - 26' 4" p.v.c.

Observation Well 19-1
SE¼NE¼ sec. 5, T. 4 N., R. 16 W.
Holmes County, Florida
Elevation: 69.15' LSD
Total Depth: 100 feet

Coordinates: 1,575,890.167 E.
652,058.888 N.

Driller's Log

Depth in Feet

0 to 36:	Drill. 6" hole. Lost mud 36'.
36	Hard limestone.
	Set 37' 4" black pipe.
36 to 47:	Drill. Hard broken limestone.
47 to 100:	Soft gray limestone.

12-5-74 - set rods air
Blew for 4 hours

Water level - 17'4" at t.o.b.
Casing: size - 4" length 37' black pipe

Observation Well 19-2
SE¼NE¼ sec. 5, T. 4 N., R. 16 W.
Holmes County, Florida
Elevation: 69.15' LSD
Total Depth: 20 feet

Coordinates: 1,575,881.132 E.
652,082.134 N.

Driller's Log

Depth in Feet

0 to 20: Drill. 6" well
Set 22' 4" p.v.c.

Casing: size - 4" length - 22' p.v.c.

CSP-ER-2

Observation Well 20-1
NE¼NE¼ sec. 20, T. 4 N., R. 16 W.
Holmes County, Florida
Elevation: 57.31' LSD
Total Depth: 100 feet

Coordinates: 1,575,244.691 E.
636,268.559 N.

Driller's Log

Depth in Feet

0 to 1.5:	Sand, brown.
1.5 to 15:	Tan sandy clay.
15 to 45:	Sand with some clay.
45	Soft clay ?? lost circulation.
45 to 58:	Broken limestone. Set 50' casing.

Casing: size - 4" length - 50' black pipe

48 to 65:	Broken limestone.
65 to 85:	Hard limestone 98' lost circulation
85 to 100:	Soft broken limestone.

Casing: size - 4" length - 50' black pipe

Observation Well 20-2
NE¼NE¼ sec. 20 T. 4 N., R. 16 W.
Holmes County, Florida
Elevation: 57.61' LSD
Total Depth: 30 feet

Coordinates: 1,575,221.804 E.
636,267.453 N.

Driller's Log

Depth in Feet

0 to 30: Drill 6" well
Set 30' of p.v.c. pipe 4"

Observation Well 22-1
NW¼SE¼ sec. 21, T. 4 N., R. 15 W.
Washington County, Florida
Elevation: 98.00' LSD
Total Depth: 320 feet

Coordinates: 1,609,533.366 E.
634,280.478 N.

Driller's Log

Depth in Feet

0 to 3:	Top soil.
3 to 17:	Sandy clay, tan.
17 to 24:	Stiff sandy clay, tan.
24 to 50:	Sand with streaks clay, tan.
50 to 60:	Sand with tan clay streaks with small amount of gravel.
60 to 68:	Sand with clay streaks.
68 to 72:	Sand with gravel.
72 to 76:	Tan clay.
76 to 86:	Tan clay with sand and gravel.
86 to 100:	Gray clay with sand and gravel.
100 to 111:	Coarse sand.
111 to 153:	Tan sandy clay.
153 to 161:	Tan clay.
161 to 170:	Reddish clay.
170 to 193:	Sandy clay.
193 to 195:	Fine sand with clay - losing water.
195 to 207:	Clayey sand streaks.
207 to 239:	Dense sand.
239 to 255:	Sand with clay streaks.
255 to 262:	Dense sand.
262	Limestone.

140' ream - 6" bit - 12-17-74 - pick up - 260' 4" pipe
140 to 262 - Ream. Casing - size 4" length - 264.5' black pipe

Wash out casing.

262 to 266:	Drill 3 7/8. Drove casing down - 12".
266 to 284:	Hard grayish-brown limestone.
284 to 305:	Dense green sand with limestone.
305 to 309:	Hard white limestone with some sand.
309 to 320:	Hard limestone with sand streaks.
320 to TD	

Run air rod in hole.

Observation Well 22-2
NW¼SE¼ sec. 21, T. 4 N., R. 15 W.
Washington County, Florida
Elevation: 98.35' LSD
Total Depth: 40 feet

Coordinates: 1,609,527.197 E.
634,303.925 N.

Driller's Log

Depth in Feet

0 to 26:	Clayey sand	3 7/8 hole
26 to 40:	Sand.	
0 to 40:	Ream.	6" hole

Blew well No. 1 - 3 hours
Casing: size - 4" length 42' p.v.c. pipe

Ash Disposal Area "A"
Test Hole 1
NW1/4NE1/4 sec. 1, T. 4 N., R. 16 W.
Washington County, Florida
Elevation: 90.35' LSD
Total Depth: 260.0'

Coordinates: 1,594,337.971 E. and 652,129.493 N.

Depth in Feet	Driller's Log
0 to 10:	Brown Clayey sand with fine gravel.
28.5057:	Gray, medium to coarse sand with fine gravel.
57 to 67:	Gray, fine to medium clayey sand with fine gravel.
67 to 102:	Gray, medium to coarse sand with fine gravel.
102 to 127:	Brown clay, fine to medium sand with fine gravel.
127 to 162:	Brown clay, medium to coarse sand with fine gravel.
162 to 189	Brown clay, fine sand with fine gravel (with clay seams).
189 to 209.6:	
209.6 to 260:	Gray sandy limestone.

2

TOB @ 260'
Water Losses - 100% - 257'
Wash Drilling .0 to 260.0 circulation samples
Casing - None

Ash Disposal Area "A"
Test Hole 2
NE1/4NE1/4 sec. 1, T. 4 N., R. 16 W.
Washington County, Florida
Elevation: 124.78' LSD
Total Depth: 290.0'

Coordinates: 1,595,870.040 E. and 653,084.233 N.

Depth in Feet	Driller's Log
0 to 26.5:	Brown clayey fine sand with fine gravel.
26.5 to 67:	Gray, fine to medium sand with fine gravel.
67 to 92:	Gray, medium to coarse sand with fine gravel.
92 to 193:	
193 to 244	Brown clayey fine to medium sand with fine gravel.
244 to 290:	Gray sandy limestone.

2

TOB @ 290.0'
Wash Drilling circulation samples .0 to 290.0'
Water Losses - 100% @ 278.0'
Casing - None

Ash Disposal Area "A"
Test Hole 3
NW1/4NW1/4 sec. 6, T. 4 N., R. 15 W.
Washington County, Florida
Elevation: 112.57' LSD
Total Depth: 265.0'

Coordinates: 1,597,243.656 E.
and 652.010.070 N.

Depth in Feet	Driller's Log
0 to 2:	Soft black top soil. 2
2 to 6:	Brown silty clayey sand.
6 to 110:	Gray, silty clayey sand.
110 to 132:	Pink silty clayey sand.
132 to 198:	Gray silty clayey sand.
198 to 226:	Tan silty clayey sand.
226 to 265:	Tan silty clayey sand and limestone layers.

Lost 50% water at 260' and 100% at 265'.

Ash Disposal Area "A"
Test Hole 4
NW1/4SW1/4 sec. 6, T. 4 N., R. 15 W.
Washington County, Florida
Elevation: 88.92' LSD
Total Depth: 166.5'

Coordinates: 1,596,169.396 E.
and 649,980.208 N.

Depth in Feet	Driller's Log
0 to 3:	Soft black top soil.
3 to 5:	Brown silty clayey sand.
5 to 37:	Tan and gray silty clayey sand.
37 to 81:	Tan silty clayey sand.
81 to 103:	Pink silty clayey sand.
103 to 113:	Yellow silty clayey sand. 2
113 to 123:	Tan silty clayey sand.
123 to 141:	Pink silty clayey sand.
141 to 145:	Pink silty clay with pea gravel and sand.
145 to 160:	Pink silty clayey sand.
160 to 165:	Open void.
165 to 165:	Pink silty clayey sand.

Boring terminated by Barnett, can't log hole, no water return
Water Losses - 100% at 160'

Ash Disposal Area "A"
Test Hole 4-A
NE1/4SE1/4 sec. 1, T. 4 N., R. 16 W.
Washington County, Florida
Elevation: 107.02' LSD
Total Depth: 248 feet

Coordinates:

Depth in Feet	Driller's Log
0 to 10:	Tan silty sandy clay.
10 to 26:	Brown silty sandy clay.
26 to 28:	Gray silty sandy clay.
28 to 44:	Tan silty sandy clay.
44 to 74:	Pink silty sandy clay and coarse sand.
74 to 84:	Light-gray coarse sandy clay.
84 to 91:	Pink coarse sandy clayey silt.
91 to 150:	Light tan, medium sand.
150 to 160:	Pink (medium sand) silty clay.
160:	Pink silty clay and medium sand.
160 to 178:	Tan, medium sand and pink silty clay.
178 to 227:	Brown medium sand (very hard!).
227 to 240:	Limestone.
248:	Lost return - Hole terminated.

2

Ash Disposal Area "A"
Test Hole 5
NE1/4NE1/4 sec. 1, T. 4 N., R. 16 W.
Washington County, Florida
Elevation: 86.09'
Total Depth: 220.0 feet

Coordinates: 1,595,178.377 E.
and 652,355.272 N.

Depth in Feet	Driller's Log
0 to 20:	Tan (very sandy) clay.
20 to 52:	Pink silty clay and medium sand. 2
52 to 81:	Pink and tan medium sand.
81 to 123:	Pink silty sandy clay.
123 to 198.7:	Brown, medium sand.
198.7 to 220:	Limestone.
220:	Hole terminated.
0 to 80:	Drilled 4" bit, set 80' 4" casing.

SECTION 3 OF APPENDIX B

This Section contains Test Boring Records of the subsurface investigations performed at the proposed plant site. All records are identified by Test Boring Record Number. These numbers are located in the upper left of each page.

The following Surface Investigation Index, cross-referenced by page number, is offered to aid in locating a specific Test Boring Number.

SUBSURFACE INVESTIGATION INDEX

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Test Boring Record, Boring No. B-1
Law Engineering Testing Company
Drilled 7-9-74
Surface Elevation: 119.7 feet

Depth in Feet	Description
0.0	Surface
0.3	Very firm light brown, fine SAND - SP
7.0	Very dense, red, fine SAND - SP
13.0	Hard, red and gray to tan and purple silty CLAY - CL
24.0	Dense pink and gray, silty fine SAND - SM
32.5	Dense to very dense pink and gray, fine to medium silty SAND - SM
63.0	Very dense light brown medium SAND - SP
67.5	Dense to very dense tan and light gray slightly silty fine SAND - SP - SM
80.0	Dense to very dense tan and light gray slightly silty fine SAND - SP - SM
92.5	Very dense, light gray, slightly silty fine to medium SAND with some gravel - SW
120.0	Boring Terminated

Test Boring Record, Boring No. B-2
Law Engineering Testing Company
Drilled 7-18, 7-19-74
Surface Elevation: 123.3 feet

Depth in Feet	Description
0.0	Surface
0.5	Very firm, tan, silty fine SAND - SM
6.0	Very dense, red, silty, clayey, fine SAND with gray sandy CLAY lenses - SC
14.0	Very firm, red, silty fine SAND - SM
17.5	Hard, red and gray SAND, silty CLAY - CL
29.0	Dense, tan and light gray silty fine to medium SAND - SM - SW
52.5	Dense, tan, slightly silty fine SAND - SP
57.5	Dense, to very dense light gray, slightly silty, fine to medium SAND with fine gravel - SM - SW
83.0	Firm, gray, tan and red silty, clayey, very fine SAND - SM
86.0	Very dense, pink, silty fine SAND - SM
92.5	Very dense, light gray, fine to medium SAND with fine gravel - SM - SW
122.0	Very dense, tan, silty, fine SAND - SM - SP
130.5	Boring Terminated

Test Boring Record, Boring No. B-3
Law Engineering Testing Company
Drilled 7-25, 7-26-74
Surface Elevation: 117.2 feet

Depth in Feet	Description
0.0	Surface
0.7	Loose, brown, silty fine SAND - SM
8.0	Very firm to dense, reddish-brown, clayey silty fine SAND with gravel - SM - SC
18.0	Very firm, tan, silty fine SAND - SM
22.0	Very firm to dense, tan and light gray clayey, silty fine SAND with fine gravel - SC
37.5	Dense, light gray and pink, silty fine to very fine SAND - SM
43.0	Dense to very dense, light gray and pink, silty, fine to medium SAND with fine gravel - SM - SW
72.0	Stiff, light gray and pink, sandy silty CLAY - CL
77.0	Dense to very dense, white, fine to very fine SAND - SP
87.5	Dense to very dense, light tan, silty, fine to medium SAND with fine gravel - SM - SW
108.0	Very stiff, tan and gray, silty CLAY - CL
112.0	Dense to very dense, light gray, silty fine to very fine SAND - SM - SP
120.5	Boring Terminated

Test Boring Record, Boring No. B-4
Law Engineering Testing Company
Drilled 7-22, 7-23-74
Surface Elevation: 122.0 Feet

Depth in Feet	Description
0.0	Surface
0.5	Dense, reddish brown, clayey, silty fine SAND with gravel (SC-SM)
6.0	Dense to very dense, tan, silty fine SAND (SM)
17.5	Very hard, gray and pink, silty CLAY (CL)
23.0	Very firm to dense, pink and light gray, silty fine to medium SAND with fine gravel (SM-SW)
32.0	Very firm to dense, light gray, silty fine SAND (SM-SP)
48.0	Dense to very dense, light tan and gray, silty fine to coarse SAND with fine gravel (SM-SW)
87.5	Very dense, yellow, silty fine SAND (SM-SP)
92.0	Very dense, light tan and gray, silty fine to coarse SAND with fine gravel (SM-SW)
138.0	Hard to very hard, purple and gray, sandy CLAY with tan fine sand lenses -(CH)
147.0	Dense, tan, silty fine SAND (SM)
153.0	Very dense, brown, clayey silty fine SAND with fine gravel (SC-SM)
162.5	Very dense, light gray and tan, silty, fine to medium SAND with fine gravel (SM-SW)
186.0	Hard, brown, cemented SAND
186.4	Very hard, tan, very sandy clayey SILT (MH)
192.0	Very dense, yellow, silty, fine to medium SAND (SM-SW)
208.4	Soft, cream, sandy LIMESTONE with gray-green fine sand lenses.
214.0	Boring terminated.

Test Boring Record, Boring No. B-5
Law Engineering Testing Company
Drilled 7-11-74
Surface Elevation: 121.8 feet

Depth in Feet	Description
0.0	Surface
0.7	Firm, brown, fine SAND - SP
6.0	Firm, reddish-tan, silty, clayey SAND - SC
13.0	Dense, reddish-tan clayey SAND - SC
17.5	Very stiff to hard, gray and tan, sandy silty, CLAY - CL - CH
27.5	Very firm to dense, pink and gray, silty, medium to fine SAND - SM
43.0	Dense, light gray, fine SAND - SP
57.5	Dense, light gray, fine to coarse SAND - SW
73.0	Firm to very firm, light gray silty fine SAND - SM
80.0	Firm to very firm, light gray silty fine SAND - SM
84.0	Dense, light gray medium SAND - SP
97.0	Very dense, light gray, fine to coarse SAND with fine gravel - SW
120.0	Boring Terminated

Test Boring Record, Boring No. B-6
Law Engineering Testing Company
Drilled 7-29, 7-30-74
Surface Elevation: 120.7 feet

Depth in Feet	Description
0.0	Surface
0.5	Firm, brown, silty fine SAND - SM
6.0	Dense to very dense, reddish-brown clayey, fine SAND with fine gravel - SC
18.0	Dense to very dense, tan, silty fine SAND - SM - SP
32.5	Very dense, light gray and tan, silty, fine to medium SAND with fine gravel and occasional clayey SAND lenses - SM - SW
88.5	Very firm to dense, light gray and pink clayey fine SAND - SC
96.0	Dense to very dense tan, silty, fine to coarse, SAND with fine gravel - SM - SW
118.0	Very hard, tan and purple, silty CLAY - CH
120.5	Boring Terminated

Test Boring Record, Boring No. B-7
Law Engineering Testing Company
Drilled 7-30-74
Surface Elevation: 117.4 feet

Depth in Feet	Description
0.0	Surface
0.7	Firm, brown, silty fine SAND - SM
12.0	Dense to very dense, reddish-brown, clayey silty fine SAND with fine gravel - SC
28.0	Dense, tan, silty, fine to medium SAND with fine gravel - SM
34.0	Dense, light tan, silty, fine SAND with trace organic SILT - SM
37.0	Very stiff, tan, sandy silty CLAY - CL
46.0	Dense, tan, silty fine SAND - SM
53.0	VOID
54.0	Soft, tan and dark brown sandy silty CLAY - CH
62.0	Moderately soft to soft, cream, sandy weathered LIMESTONE
90.0	Boring Terminated

Testing Boring Record, Boring No. B-8
Law Engineering Testing Company
Drilled 8-9, 8-14-74
Surface Elevation: 106.7 feet

Depth in Feet	Description
0.0	Very firm, light gray and tan, silty, fine to medium SAND - SM
7.5	Dense, very firm, light gray and tan, silty, fine to medium SAND - SM
12.5	Very firm, dense, light gray and tan, silty, fine to medium SAND - SM
27.5	Firm, light gray and tan, silty, fine to medium SAND - SM
32.5	Very firm, light gray and tan, silty, fine to medium SAND - SM
37.5	Dense, very firm, light gray and tan, silty, fine to medium SAND - SM
42.5	Dense to very dense, light gray, fine to coarse SAND with fine gravel - SW
72.5	Dense, light gray, silty, fine to medium SAND with fine gravel - SM - SW
73.0	Very fine to dense, light gray and tan, clayey, fine to coarse SAND with fine gravel - SC - SW
117.5	Hard, light tan, very sandy CLAY - CL
122.5	Very dense, light gray, silty, fine to coarse SAND - SM - SW
128.0	Very firm, tan, clayey, fine to coarse SAND - SC
133.0	Stiff to very stiff, red and tan, sandy silty CLAY with fine SAND lenses - CH
143.5	Very dense, tan, clayey, fine to coarse SAND - SC
147.0	Very firm, tan, clayey, fine to coarse SAND - SC (no sample recovered)
153.0	Very dense, tan, silty, fine to coarse SAND - SM
159.0	Very stiff, tan, gray and red, sandy silty CLAY - CH
177.0	Very dense, light green, silty, fine SAND - SM - SW
185.0	Dense to very dense, light green, silty, fine SAND, interbedded with light tan, sandy LIMESTONE
200.5	Boring Terminated

Test Boring Record, Boring No. B-9
Law Engineering Testing Company
Drilled 8-14, 8-15-74
Surface Elevation: 119.5 feet

Depth in Feet	Description
0.0	Surface - loose, light brown silty fine SAND - SM
7.5	Dense, tan to reddish-tan, clayey silty fine SAND - SM
27.5	Very firm, tan and light gray, clayey, silty, fine to medium SAND - SM
32.5	Very firm to dense, reddish-tan, silty, fine SAND - SM
47.5	Dense, light gray and pink, silty, fine to medium SAND with thin sandy CLAY lenses - SM - SW
67.5	Very dense, light gray, slightly silty, fine SAND, fine gravel - SM - SP
77.5	Dense, light gray and pink, very fine SAND - SP
82.5	Very dense, light tan, silty fine SAND - SM
87.5	Very dense, light gray and pink, silty, fine to medium SAND - SM - SW
98.5	Very dense, light gray and pink, silty, fine SAND with gravel - SM
122.5	Very dense, light tan, silty, medium SAND - SM
132.5	Very hard, tan, sandy, silty CLAY - CH
137.5	Hard, tan, silty CLAY - CL
149.0	Boring Terminated

Test Boring Record, Boring No. B-10
Law Engineering Testing Company
Drilled 8-1-74
Surface Elevation: 115.9 feet

Depth in Feet	Description
0.0	Surface
0.7	Firm, brown, silty, fine SAND - SM
7.0	Very firm to dense, reddish-brown, clayey, silty, fine SAND with gravel - SM - SC
24.0	Dense, light tan, silty, fine SAND with fine gravel - SM - SD
42.5	Dense to very dense, light tan and light gray, silty, fine to medium SAND with fine gravel - SM - SW
77.5	Firm, yellow, silty, fine to very fine SAND - SM - SP
83.0	Stiff to very stiff, tan and brown, silty, sandy CLAY-CL
94.0	Soft, cream, sandy with LIMESTONE
99.0	Boring Terminated

Test Boring Record, Boring No. B-12
Law Engineering Testing Company
Drilled 9-5-74
Surface Elevation: 93.3 feet

Depth in Feet	Description
0.0	Surface
0.5	Very stiff, gray and tan, sandy, silty CLAY - CL
23.0	Loose, tan, clayey, silty, fine SAND - SM
26.0	Firm, gray, silty, fine SAND - SM
32.0	Stiff, tan and gray, very sandy, silty CLAY - SC - CL
37.0	Firm to stiff, tan and gray, silty CLAY - CL
46.0	Soft to moderately soft, cream, sandy LIMESTONE
60.5	Boring Terminated

Test Boring Record, Boring No. B-13
Law Engineering Testing Company
Drilled 9-1-74
Surface Elevation: 91.0

Depth in Feet	Description
0.0	Surface. Dense, gray, medium grain silty SAND with few quartz gravel
5.5	Dense, tan and gray, coarse grain silty SAND with much quartz gravel
17.0	Stiff to very stiff, light gray, silty, clayey, coarse grain SAND with some quartz gravel and CLAY lenses
32.0	Dense, light gray and tan, silty, clayey, coarse grained SAND
38.0	Stiff to very stiff, light gray, silty, clayey, coarse grained SAND with quartz gravel and CLAY lenses
47.5	Dense, light gray, silty, clayey, coarse grain SAND with CLAY lenses
52.0	Stiff to loose, light gray, silty, clayey SAND with dark gray, thick CLAY lenses
64.0	Loose, coarse grain, clayey SAND with quartz gravel and layered red, gray, and yellow CLAY lenses
69.0	Very soft, dark gray, silty, sandy CLAY with red and tan lenses and few rock fragments
73.5	Soft, white and gray, clayey SILT grading to stiff to very stiff white and yellow clayey SILT with weathered rock fragments
85.5	Boring Terminated

Test Boring Record, Boring No. B-15
Law Engineering Testing Company
Drilled 8-14, 8-16-74
Surface Elevation: 90.0 feet

Depth in Feet	Description
0.0	Surface
0.7	Loose to firm, tan and gray silty fine SAND - SM
13.0	Very soft, black, sandy, very organic SILT - ML - OL
40.0	Loose to firm, silty, gray, silty fine SAND - SM - SP
88.0	Loose to very firm, gray, silty, clayey SAND - SC
103.5	Very dense, gray, silty fine SAND - SM
108.0	Firm, gray, clayey fine SAND -SC
112.0	Stiff, gray, sandy, silty CLAY - CL
123.0	Very soft, gray, sandy, silty CLAY - CL
127.5	Stiff, very soft, gray, sandy, silty CLAY - CL
132.5	Soft, stiff, gray, sandy, silty CLAY - CL
137.5	Very loose, gray, silty, fine SAND - SM
148.0	Very loose, dark gray, clayey, fine SAND - SC
152.5	Very soft, dary gray, sandy, silty CLAY - CL
157.5	Very dense, grayish-green, fine SAND - SP
164.0	Soft, cream, sandy LIMESTONE
170.0	Boring Terminated

Test Boring Record, Boring No. B-16
Law Engineering Testing Company
Drilled 9-3, 9-4-74
Surface Elevation: 93.6 feet

Depth in Feet	Description
0.0	Surface. Firm to very firm, tan, clayey silty, fine SAND - SM - SC
42.5	Loose, gray, silty, organic, fine SAND - SM
47.0	Firm, black, organic CLAY - OL
52.5	Dense to very dense, gray, silty, organic, fine SAND - SM
82.5	Very dense, grayish-green, silty, fine SAND - SM
87.5	Stiff, brown, silty CLAY with LIMESTONE fragments
92.5	Moderately soft to soft, cream, sandy LIMESTONE
100.5	Boring Terminated

Test Boring Record, Boring No. B-17
Law Engineering Testing Company
Drilled 6-30, 7-1-74
Surface Elevation: 118.0 feet

Depth in Feet	Description
0.0	Surface. Firm to dense, tan and red silty fine SAND with tan, clayey, fine to coarse sand lenses - SM with SC
17.5	Very firm, tan and red, slightly clayey, fine to medium SAND - SW - SC
22.5	Firm to very firm tan and red slightly clayey fine to medium SAND with gray clayey fine sand lenses - SW with SC
45.0	Very firm, light gray, slightly silty medium to fine SAND - SM - SW
47.5	Firm to dense light gray, clayey silty, fine to coarse SAND with fine gravel - SM - SW
75.0	Very stiff, light gray, very sandy CLAY - CL
80.5	Boring Terminated

Testing Boring Record, Boring No. B-18
Law Engineering Testing Company
Drilled 8-7, 8-8-74
Surface Elevation: 113.0 feet

Depth in Feet	Description
0.0	Surface
0.7	Firm to dense, brown, silty clayey fine SAND - SM
12.5	Dense, reddish-brown, clayey silty fine SAND with fine gravel - SC - SM
23.0	Very firm to dense, tan, silty fine SAND - SM - SP
37.5	Very firm to dense, light gray and tan, silty fine to medium SAND with fine gravel - SP - SW
72.5	Firm, light gray and pink, silty fine SAND - SM - SP
80.0	Firm, light gray and pink, silty fine SAND - SM - SP
92.5	Loose to firm, light gray and tan silty fine to very fine SAND - SM - SP
117.5	Firm, light gray and tan, clayey silty, fine to coarse SAND with fine gravel - SC - SM
129.0	Stiff to very stiff, tan and purple, sandy silty CLAY with tan fine sand linses - CH
143.0	Firm, tan, silty, fine to medium SAND - SM
147.0	Dense to very dense, light gray, silty, clayey, fine to coarse SAND with fine gravel - SM - SW
160.0	Dense to very dense, light gray, silty, clayey, fine to coarse SAND with fine gravel - SM - SW
165.5	Boring Terminated

Test Boring Record, Boring No. B-19
Law Engineering Test Company
Drilled 6-27, 6-28-74
Surface Elevation: 96.9 feet

Depth in Feet	Description
0.0	Surface. Loose light gray silty fine SAND - SM
2.0	Firm, light brown fine SAND - SP
6.5	Very firm to dense, reddish-brown, slightly silty fine to medium SAND - SW
17.0	Firm, red and gray, clayey fine to coarse SAND with gray clay lenses - SC
27.5	Very firm, red and gray, clayey fine to coarse SAND with gray clay lenses - SC
40.0	Stiff red and gray silty CLAY - CL
42.5	Firm to stiff, red and gray sandy, silty CLAY with coarse sand and fine gravel lenses - CL
57.5	Firm, reddish-brown, fine to coarse SAND with gray clayey sand lenses - SC
66.0	Void or very soft CLAY
72.5	Very soft to moderately soft, cream, sandy fossiliferous LIMESTONE
80.5	Boring Terminated

Test Boring Record, Boring No. B-20
Law Engineering Testing Company
Drilled 8-18-74
Surface Elevation: 104.6 feet

Depth in Feet	Description
0.0	Surface
0.5	Firm, brown, silty, fine SAND - SM
6.0	Dense to very dense, reddish-brown, clayey, fine SAND - SC
16.0	Very firm, light tan, silty, fine SAND - SM
22.5	Dense, light tan, silty, fine to coarse SAND with fine gravel and a few sandy clayey lenses - SM - SW
42.5	Dense, light gray and pink, silty fine SAND - SM - SP
57.5	Very firm, light gray, silty, fine to medium SAND - SM - SW
67.0	Dense, white, silty, fine SAND - SM - SP
72.5	Very dense, white, silty, fine to medium SAND with fine gravel - SM - SW
76.5	Very firm, white, silty, fine SAND with fine gravel - SM - SP
82.0	Very soft, brown, sandy CLAY - CL
92.5	Stiff, red and brown, sandy, silty CLAY with angular chert gravels - CH
105.4	Moderately soft to soft, cream, sandy, with LIMESTONE
120.5	Boring Terminated

Test Boring Record, Boring No. B-21
Law Engineering Testing Company
Drilled 6-29, 6-30-74
Surface Elevation: 112.6 feet

Depth in Feet	Description
0.0	Surface. Very firm to dense, tan and red, silty, fine SAND with tan, clayey, fine to coarse sand lenses - SM with SC
17.5	Firm tan and red, slightly clayey, fine to medium SAND - SW
22.5	Firm to very firm tan, fine to medium SAND - SW
32.5	Firm to very firm, white and pink, clayey, fine to coarse SAND - SC
42.5	Very stiff, white and pink, very sandy CLAY - CL
47.5	Very firm tan and white, silty fine SAND - SP
52.5	Firm, white and pink, slightly silty, fine SAND - SP
62.5	Very firm, brown, fine to medium SAND - SW
66.0	Firm to very firm, white and pink, fine SAND - SP
80.5	Boring Terminated

Test Boring Record, Boring No. B-22
Law Engineering Testing Company
Drilled 8-17-74
Surface Elevation: 118.1 feet

Depth in Feet	Description
0.0	Surface
0.7	Loose, tan, clayey, silty, fine SAND with fine gravel - SC
6.0	Very stiff, gray, silty CLAY - CL
13.0	Very firm, gray, silty, clayey, fine SAND - SM
18.0	Very dense, white, very fine SAND - SP
22.0	Very firm, light tan and light gray, slightly clayey, silty, fine SAND - SM - SP
52.0	Very stiff, gray, very sandy, silty CLAY - CL
57.0	Very firm to dense, light gray and pink, slightly clayey, silty, fine to medium SAND with fine gravel - SM
67.5	Very firm, tan, silty, fine SAND - SM - SP
73.0	Dense to very dense, tan and light gray, slightly silty, fine to medium SAND with fine gravel - SM - SW
104.0	Very dense, light gray, silty, fine to coarse SAND with fine gravel - SM - SW
117.5	Dense, white, silty, fine SAND - SM - SP
120.5	Boring Terminated

Test Boring Record, Boring No. B-23
Law Engineering Testing Company
Drilled 8-17-74
Surface Elevation: 118.3 feet

Depth in Feet	Description
0.0	Surface
0.5	Very firm, tan and gray, clayey, fine SAND - SC
6.0	Very dense, light tan, clayey, fine SAND - SC - SM
17.0	Dense, tan, silty, fine SAND - SM
26.5	Hard, gray, sandy CLAY - CL
33.0	Dense, light gray and pink, silty, fine to very fine SAND - SM - SP
57.5	Hard, gray, sandy, silty CLAY - CL
62.0	Very dense, light gray, silty, fine to medium SAND - SM - SW
73.5	Very stiff, light gray, sandy, silty CLAY - CL
77.0	Very dense, light gray, silty, fine to coarse SAND with fine gravel - SM - SW
87.5	Very dense, light gray, clayey, fine to coarse SAND - SC
92.5	Very dense, light gray, silty, fine to medium SAND with fine gravel - SM - SW
113.5	Stiff, red and tan, sandy, silty CLAY - CL
116.0	Very firm, tan, clayey, fine SAND - SC
120.5	Boring Terminated

Test Boring Record, Boring No. B-24
Law Engineering Testing Company
Drilled 7-10-74
Surface Elevation: 117.4 feet

Depth in Feet	Description
0.0	Surface
0.5	Firm brown, silty, fine SAND - SM
7.0	Hard, gray, silty CLAY - BLOCKY STRUCTURE - CL
13.0	Dense, pink and gray, grading to tan, clayey, silty, fine to medium SAND with fine gravel - SM
37.5	Dense to very dense, pink and gray, clayey, fine SAND - SC
47.5	Dense to very dense, light gray, silty, fine to very fine SAND - SM - SP
59.0	Dense to very dense, light gray and tan, fine to medium SAND with fine gravel - SW
72.5	Very dense, light gray and tan, medium to coarse SAND with fine gravel - SW
80.0	Boring Terminated

Test Boring Record, Boring No. B-26
Law Engineering Testing Company
Drilled 8-19, 8-20-74
Surface Elevation: 119.9 feet

Depth in Feet	Description
0.0	Surface
0.5	Firm, brown, silty, fine SAND with gravel - SM
7.0	Dense, red, clayey, fine SAND with fine gravel - SC
19.0	Firm, tan, slightly clayey, fine SAND - SC - SP
22.0	Very firm, white, slightly silty, fine to medium SAND with fine gravel - SM - SW
27.0	Dense, tan, slightly silty, fine to medium SAND - SM - SW
38.0	Firm, tan, silty, fine SAND - SM
42.5	Very firm, light gray, silty, fine SAND - SM
52.5	Dense to very dense, light gray, slightly silty, fine SAND - SM - SP
64.5	Very firm, light tan, silty, fine to coarse SAND with fine gravel - SM - SW
68.5	Firm, red and gray, silty CLAY - CL
70.0	Dense, tan, slightly silty, fine to coarse SAND with fine gravel - SM - SW
82.5	Dense to very dense, tan, silty, fine SAND with fine gravel - SM - SP
93.0	Firm, tan, silty, fine SAND - SM
102.5	Very soft, red and gray, sandy, silty CLAY with tan fine sand lenses - CL
118.0	Firm to stiff, red and tan, silty CLAY with tan fine sand lenses - CH
127.5	Very soft, red and tan, silty CLAY - CH
144.0	Stiff to very stiff, tan, silty CLAY - CH
156.0	Firm, tan, silty CLAY - CH
163.0	Very soft to soft, tan, silty CLAY - CH
175.5	Boring Terminated

Test Boring Record, Boring No. B-27
Law Engineering Testing Company
Drilled 8-17, 8-18-74
Surface Elevation: 116.5 feet

Depth in Feet	Description
0.0	Surface
0.5	Loose, brown, silty, fine SAND - SM
6.0	Very dense, reddish-tan, clayey, fine to medium SAND - SC
13.0	Very stiff, gray, sandy, silty CLAY - CL
23.0	Dense, light tan and gray, silty, fine SAND - SM
47.0	Firm to dense, light tan and gray, silty, fine SAND with fine gravel - SM
73.0	Firm to very firm, light tan, silty, fine to medium SAND - SM - SW
83.5	Very stiff, gray, sandy, silty CLAY with gray, fine sand lenses - CL
95.3	Dense, light gray, silty, fine to medium SAND - SM - SW
112.5	Dense, white, silty, fine to very fine SAND - SM - SP
120.5	Boring Terminated

Test Boring Record, Boring No. B-28
Law Engineering Testing Company
Drilled 8-2, 8-6-74
Surface Elevation: 118.4 feet

Depth in Feet	Description
0.0	Surface. Firm, brown, silty, fine SAND - SM
6.0	Very firm, reddish-brown, clayey, silty, fine to medium SAND with gravel - SC
13.0	Very stiff, light gray, silty CLAY - CL - ML
19.0	Dense, tan and light gray, silty, fine SAND - SM
27.5	Very firm, tan, silty, fine SAND - SM
32.0	Very firm, light gray, clayey, silty, fine to medium SAND - SC - SM
38.0	Stiff, light gray, sandy, silty CLAY - CL
43.0	Dense to very dense, light gray, silty, fine SAND with occasional coarse SAND lenses - SM - SP
88.0	Stiff, light gray and tan, sandy, silty CLAY with dense, fine SAND lenses - CL
90.0	Dense, light gray, silty, fine SAND - SM - SP
92.0	Dense, yellow, clayey, silty, fine SAND - SM - SC
102.5	Dense to very dense, light gray and tan, silty fine to coarse SAND with fine gravel - SM - SW
133.0	Very stiff, light gray, sandy, silty CLAY - CL - ML
142.5	Stiff, tan and gray, silty CLAY - CH
153.0	Firm to very firm, tan, silty, fine SAND with fine gravel - SM
179.0	Firm, tan, clayey, silty, fine SAND - SC
180.5	Boring Terminated

Test Boring Record, Boring No. B-29
Law Engineering Testing Company
Drilled 8-14, 8-15-74
Surface Elevation: 112.6 feet

Depth in Feet	Description
0.0	Surface
0.5	Firm to very dense, reddish-tan, silty, fine to coarse SAND with fine gravel - SM
18.0	Dense, reddish-tan, silty, fine to medium SAND - SM
27.5	Very firm, light gray and reddish-tan, silty, clayey, fine to coarse SAND - SC
37.0	Very stiff, purple and tan, sandy, silty CLAY with gravel - CL - CH
40.0	Firm, light gray, silty, clayey, fine to coarse SAND - SC
46.0	Firm, tan, sandy, silty CLAY with medium sand lenses - CL
62.5	Stiff, tan, silty CLAY with angular chert gravel (iron stained) - CH
78.0	Very soft, white, sandy LIMESTONE
89.9	Boring Terminated

Test Boring Record, Boring No. B-30
Law Engineering Testing Company
Drilled 8-16, 8-19-74
Surface Elevation: 117.9 feet

Depth in Feet	Description
0.0	Surface
0.5	Loose, reddish-brown, clayey, silty, fine SAND with fine gravel - SC - SM
7.5	Very firm to dense, reddish-brown, clayey, silty, fine SAND with fine gravel - SC
17.5	Very firm to dense, tan, silty, fine SAND with occasional fine gravel - SM
57.5	Very stiff, gray, sandy, silty CLAY - CL
67.5	Dense, gray, silty, fine to medium SAND - SM - SW
87.5	Very dense, gray and tan, silty, fine to medium SAND - SM - SW
102.5	Dense, gray, clayey, silty, fine SAND - SM
112.5	Dense to very dense, light gray and tan, silty, fine to medium SAND with fine gravel - SM - SW
137.5	Very firm, light gray, clayey, silty, fine to medium SAND - SC - SM
142.5	Medium stiff, red and purple to red and tan, silty CLAY - CL
152.5	Very dense, light gray and tan, silty, fine to medium, SAND with fine gravel - SM - SW
182.5	Very firm, grayish-green, silty, fine SAND - SM
187.5	Very dense, yellow to grayish-green, silty, fine SAND - SM - SP
200.0	Boring Terminated

Test Boring Record, Boring No. B-31
Law Engineering Testing Company
Drilled 8-20-74
Surface Elevation: 115.5

Depth in Feet	Description
0.0	Surface
0.5	Firm, brown, silty, fine SAND - SM
6.0	Dense, reddish-brown, clayey, fine SAND with fine gravel - SC
12.5	Very firm to dense, reddish-brown, clayey, silty, fine SAND - SC - SM
22.5	Very dense, light tan to light gray, silty, fine to coarse SAND with fine gravel - SM - SW
51.5	Very firm, light tan to light gray, silty, fine SAND - SM - SP
72.0	Dense to very dense, light tan to light gray, silty, fine to coarse SAND with fine gravel - SM - SW
93.5	Firm, tan, clayey, silty SAND - SM
97.5	Moderately soft, cream, sandy LIMESTONE
100.5	Boring Terminated

Test Boring Record, Boring No. B-32
Law Engineering Testing Company
Drilled 8-15, 8-16-74
Surface Elevation: 119.3 feet

Depth in Feet	Description
0.0	Surface
0.7	Loose, brown, silty, fine SAND - SM
8.5	Firm, reddish-brown, clayey, fine to medium SAND - SC
12.5	Dense, reddish-brown, clayey, fine to medium SAND - SC
33.5	Dense, reddish-brown, silty, fine SAND - SM
38.0	Very firm, gray, silty, fine to very fine SAND - SM - SP
47.5	Dense, gray, silty, fine SAND - SM - SP
57.5	Very dense, gray, silty, fine to coarse SAND with fine gravel - SM - SW
67.5	Dense, gray, silty, fine SAND - SM - SP
73.0	Very stiff, gray, sandy, silty CLAY with fine gravel - CL
77.5	Very dense, gray to light tan, silty, fine to coarse SAND with fine gravel - SM - SW
108.0	Very stiff, purple and tan, sandy, silty CLAY - CL
111.0	Firm, purple and tan, sandy, silty CLAY - CL
117.5	Stiff, tan, very sandy, silty CLAY - CL - SC
123.0	Very stiff, tan and brown, very silty CLAY - CL - ML
131.5	Firm, brown, silty CLAY with fine sand lenses - CL - CH
142.0	Very soft, brown, silty CLAY - CH
152.5	Stiff, brown, sandy, silty CLAY with cemented SAND fragments - CH
158.0	Very soft, brown, sandy, silty CLAY - CH
168.0	Soft to moderately soft, cream, sandy LIMESTONE
180.5	Boring Terminated

Test Boring Record, Boring No. B-33
Law Engineering Testing Company
Drilled 8-29, 8-31-74
Surface Elevation: 118.7 feet

Depth in Feet	Description
0.0	Surface
0.5	Firm, brown, silty, fine SAND - SM
8.0	Very dense, reddish-brown, clayey, fine to medium SAND with cemented SAND fragments - SC
12.5	Dense, reddish-brown, silty, fine SAND - SM
22.5	Very stiff, tan and gray, sandy, silty CLAY - CL
32.5	Stiff to firm, gray and purple, silty CLAY - CL
52.5	Very firm, tan, clayey, silty SAND - SC
62.5	Firm, pink, silty, fine SAND - SM - SP
67.5	Dense, gray, silty, fine to medium SAND with fine gravel - SM - SW
87.5	Very dense, gray, silty, fine to coarse SAND with fine gravel - SM - SW
92.5	Very dense, gray, silty, fine to very fine SAND - SM - SP
107.5	Dense to very dense, gray, silty, fine to medium SAND - SM - SW
117.5	Very dense, gray, clayey, fine to coarse SAND with fine gravel - SC - SW
127.5	Stiff, purple and gray, silty CLAY with dense, gray SAND lenses - CL
132.5	Dense to very dense, gray, silty, fine to medium SAND - SM - SW
150.5	Boring Terminated

Testing Boring Record, Boring No. B-34
Law Engineering Testing Company
Drilled 8-22-74
Surface Elevation: 110.0 feet

Depth in Feet	Description
0.0	Surface
0.8	Dense, reddish-brown, clayey silty fine SAND with fine gravel - SC
8.0	Very stiff to hard, light gray and brown, sandy silty CLAY - CL
23.0	Very firm to dense, light gray, silty clayey fine SAND with fine gravel - SM, SC
52.0	Very firm yellow, silty, very fine SAND - SM - SP
56.5	Very dense, light gray, silty fine SAND with fine gravel - SM - SP
80.0	Very dense, light gray, silty fine SAND with fine gravel - SM - SP
82.5	Very dense, light gray, silty fine to coarse SAND with fine gravel - SM - SW
87.5	Very dense, light gray silty fine SAND - SM - SP
93.0	Firm, light gray, clayey silty fine SAND - SM - SC
96.0	Very dense light gray, silty fine SAND - SM - SP
112.5	Very dense, light gray, silty fine to medium SAND with fine gravel - SM - SW
120.0	Boring Terminated

Test Boring Record, Boring No. B-35
Law Engineering Testing Company
Drilled 8-21-74
Surface Elevation:

Depth in Feet	Description
0.0	Surface. Firm, brown, silty, fine SAND - SM
7.0	Dense to very dense, reddish brown, silty, fine SAND - SM
17.5	Very dense, light gray, silty, fine SAND - SM - SP
120.5	Boring Terminated

Test Boring Record, Boring No. B-36
Law Engineering Testing Company
Drilled 8-27, 8-28-74
Surface Elevation: 108.0 feet

Depth in Feet	Description
0.0	Surface
0.5	Very firm, brown, clayey, fine SAND - SC
6.0	Very hard, gray, sandy, silty CLAY - CL
12.0	Very stiff, gray, sandy, silty CLAY - CL
17.0	Very dense, light tan, silty, fine SAND - SM
23.0	Stiff, gray, silty CLAY - CL
28.0	Hard, pink and gray, sandy, silty CLAY - CL
32.5	Dense, gray and pink, silty, fine SAND - SM - SP
37.5	Dense, gray, silty, fine to medium SAND - SM - SW
42.5	Dense, gray, silty, fine to very fine SAND - SM - SP
52.5	Hard, purple and gray, sandy, silty CLAY - CL
57.5	Very dense, gray, silty, fine to coarse SAND with fine gravel - SM - SW
77.0	Very firm, gray, silty, fine SAND - SM - SP
82.0	Very dense, light gray, fine to medium SAND - SW
87.5	Very dense, gray, silty, fine SAND - SM - SP
97.0	Very stiff, tan and purple, sandy, silty CLAY - CL
107.5	Very stiff, tan, very silty CLAY - CL - ML
114.5	Hard, tan, sandy, very silty CLAY - CL - ML
133.0	Very dense, gray, silty, fine SAND with gray CLAY lenses - SM
142.0	Moderately soft to soft, cream, sandy LIMESTONE
155.5	Boring Terminated

Test Boring Record, Boring No. B-37
Law Engineering Testing Company
Drilled 8-20, 8-27-74
Surface Elevation: 114.0 feet

Depth in Feet	Description
0.0	Surface. Firm, brown, silty, clayey SAND with trace iron cemented rounded SAND nodule - SC
7.5	Dense to very firm, gray and tan, silty, clayey, fine SAND - SC
27.5	Very firm, brown, fine to coarse SAND with quartz gravels and gray plastic CLAY lenses - SC
32.5	Dense, yellow, silty, clayey SAND with brown and violet SAND lenses and trace organics - SC
37.5	Dense, yellow, silty, clayey SAND with quartz gravels - SC
42.5	Very firm, yellow, silty, clayey, micaceous SAND with gray plastic CLAY lenses - SC
47.5	Very firm, grayish-pink, silty, clayey SAND - SC
52.5	Very firm to dense, yellow and tan, silty, clayey SAND - SC
67.5	Very stiff, purple, sandy, silty CLAY - CL
87.5	Very stiff, brown, sandy, silty CLAY with rounded quartz gravels.
94.0	Very dense, brown, coarse LIMESTONE gravel with some silty CLAY matrix
107.5	Very dense, gray, fine and coarse SAND
112.5	Very dense, gray, coarse LIMESTONE gravel
117.5	Boring Terminated

Test Boring Record, Boring No. B-38
Law Engineering Testing Company
Drilled 8-23-74
Surface Elevation:

Depth in Feet	Description
0.0	Surface
0.5	Loose, brown, silty, fine SAND - SM
8.0	Hard, purple and tan, silty CLAY - CL
12.0	Very dense, gray, clayey, fine SAND - SC
16.0	Hard, gray, sandy, silty CLAY with tan, fine SAND lenses - CL
22.5	Dense, light brown, clayey, fine to coarse SAND with fine gravel - SC
27.5	Very dense, reddish-brown, silty, fine to coarse SAND with fine gravel - SM
33.5	Dense, light gray, silty, fine to very fine SAND - SM
37.5	Dense to very dense, reddish-brown to gray, silty, fine SAND - SM - SP
57.5	Very dense, gray, silty, fine to coarse SAND with fine gravel - SM - SW
73.5	Firm, tan, silty, fine SAND with gray CLAY lenses - SM
77.0	Very stiff, purple and tan, sandy, silty CLAY with tan, fine SAND lenses - CL
84.5	Dense, tan, silty, fine SAND - SM - SP
87.5	Very dense, gray, silty, fine to coarse SAND with fine gravel and occasional gray CLAY lenses - SM - SW
107.5	Very dense, tan, clayey, silty, fine SAND - SC
113.5	Dense, tan, silty, fine to medium SAND - SM
117.0	Very stiff, dark brown, silty CLAY - BLOCKY STRUCTURE - SLICKENSIDED - CH
122.0	Moderately soft to soft, cream, sandy LIMESTONE with abundant angular CHERT fragments
135.5	Boring Terminated

Test Boring Record, Boring No. B-39
Law Engineering Testing Company
Drilled 8-29, 9-4-74
Surface Elevation: 116.0 feet

Depth in Feet	Description
0.0	Surface. Firm, tan and red layered, silty, clayey SAND with some small roots - SC
6.0	Dense, red and tan, clayey, silty, coarse SAND with gray clay lenses - SC
18.0	Stiff, red and tan, silty CLAY - CL
24.0	Dense, red and tan, silty, fine to coarse SAND with clay lenses - SM - SW
40.0	Dense, tan and gray, silty, fine to coarse grain SAND - SM - SW
57.0	Stiff to very stiff, tan and gray, silty CLAY - CL
78.0	Firm, tan, clayey, fine to coarse SAND - SC
84.0	Very stiff, dark gray, silty CLAY - CL
89.0	Varying layers of very stiff to hard red, gray, tan, and brown, silty, sandy CLAY
117.0	Dense, gray and white, coarse, silty, clayey SAND with few quartz gravels
134.0	Dense, tan, red, and gray, very silty, clayey SAND with some thin clay lenses
150.5	Boring Terminated

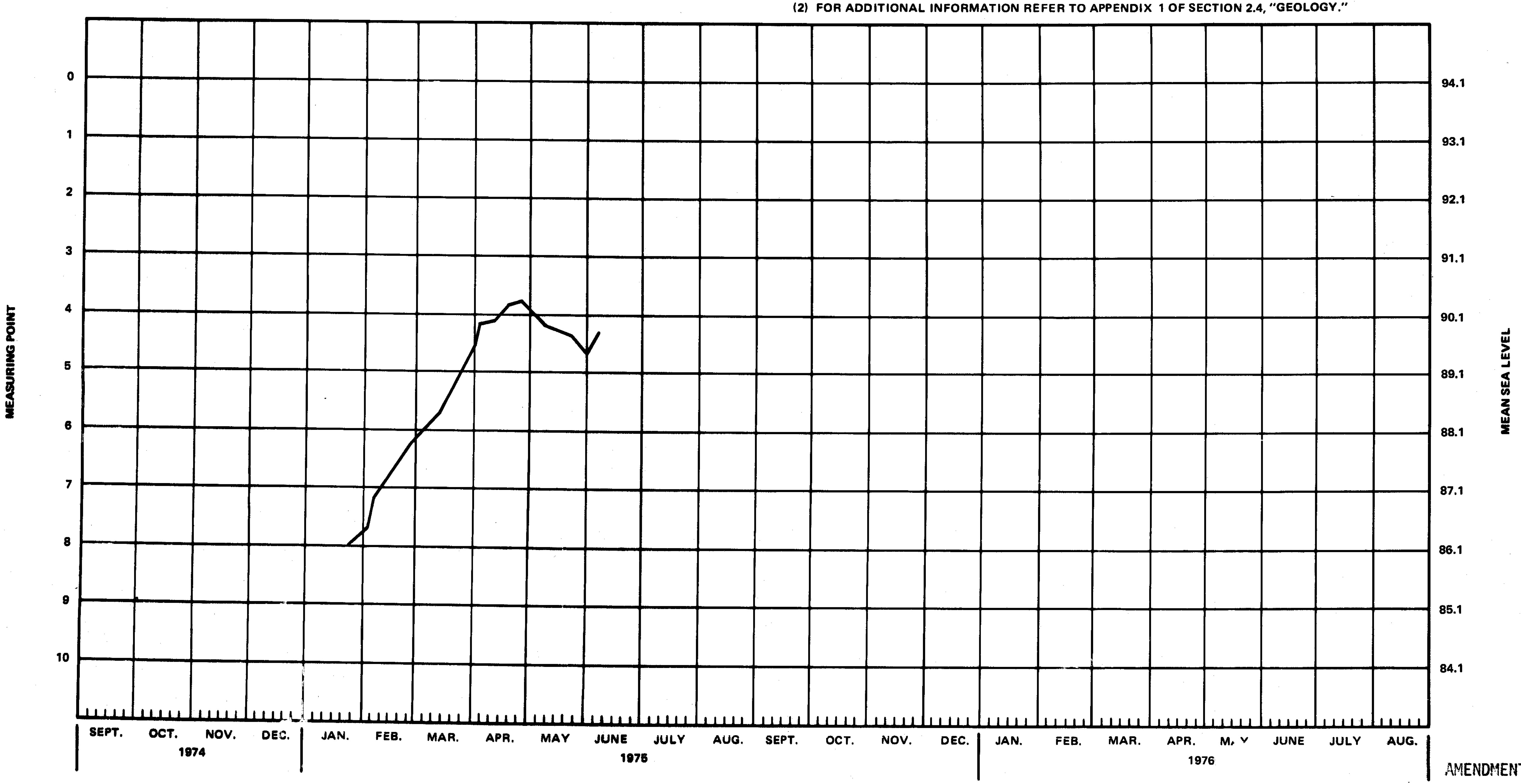
APPENDIX C

SECTION 1 OF APPENDIX C

This appendix contains the hydrographs of the wells and ponds being monitored by Gulf. These hydrographs will be updated periodically as new data are obtained. 2

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 1-1
LOCATION: SE 1/4, NW 1/4 SEC. 6, T 4 N, R 15 W
WASHINGTON COUNTY, FLORIDA
COORDINATES: 1,598,558.767 E
650,753.092 N

DEPTH OF WELL: 260 FT.
FEET OF CASING: 211
AQUIFER: FLORIDAN
ELEV. OF M.P.: 94.10
ELEV. OF L.S.D:
RECORD BEGAN: 1-24-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

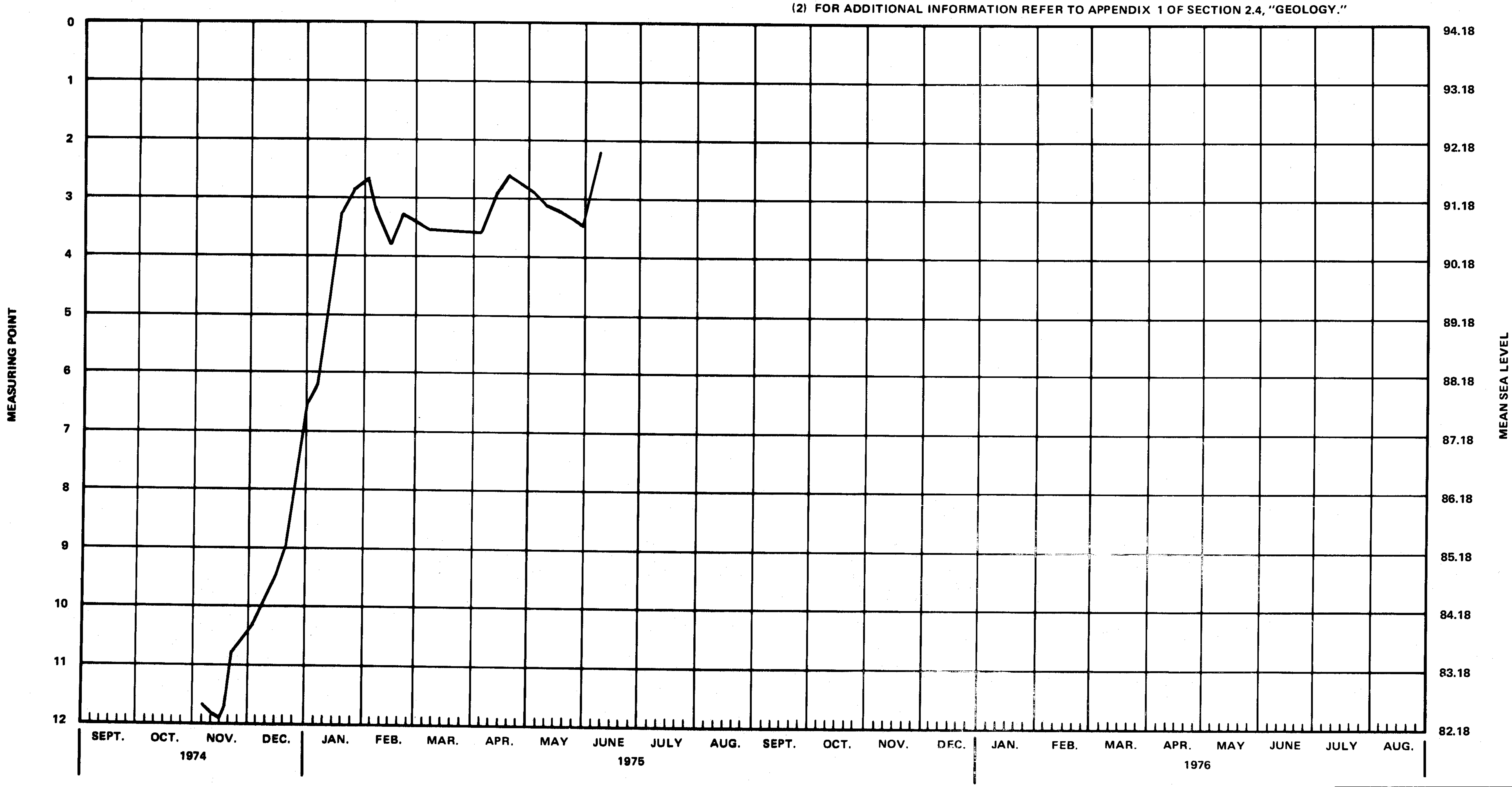
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 1-1

FIGURE 2.5B-1

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 1-2
LOCATION: SE 1/4, NW 1/4 SEC. 6, T 4 N, R 15 W
WASHINGTON COUNTY, FLORIDA
COORDINATES:
1,598,562.101 E
650,763.080 N

DEPTH OF WELL: 52 FT.
FEET OF CASING: 53
AQUIFER: WATER TABLE
ELEV. OF M.P.: 94.18
ELEV. OF L.S.D:
RECORD BEGAN: 11-5-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

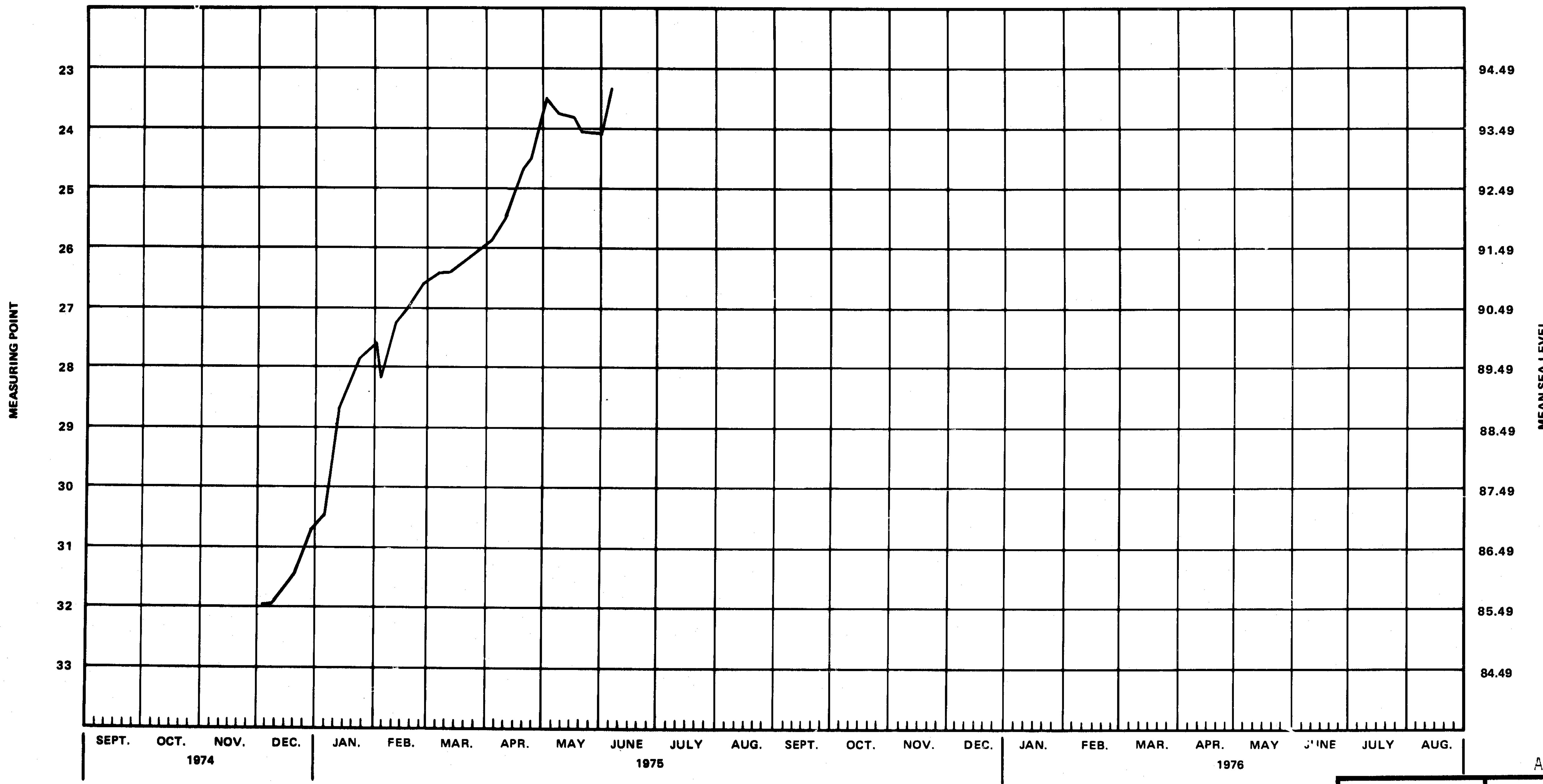
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 1-2

FIGURE 2.5B-2

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 2-1
LOCATION: SE 1/4, SE 1/4 SEC. 31, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,600,089.519 E
654,096.285 N

DEPTH OF WELL: 220 FT
FEET OF CASING: 91
AQUIFER: FLORIDAN
ELEV. OF M.P.: 117.49
ELEV. OF L.S.D:
RECORD BEGAN: 12-3-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

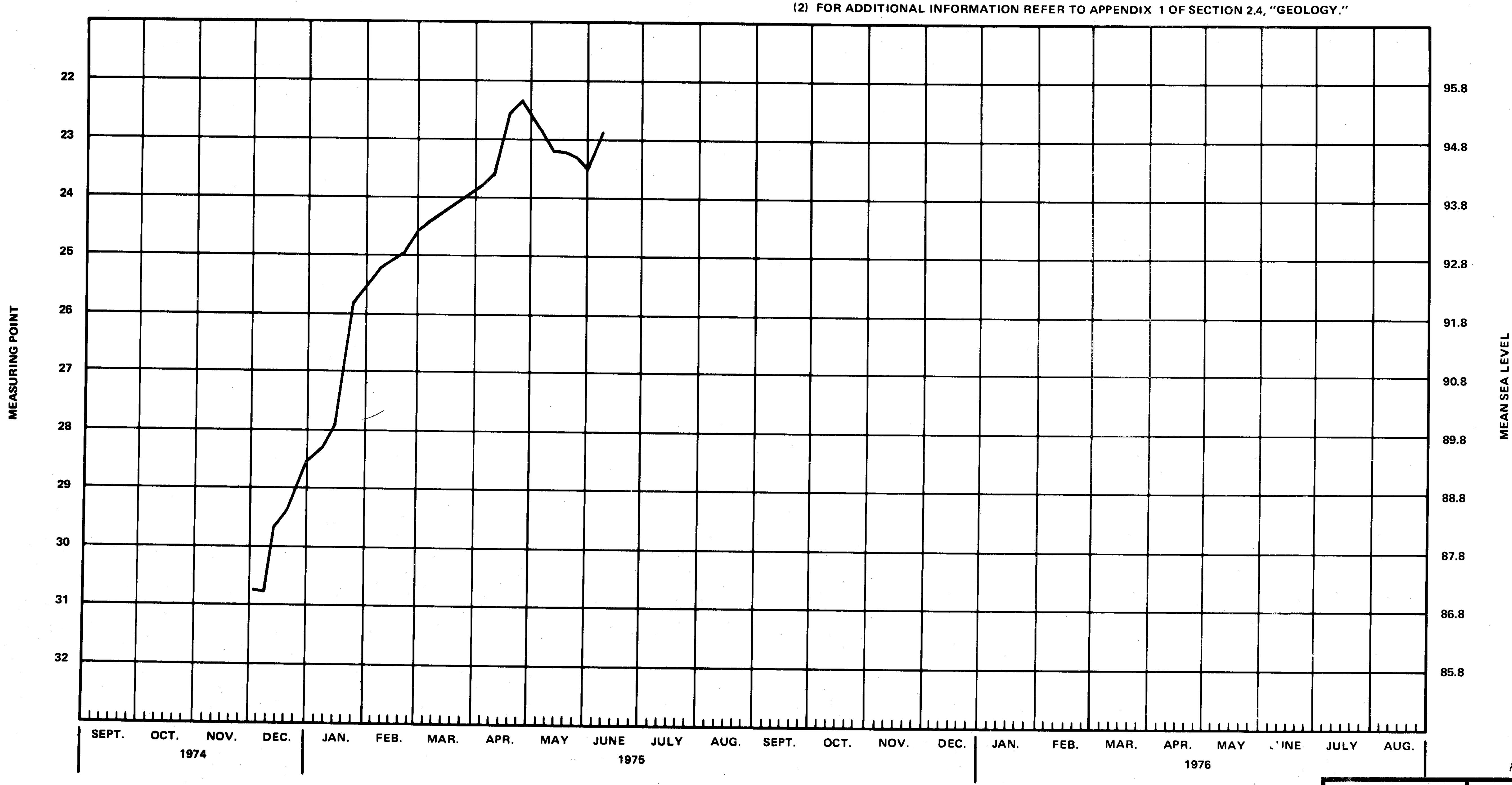
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 2-1

FIGURE 2.5B-3

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 2-2
LOCATION: SE 1/4, SE 1/4 SEC.31, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,600,082.356 E
654,079.628 N

DEPTH OF WELL: 75 FT
FEET OF CASING: 76
AQUIFER: WATER TABLE
ELEV. OF M.P.: 117.80
ELEV. OF L.S.D:
RECORD BEGAN: 12-2-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

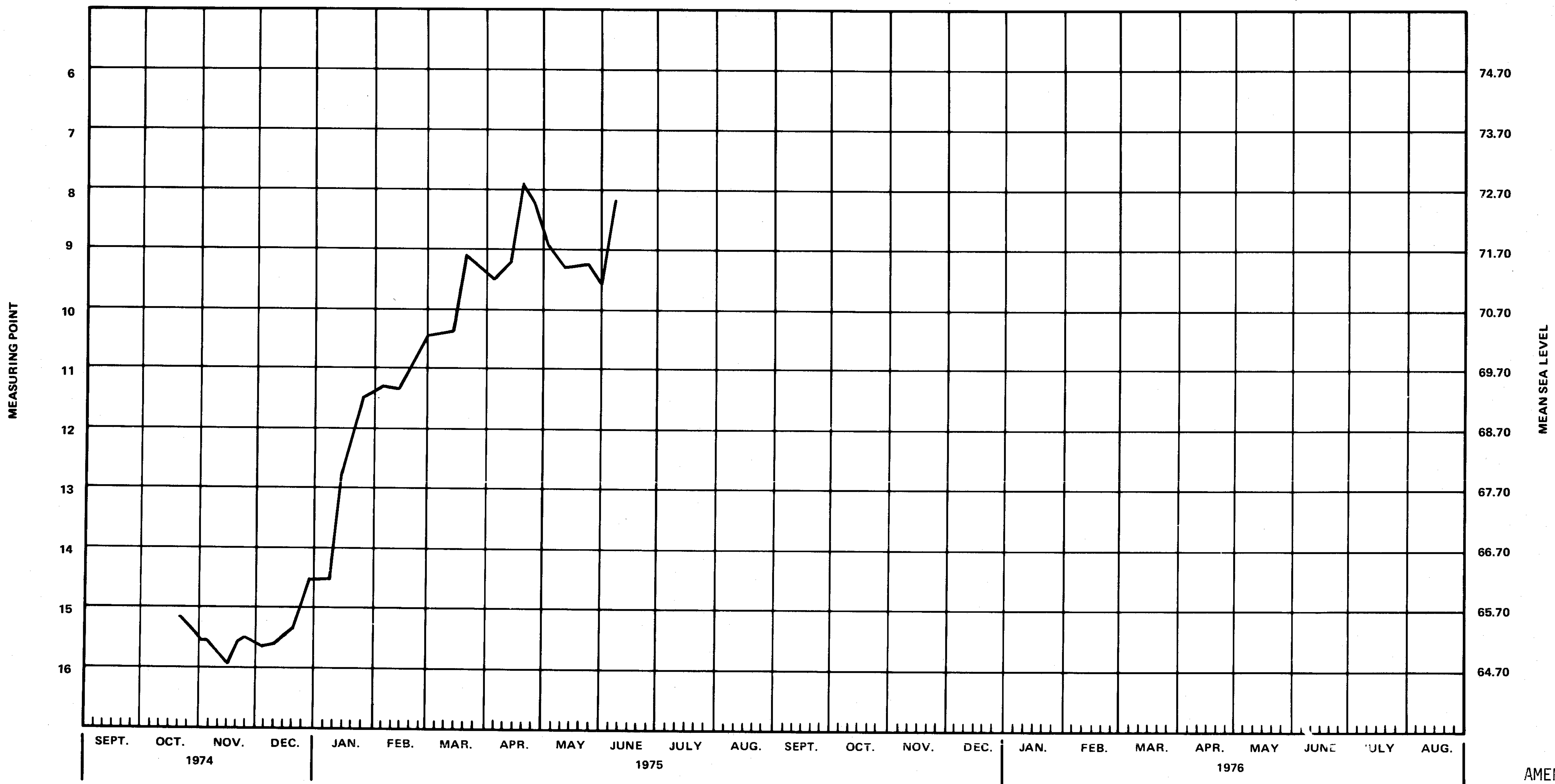
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 2-2

FIGURE 2.5B-4

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 3-1
LOCATION: NW 1/4, NE 1/4 SEC. 1, T 4 N, R 16 W
WASHINGTON COUNTY, FLORIDA
COORDINATES:
1,593,403.638 E
652,883.327 N

DEPTH OF WELL: 150 FT.
FEET OF CASING: 78
AQUIFER: FLORIDAN
ELEV. OF M.P.: 80.70
ELEV. OF L.S.D:
RECORD BEGAN: 10-22-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

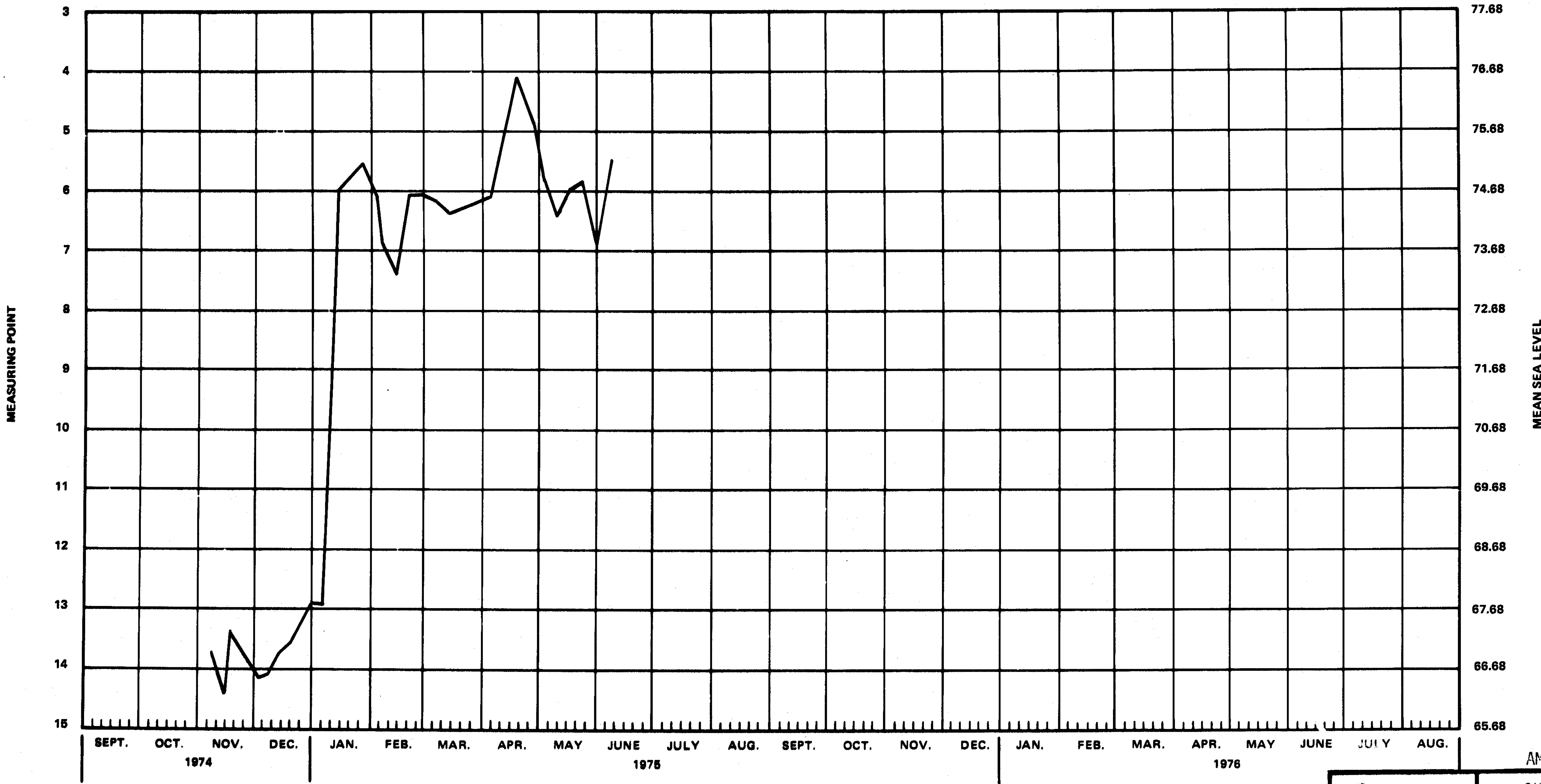
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 3-1

FIGURE 2.5B-5

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 3-2
LOCATION: NW 1/4, NE 1/4 SEC. 1, T 4 N, R 16 W
WASHINGTON COUNTY, FLORIDA
COORDINATES:
1,593,406.744 E
652,863.468 N

DEPTH OF WELL: 42 FT.
FEET OF CASING: 43
AQUIFER: WATER TABLE
ELEV. OF M.P.: 80.68
ELEV. OF L.S.D:
RECORD BEGAN: 11-8-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

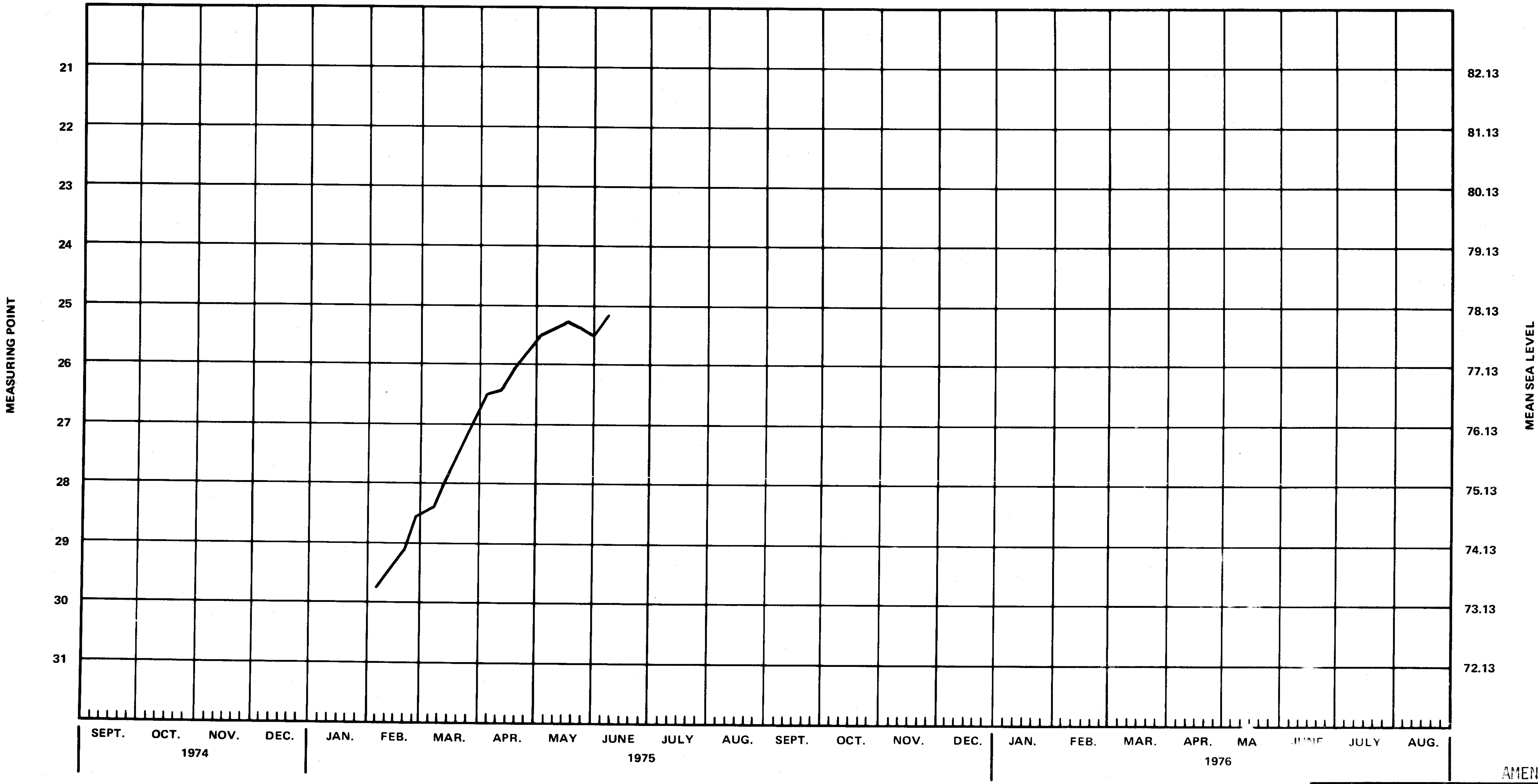
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 3-2

FIGURE 2.5B-6

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 4-1
LOCATION: SW 1/4, NE 1/4 SEC. 36, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,593,576.431 E
656,261.133 N

DEPTH OF WELL: 350 FT.
FEET OF CASING: 192
AQUIFER: FLORIDAN
ELEV. OF M.P.: 103.13
ELEV. OF L.S.D:
RECORD BEGAN: 2-5-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

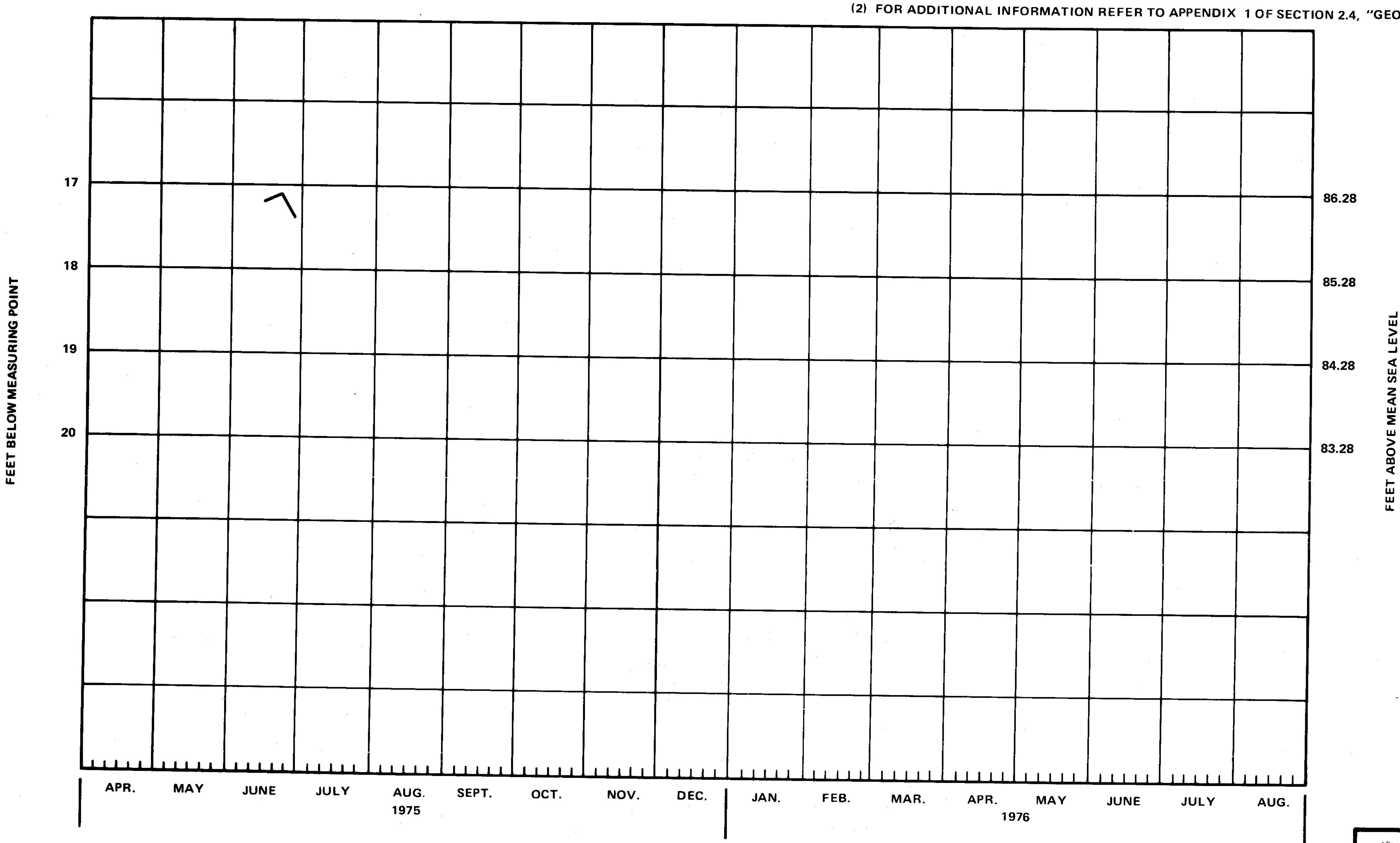
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 4-1

FIGURE 2.5B-7

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 4-2
LOCATION: SW 1/4 NE 1/4 SEC. 36 T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES: 1,593,568.420 E
656,283.445 N

DEPTH OF WELL: 70 FT
FEET OF CASING: 70
AQUIFER: WATER TABLE
ELEV. OF M.P.: 103.28
ELEV. OF L.S.D.: 101.77
RECORD BEGAN: 6-13-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

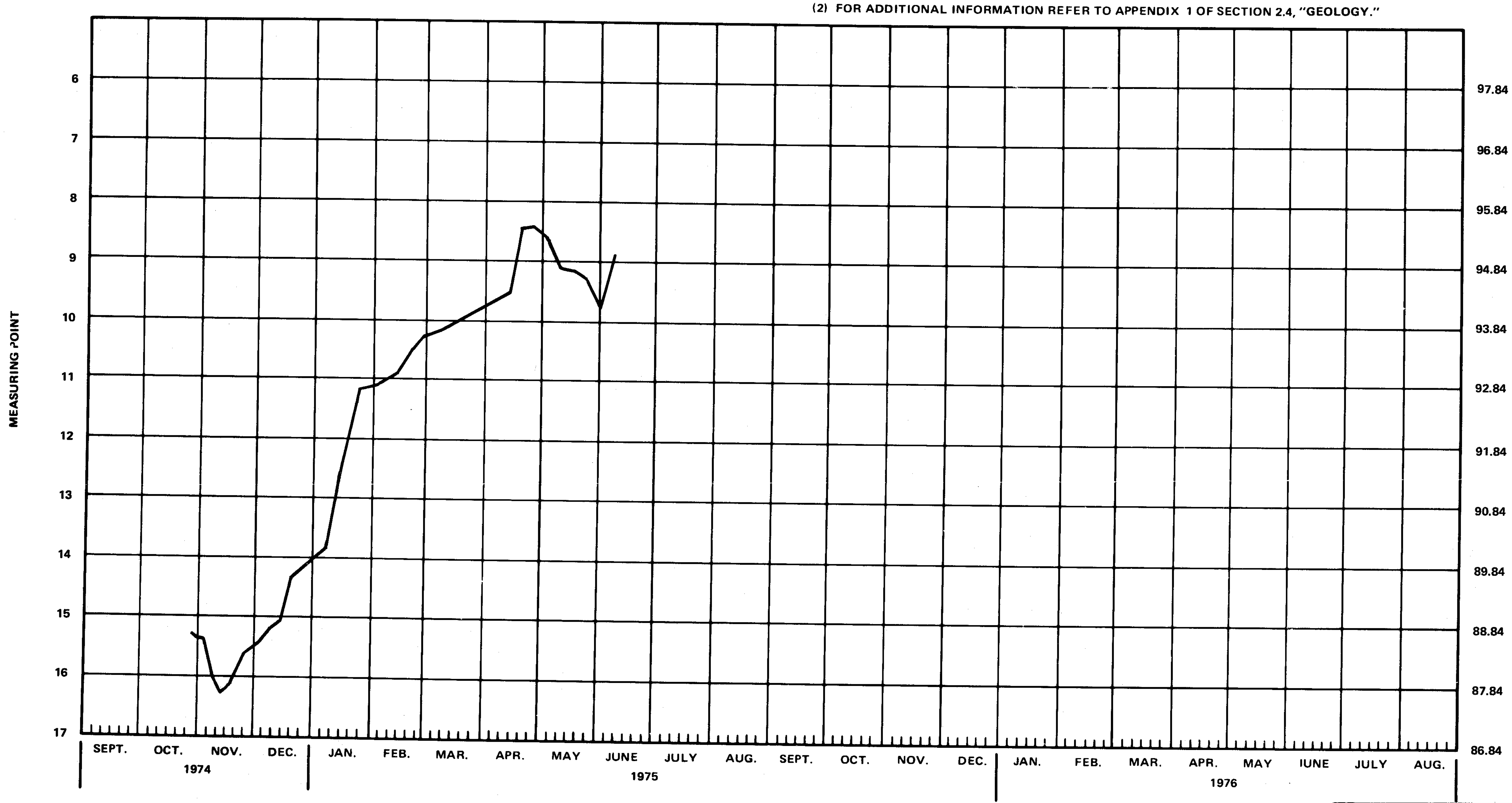
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 4-2

FIGURE 2.5B-8

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 5-1
LOCATION: NE 1/4, NE 1/4 SEC. 31, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,601,257.886 E
658,513.785 N

DEPTH OF WELL: 265 FT.
FEET OF CASING: 215
AQUIFER: FLORIDAN
ELEV. OF M.P.: 103.84
ELEV. OF L.S.D:
RECORD BEGAN: 10-29-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

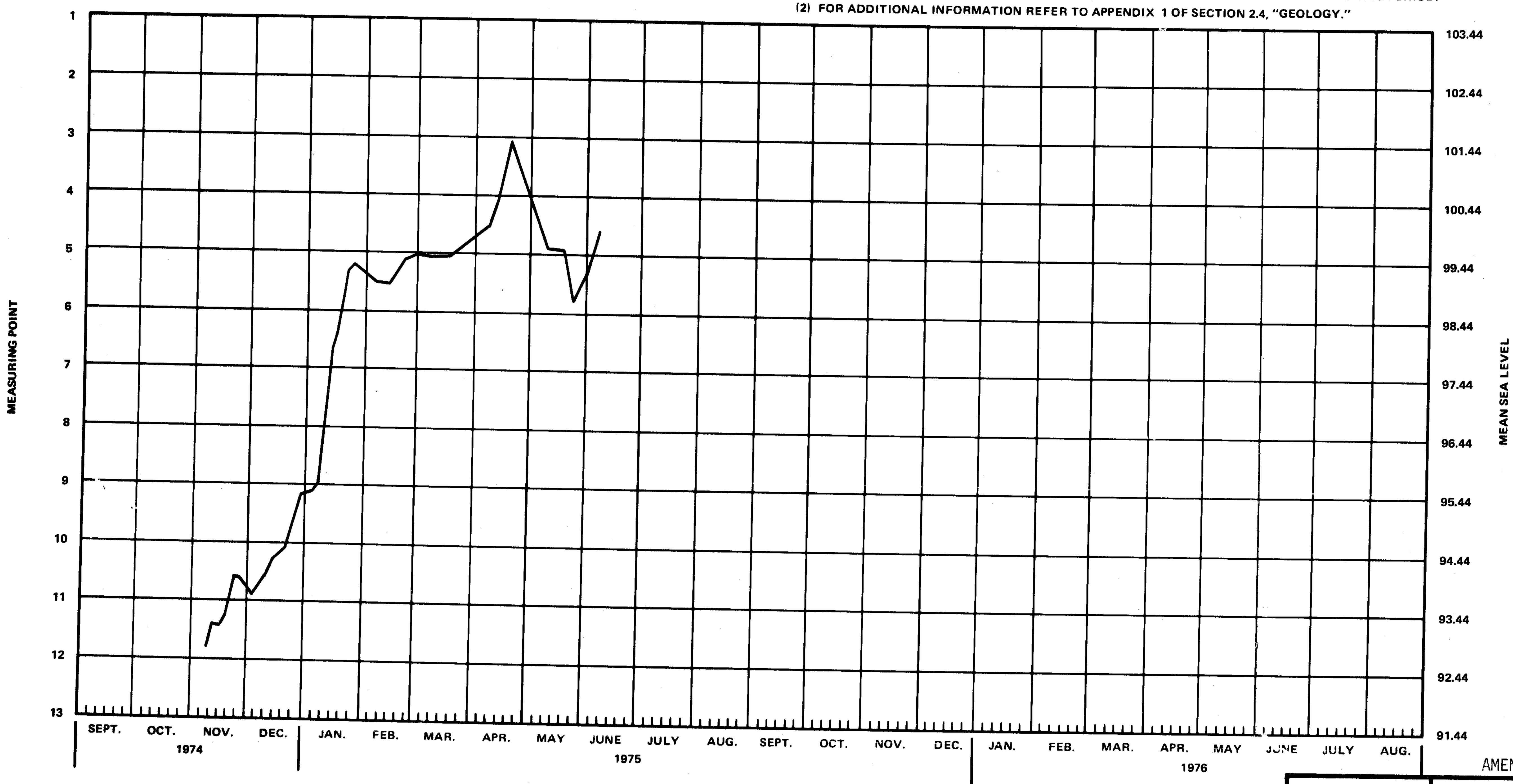
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 5-1

FIGURE 2.5B-9

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 5-2
LOCATION: NE 1/4, NE 1/4 SEC. 31, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,601,246.760 E
658,491.813 N

DEPTH OF WELL: 50 FT
FEET OF CASING: 51
AQUIFER: WATER TABLE
ELEV. OF M.P.: 104.44
ELEV. OF L.S.D.:
RECORD BEGAN: 11-8-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

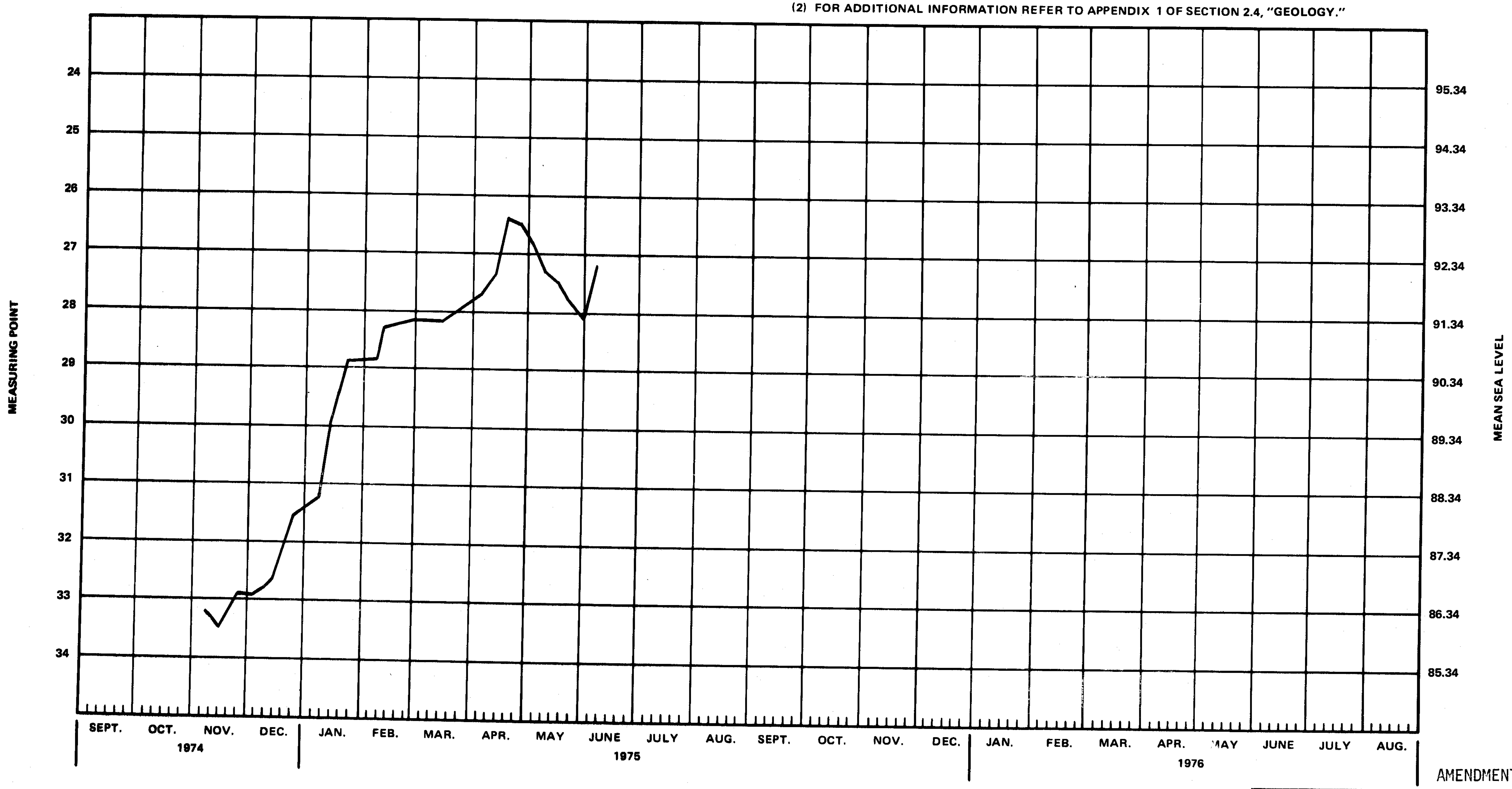
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 5-2

FIGURE 2.5B-10

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 6-1
LOCATION: SE 1/4, NW 1/4 SEC. 30, T 5 N, R 15W
HOLMES COUNTY, FLORIDA
COORDINATES: 1,598,253.401 E
662,108.679 N

DEPTH OF WELL: 265 FT
FEET OF CASING: 215
AQUIFER: FLORIDAN
ELEV. OF M.P.: 119.34
ELEV. OF L.S.D:
RECORD BEGAN: 11-8-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

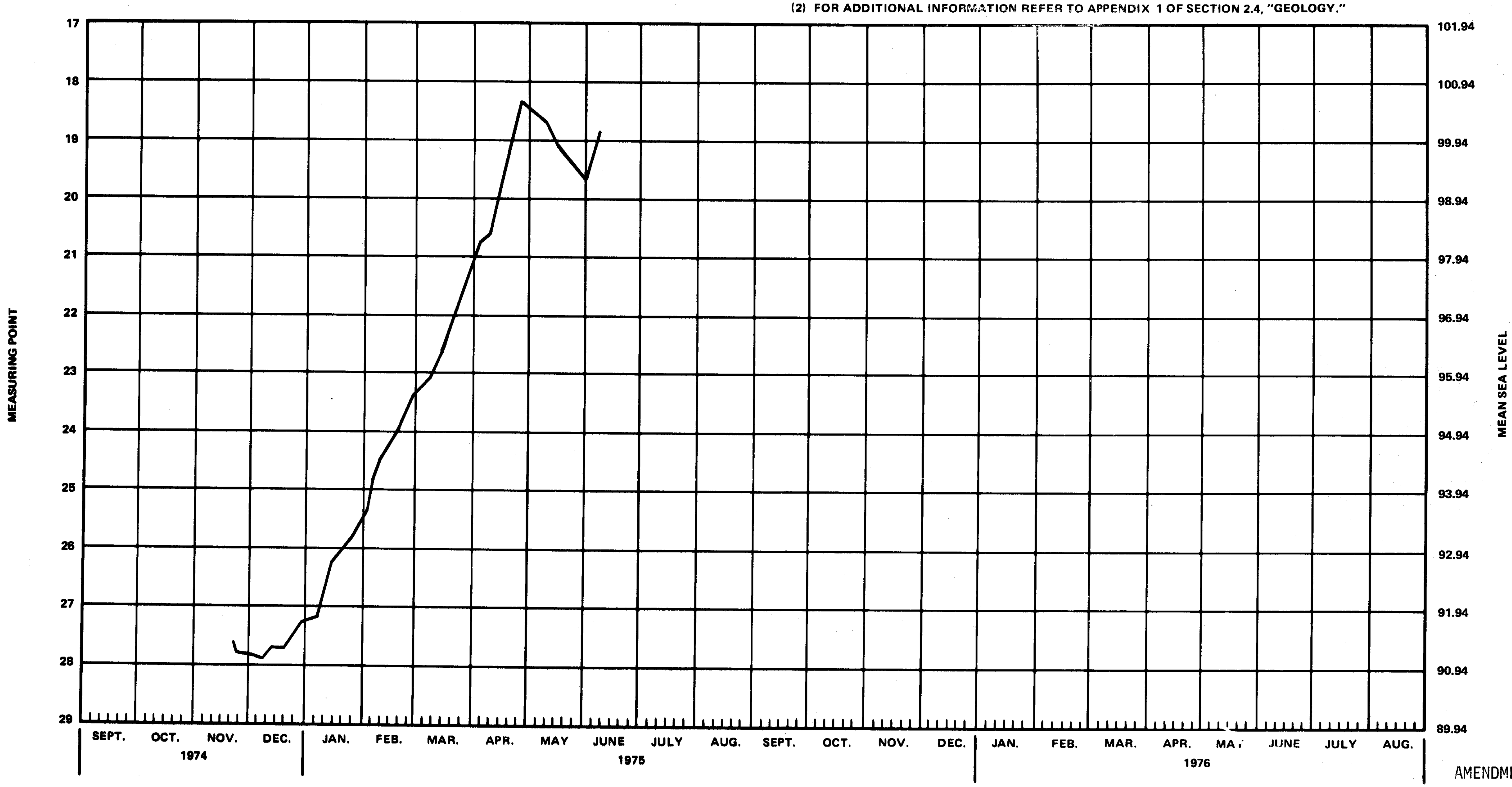
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 6-1

FIGURE 2.5B-11

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 6-1
LOCATION: SE 1/4, NW 1/4 SEC. 30, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES: 1,598,271.256 E
662,090.007 N

DEPTH OF WELL: 40 FT.
FEET OF CASING: 41
AQUIFER: WATER TABLE
ELEV. OF M.P.: 118.94
ELEV. OF L.S.D:
RECORD BEGAN: 11-12-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

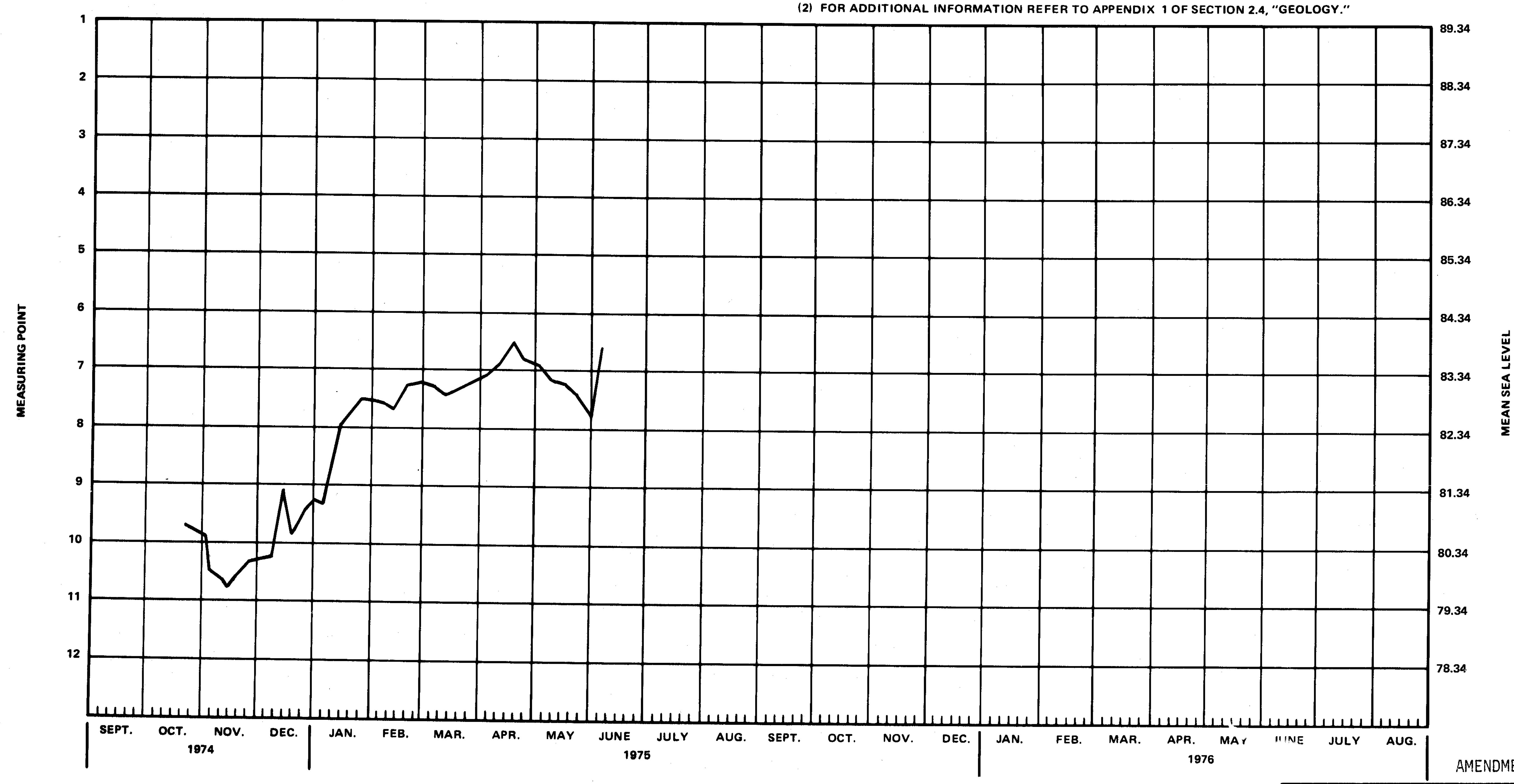
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 6-2

FIGURE 2.5B-12

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 7-1
LOCATION: NW 1/4, NW 1/4 SEC. 31, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES: 1,596,124.007 E
658,642.349 N

DEPTH OF WELL: 151 FT.
FEET OF CASING: 35
AQUIFER: FLORIDAN
ELEV. OF M.P.: 90.34
ELEV. OF L.S.D:
RECORD BEGAN: 10-22-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

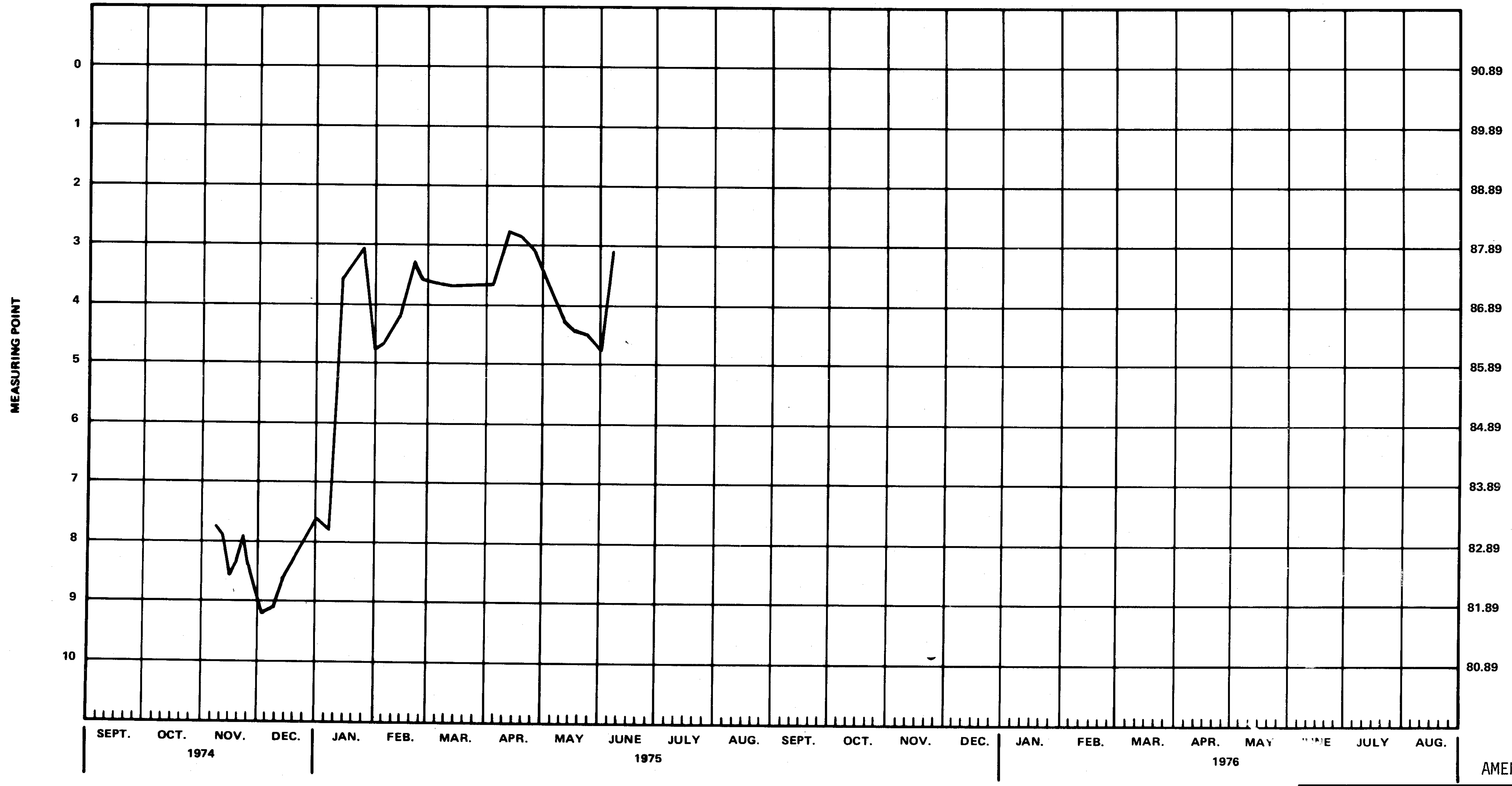
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 7-1

FIGURE 2.5B-13

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 7-2
LOCATION: NW 1/4, NW 1/4 SEC. 31, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES: 1,596,138.631 E
658,620.427 N

DEPTH OF WELL: 25 FT.
FEET OF CASING: 26
AQUIFER: WATER TABLE
ELEV. OF M.P.: 90.89
ELEV. OF L.S.D:
RECORD BEGAN: 11-8-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

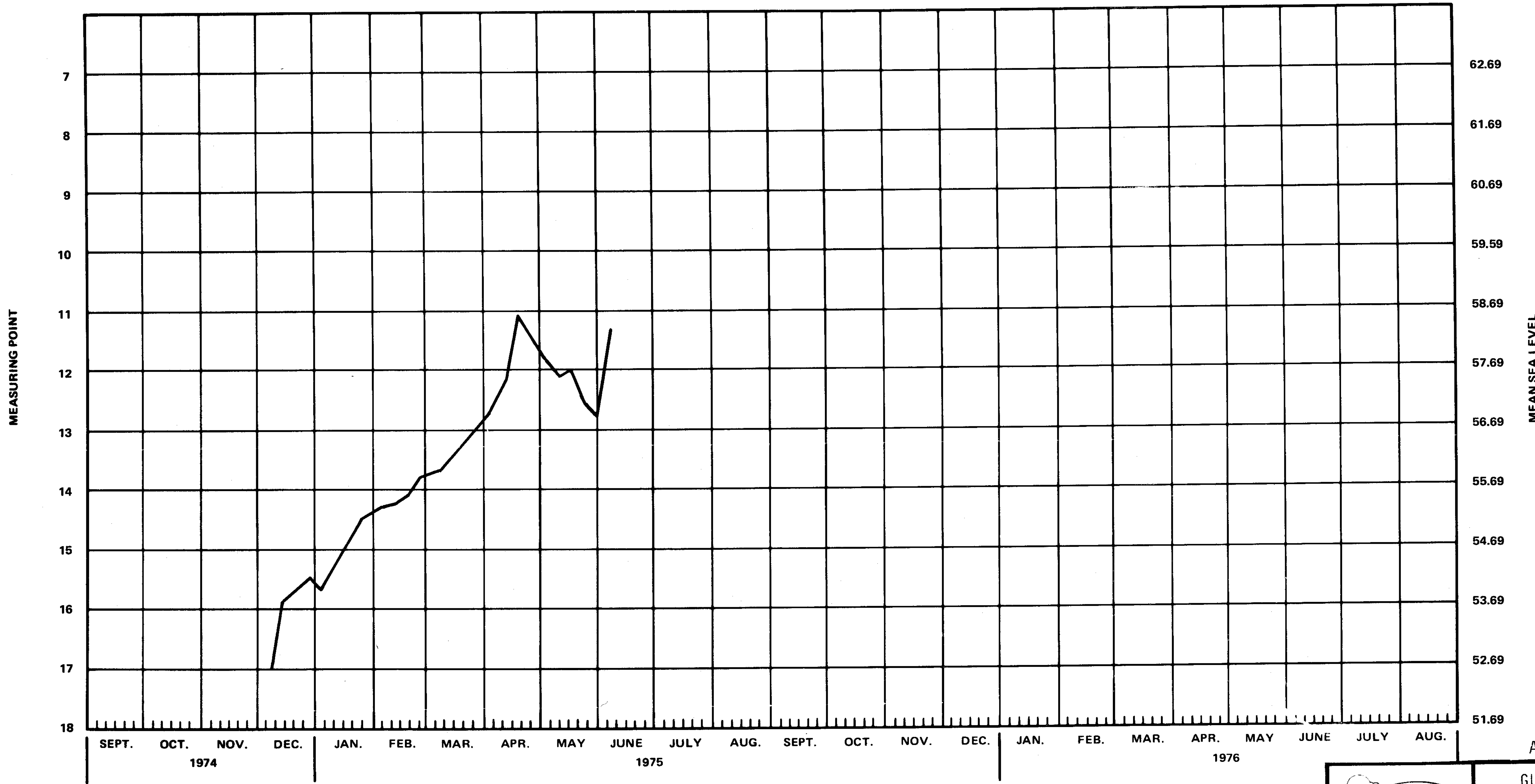
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 7-2

FIGURE 2.5B-14

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 8-1
LOCATION: SW 1/4, NW 1/4 SEC. 25, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,591,029.797 E
661,495.741 N

DEPTH OF WELL: 110.5 FT.
FEET OF CASING: 60
AQUIFER: FLORIDAN
ELEV. OF M.P.: 69.69
ELEV. OF L.S.D:
RECORD BEGAN: 12-9-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

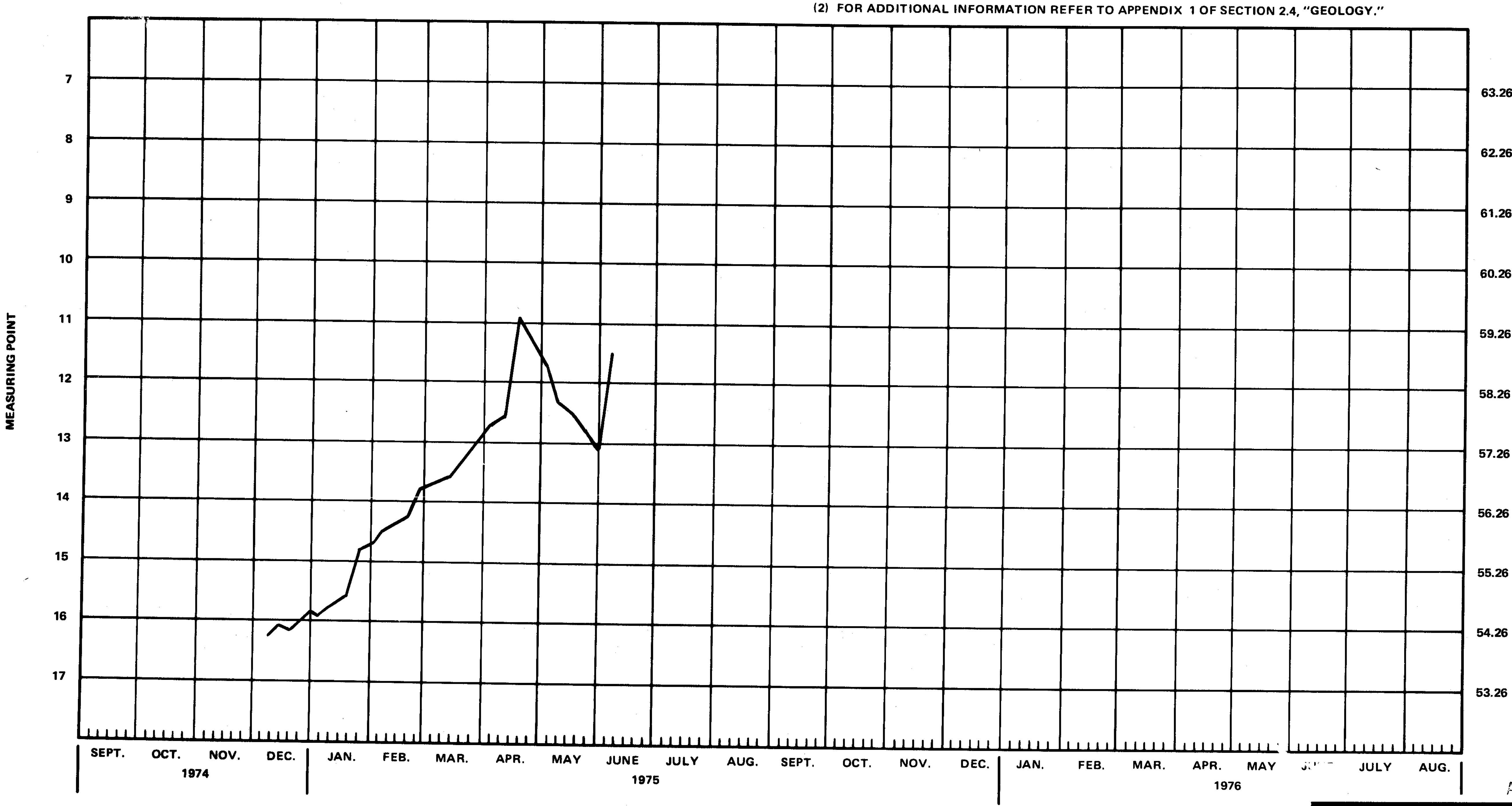
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 8-1

FIGURE 2.5B-15

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 8-2
LOCATION: SW 1/4, NW 1/4 SEC. 25, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,591,004.274 E
661,486.273 N

DEPTH OF WELL: 25 FT.
FEET OF CASING: 26
AQUIFER: WATER TABLE
ELEV. OF M.P.: 70.26
ELEV. OF L.S.D:
RECORD BEGAN: 12-9-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



AMENDMENT 2 8/75

WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

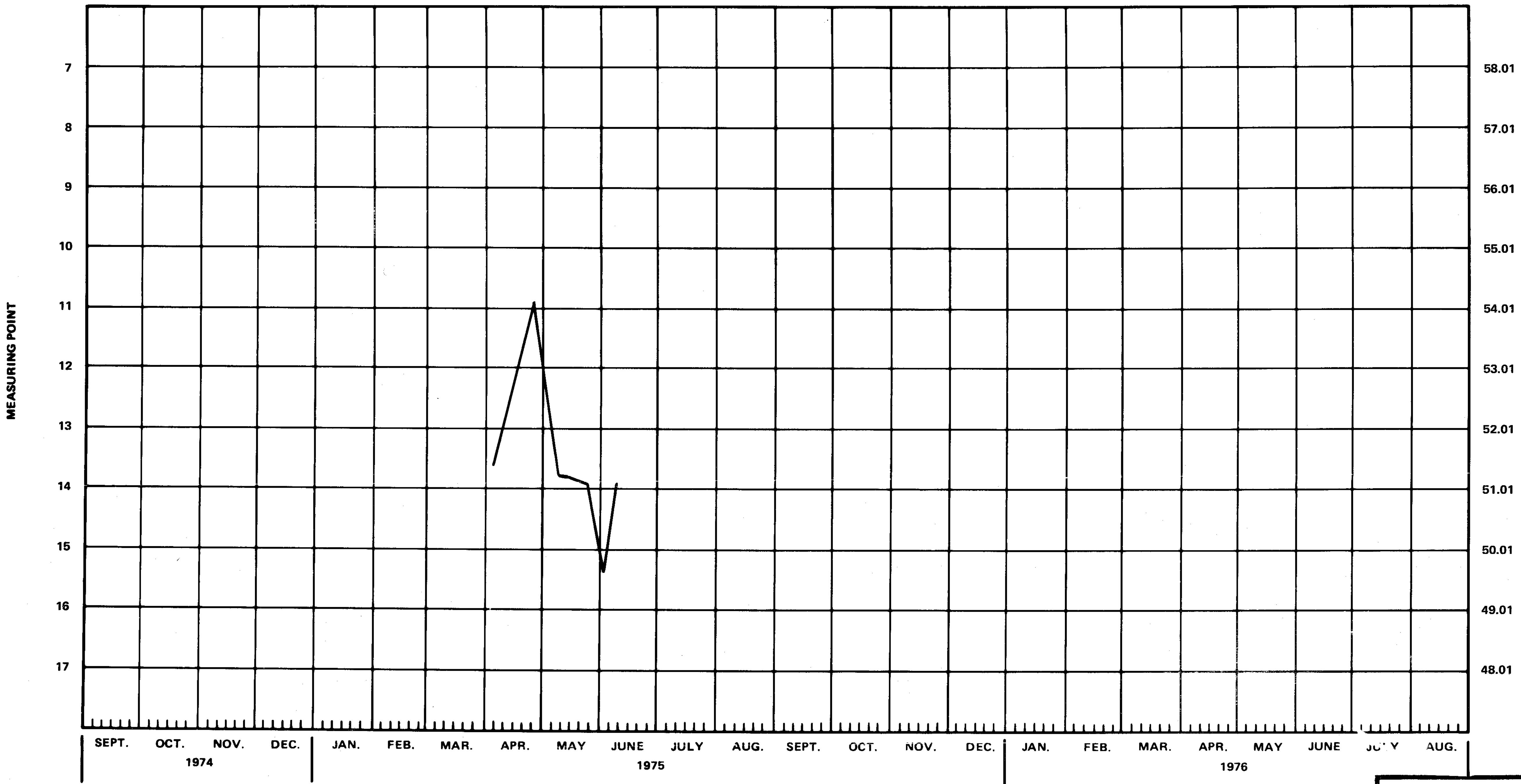
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 8-2

FIGURE 2.5B-16

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 9-1
LOCATION: NW 1/4, SE 1/4 SEC. 23, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,589,118.106 E
666,062.104 N

DEPTH OF WELL: 120 FT.
FEET OF CASING: 83
AQUIFER: FLORIDAN
ELEV. OF M.P.: 65.01
ELEV. OF L.S.D:
RECORD BEGAN: 4-4-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

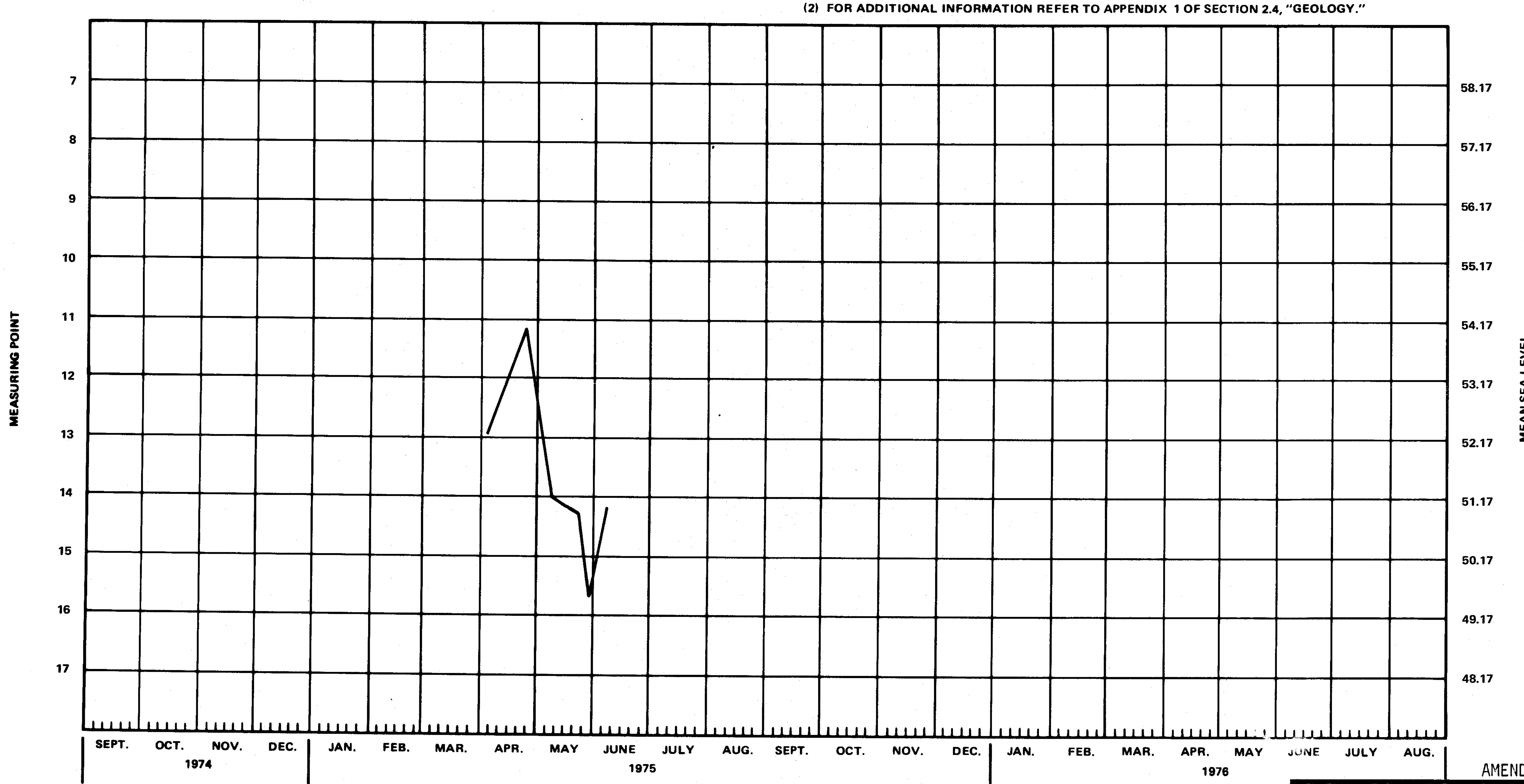
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 9-1

FIGURE 2.5B-17

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 9-2
LOCATION: NW 1/4, SE 1/4 SEC. 23, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,589,124.831 E
666,085.210 N

DEPTH OF WELL: 40 FT.
FEET OF CASING: 36
AQUIFER: WATER TABLE
ELEV. OF M.P.: 65.17
ELEV. OF L.S.D:
RECORD BEGAN: 4-4-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

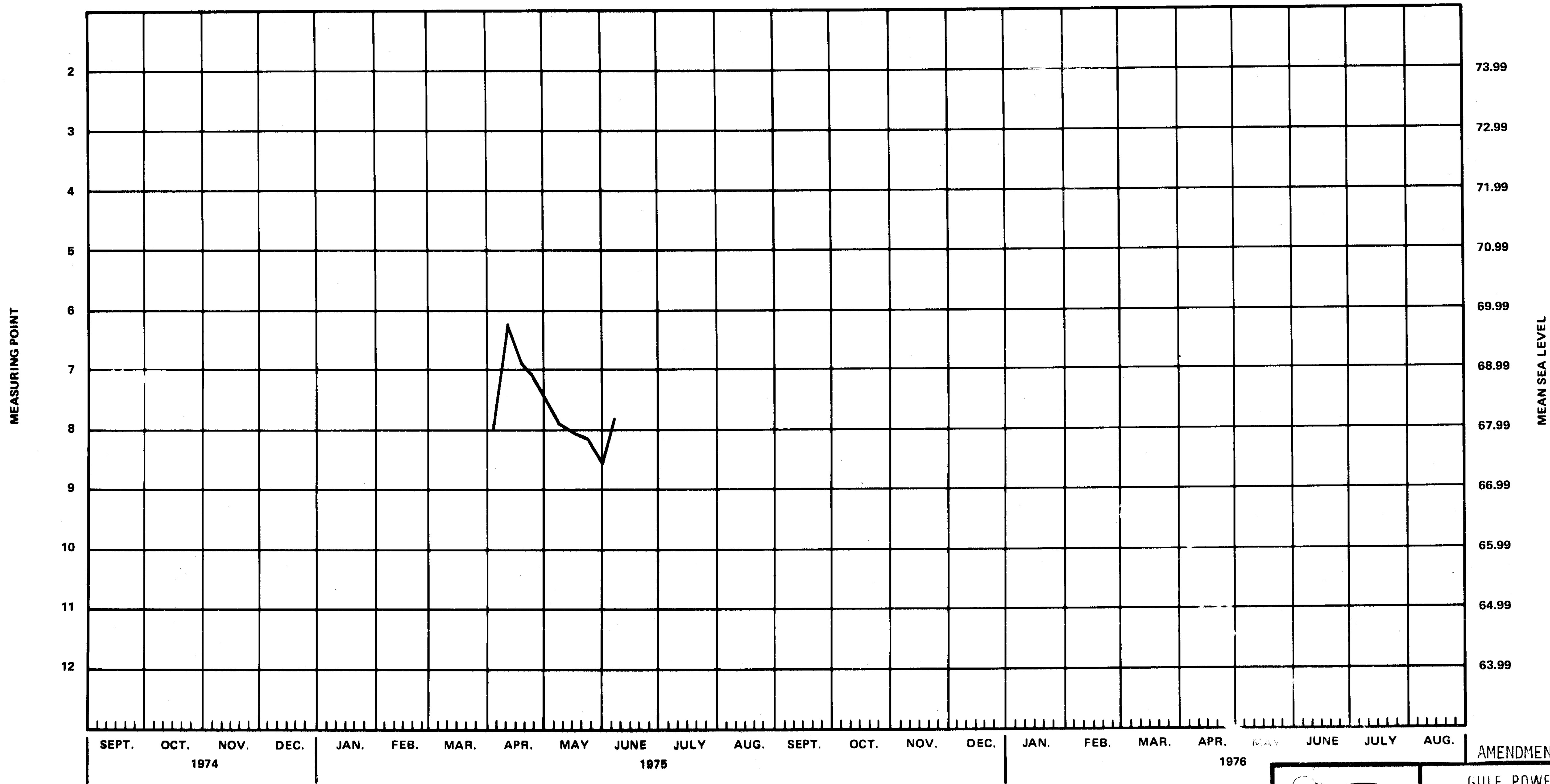
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 9-2

FIGURE 2.5B-18

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 10-1
LOCATION: SE 1/4, SW 1/4 SEC. 15, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:

DEPTH OF WELL: 301 FT.
FEET OF CASING: 59
AQUIFER: FLORIDAN
ELEV. OF M.P.: 75.99
ELEV. OF L.S.D:
RECORD BEGAN: 4-4-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

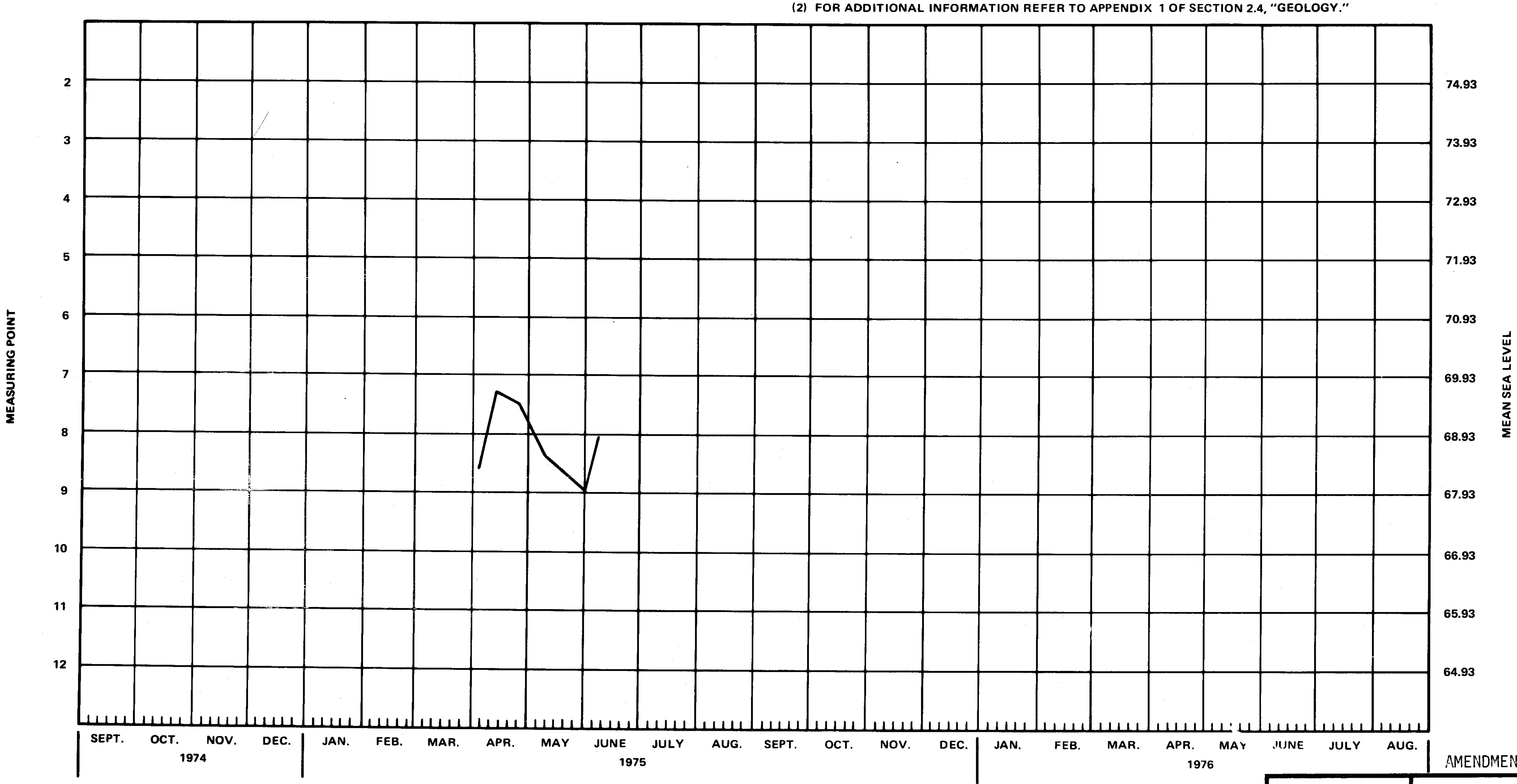
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 10-1

FIGURE 2.5B-19

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 10-2
LOCATION: SE 1/4, SW 1/4 SEC. 15, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:

DEPTH OF WELL: 21 FT.
FEET OF CASING: 20
AQUIFER: WATER TABLE
ELEV. OF M.P.: 76.93
ELEV. OF L.S.D:
RECORD BEGAN: 4-4-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

GULF POWER CO.
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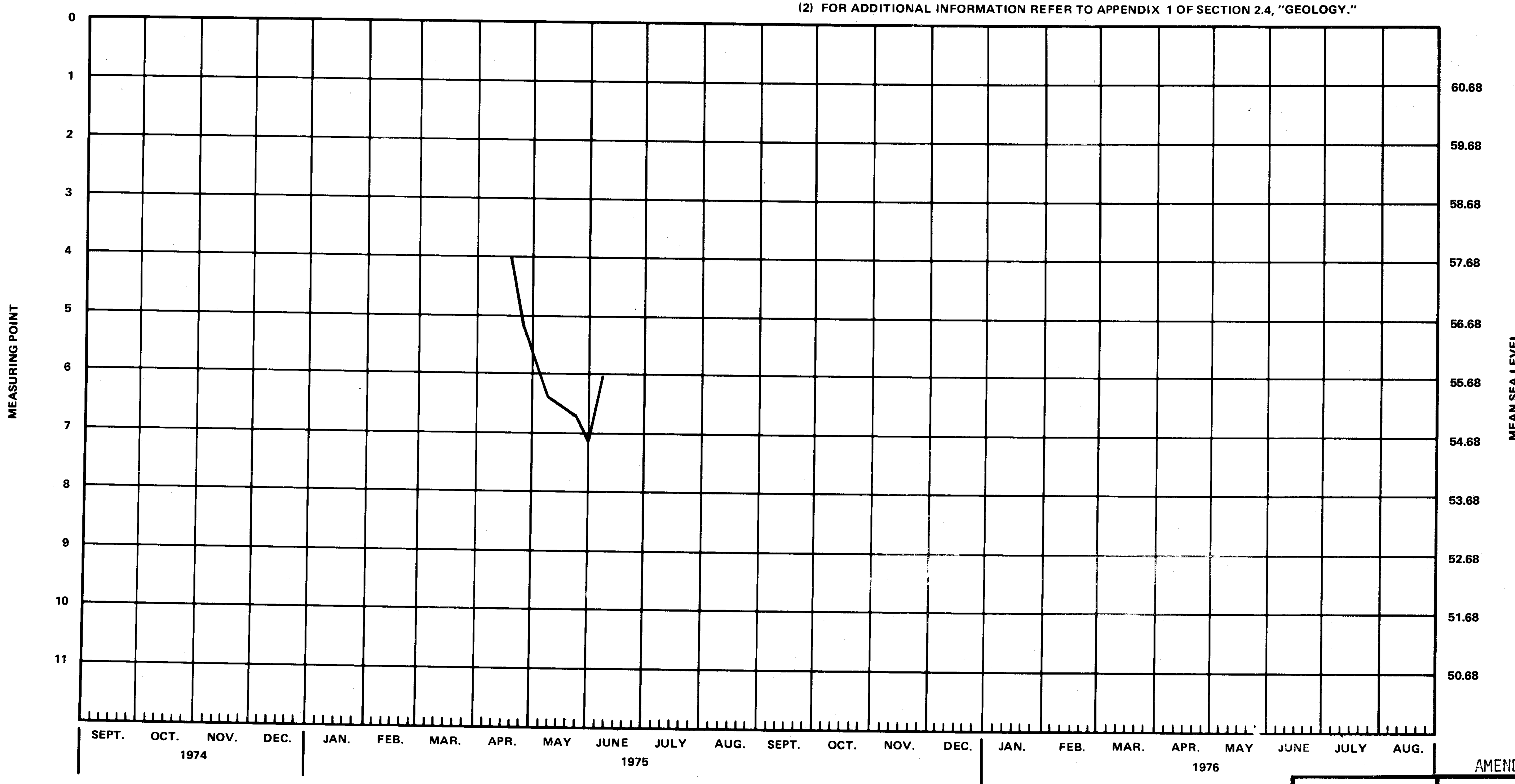
HYDROGRAPH OF OBSERVATION WELL 10-2

FIGURE 2.5B-20

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 11-1
LOCATION: NW COR. SEC. 26, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,585,928.044 E
664,190.741 N

DEPTH OF WELL: 107 FT.
FEET OF CASING: 42
AQUIFER: FLORIDAN
ELEV. OF M.P.: 61.68
ELEV. OF L.S.D.:
RECORD BEGAN: 4/18/75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

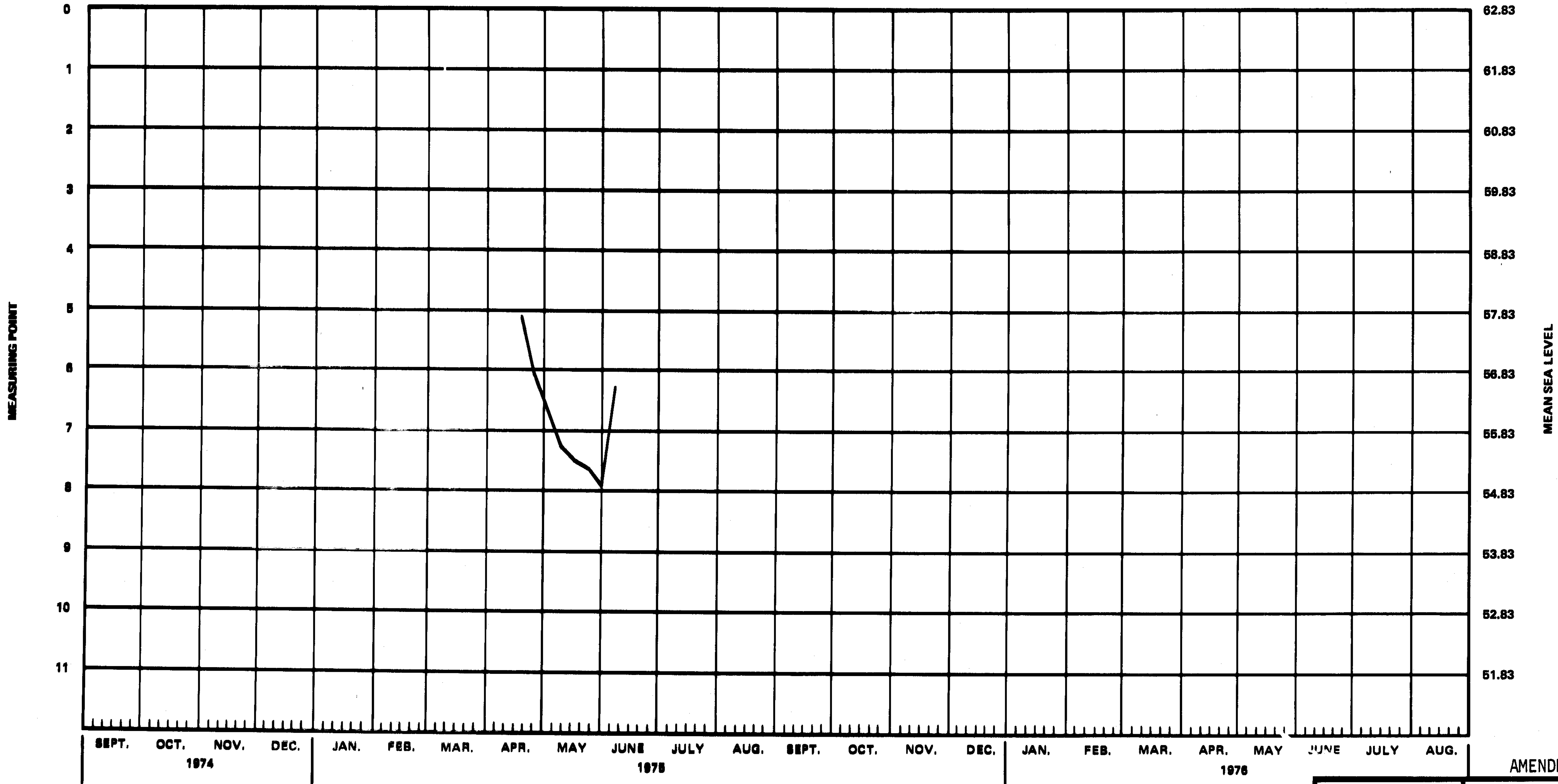
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 11-1

FIGURE 2.5B-21

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 11-2
LOCATION: NW COR. SEC. 26, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,585,937.130 E
664,211.534 N

DEPTH OF WELL: 30 FT.
FEET OF CASING: 29
AQUIFER: WATER TABLE
ELEV. OF M.P.: 62.83
ELEV. OF L.S.D:
RECORD BEGAN: 4/18/75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

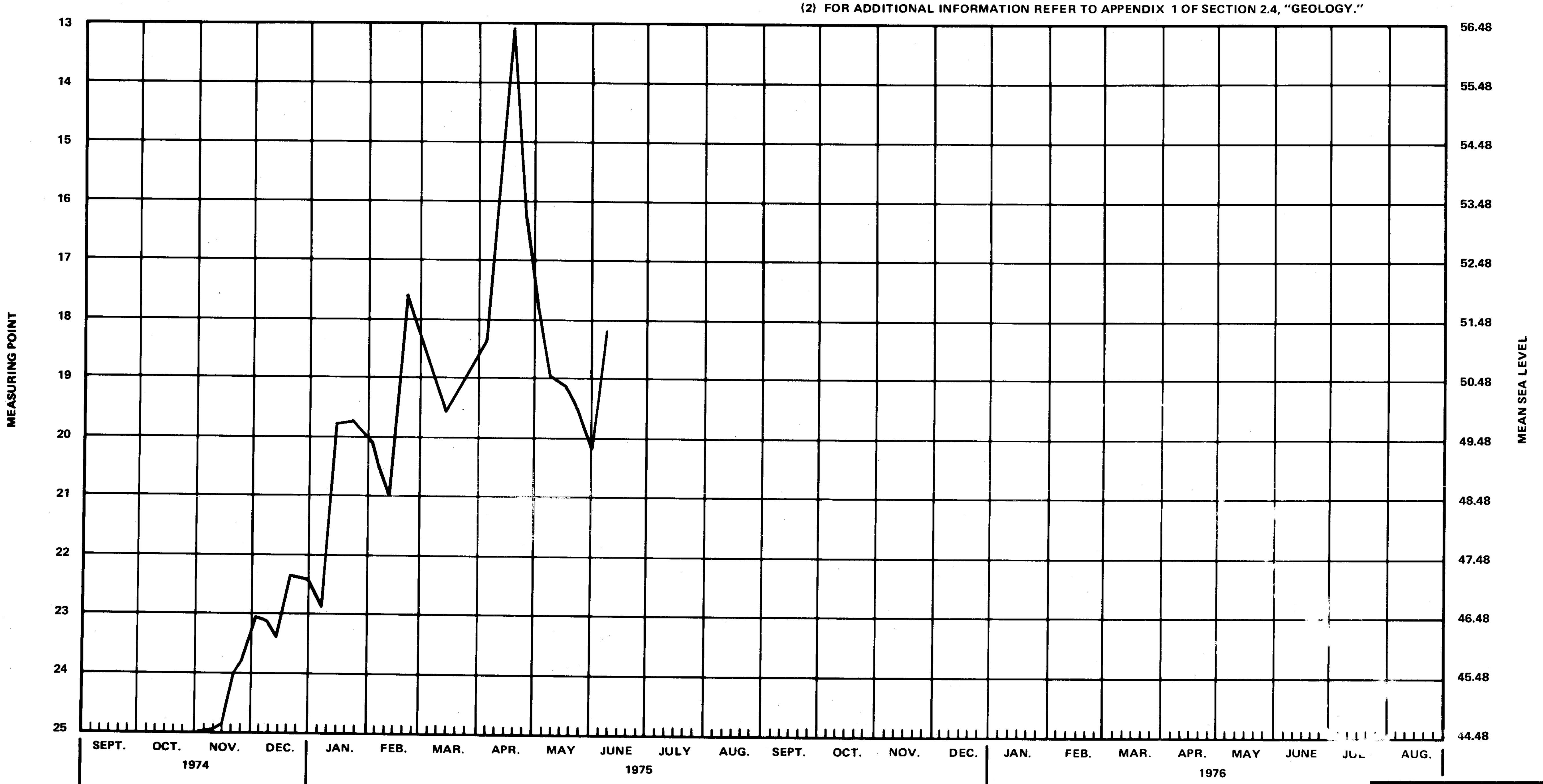
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 11-2

FIGURE 2.5B-22

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 12-1
LOCATION: SE 1/4 SW 1/4 SEC. 26, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,587,269.331 E
659,470.175 N

DEPTH OF WELL: 190 FT
FEET OF CASING: 128
AQUIFER: FLORIDAN
ELEV. OF M.P.: 69.48
ELEV. OF L.S.D:
RECORD BEGAN: 11/1/74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

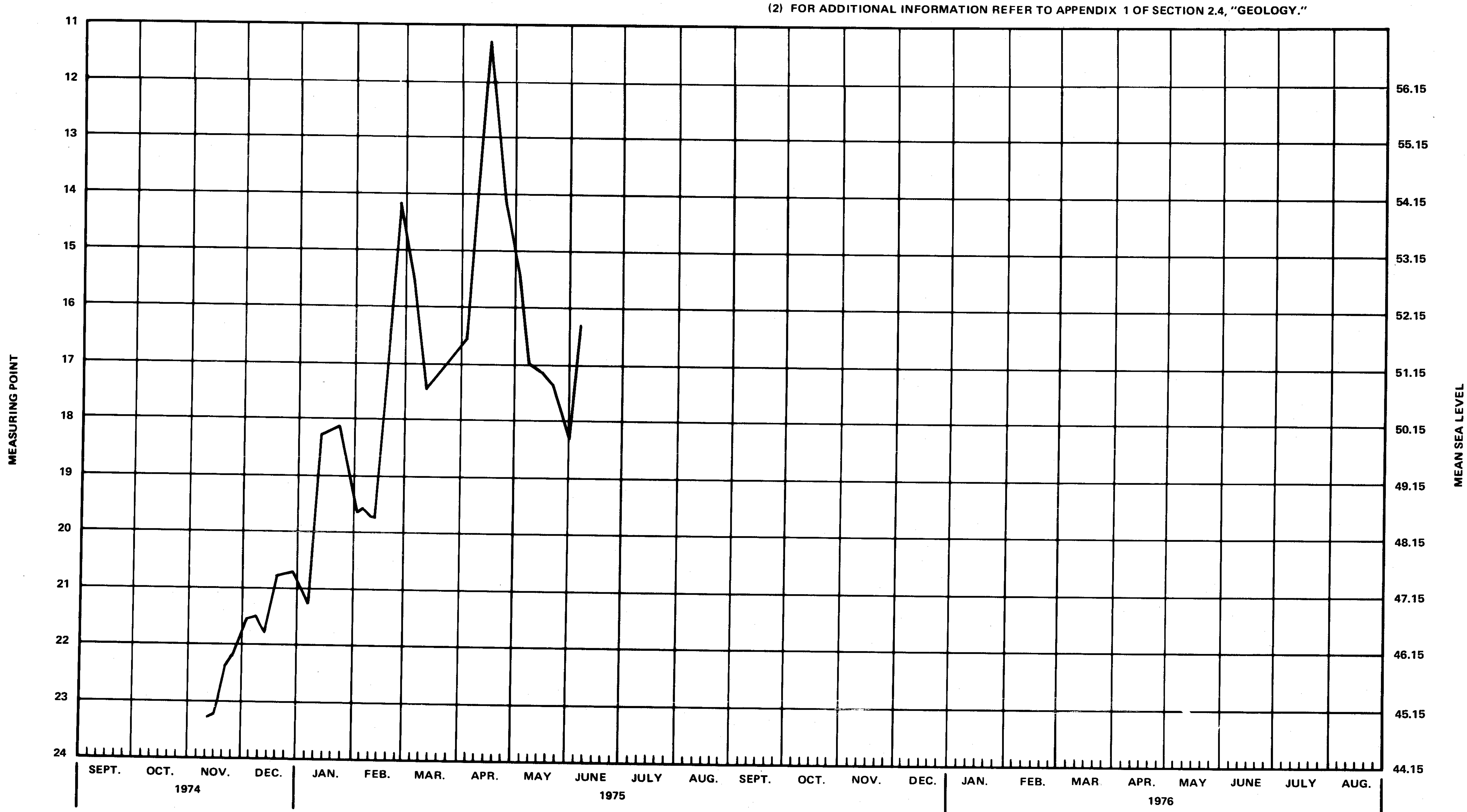
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 12-1

FIGURE 2.5B-23

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 12-2
LOCATION: SE 1/4 SW 1/4 SEC. 26, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,587,251.811 E
659,485.863 N

DEPTH OF WELL: 60 FT.
FEET OF CASING: 61
AQUIFER: WATER TABLE
ELEV. OF M.P.: 68.15
ELEV. OF L.S.D:
RECORD BEGAN: 11/11/74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



AMENDMENT 2 8/75

WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

GULF POWER COMPANY

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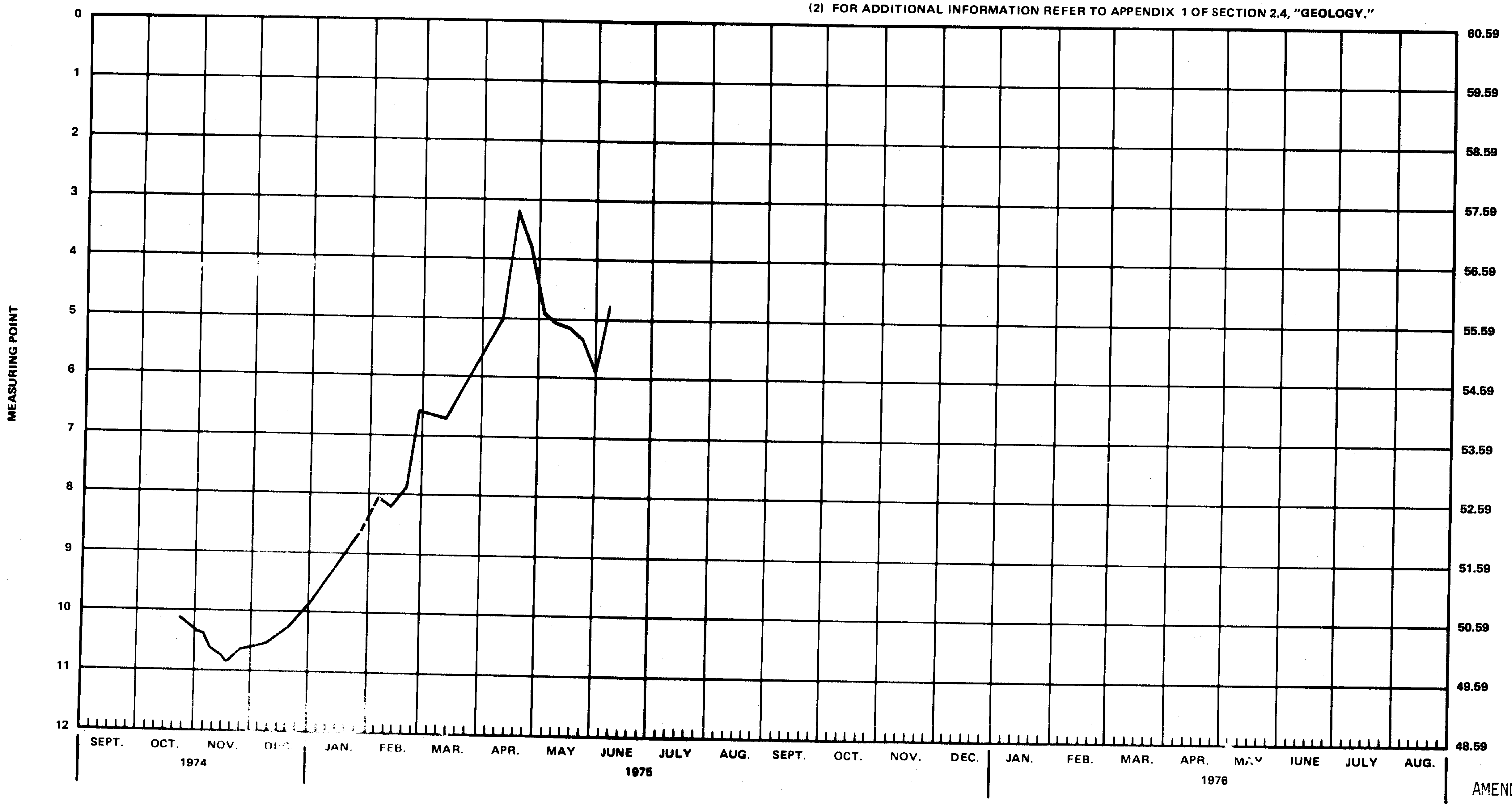
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 12-2

FIGURE 2.5B-24

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 13-1
LOCATION: SE 1/4 SW 1/4 SEC. 35, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES: 1,587,766.710 E
654,614.966 N

DEPTH OF WELL: 150 FT
FEET OF CASING: 54
AQUIFER: FLORIDAN
ELEV. OF M.P.: 60.59
ELEV. OF L.S.D:
RECORD BEGAN: 10/22/74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

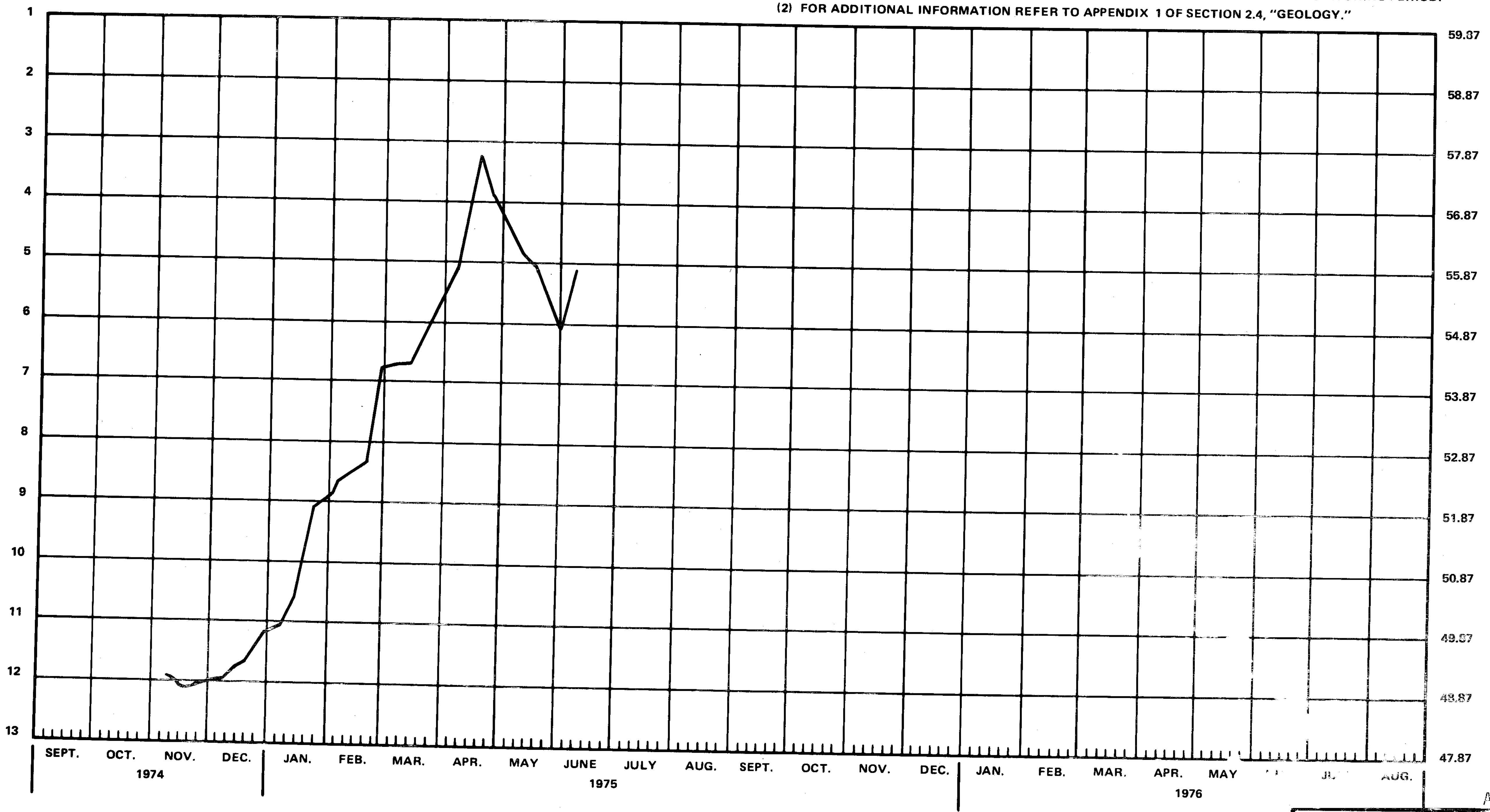
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 13-1

FIGURE 2.5B-25

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 13-2
LOCATION: SE 1/4 SW 1/4 SEC. 35, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,587,763.886 E
654,638.712 N

DEPTH OF WELL: 18 FT.
FEET OF CASING: 19
AQUIFER: WATER TABLE
ELEV. OF M.P.: 60.87
ELEV. OF L.S.D:
RECORD BEGAN: 11/8/74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

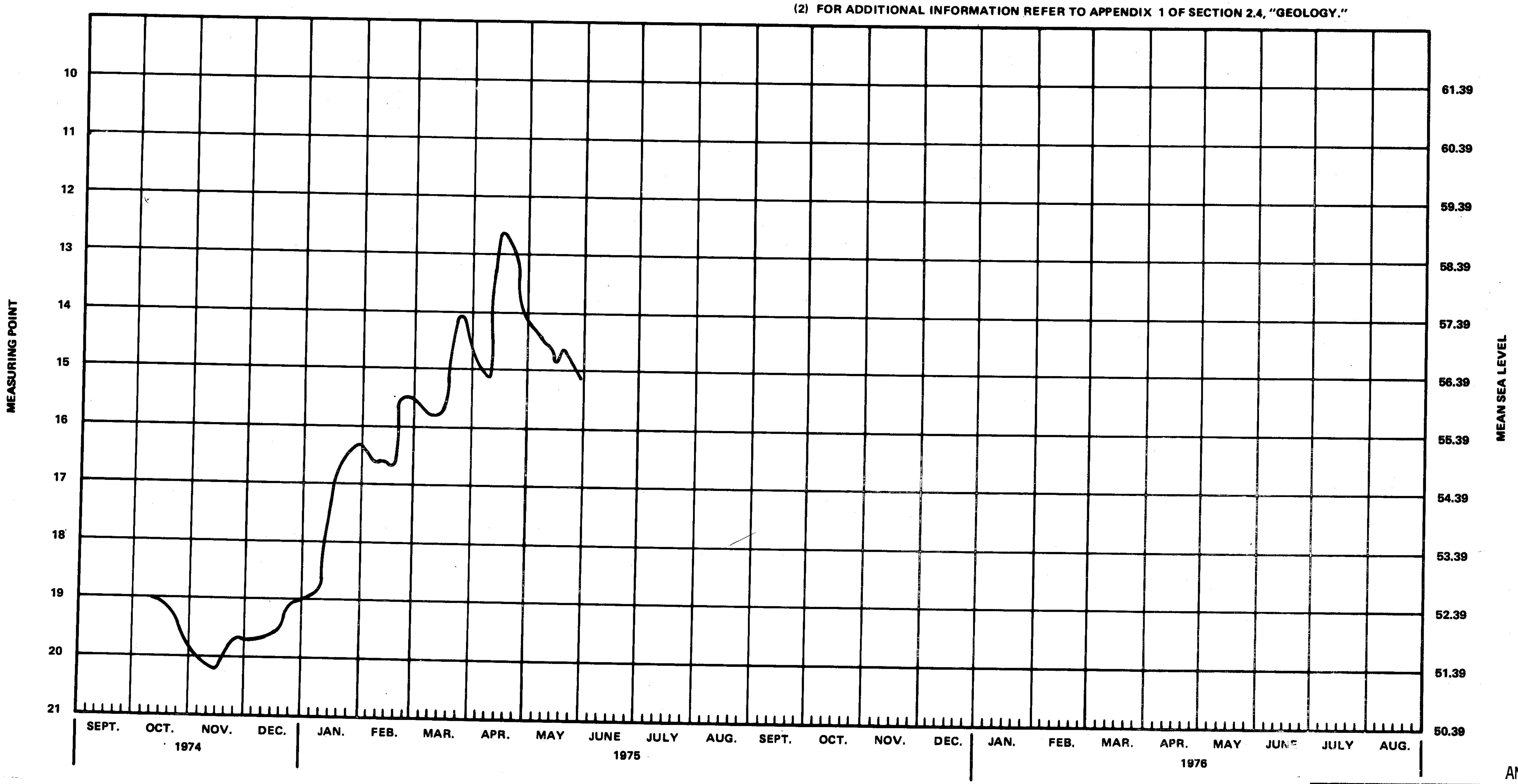
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 13-2

FIGURE 2.5B-26

WATER-LEVEL MEASUREMENTS: Chart Recorder
WELL NUMBER: 14-1
LOCATION: SE 1/4 NE 1/4 SEC. 2, T 4 N, R 16 W
WASHINGTON COUNTY, FLORIDA
COORDINATES:
1,589,661.261 E
651,525.676 N

DEPTH OF WELL: 100 FT.
FEET OF CASING: 47
AQUIFER: FLORIDAN
ELEV. OF M.P.: 71.39
ELEV. OF L.S.D:
RECORD BEGAN: 11/10/74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

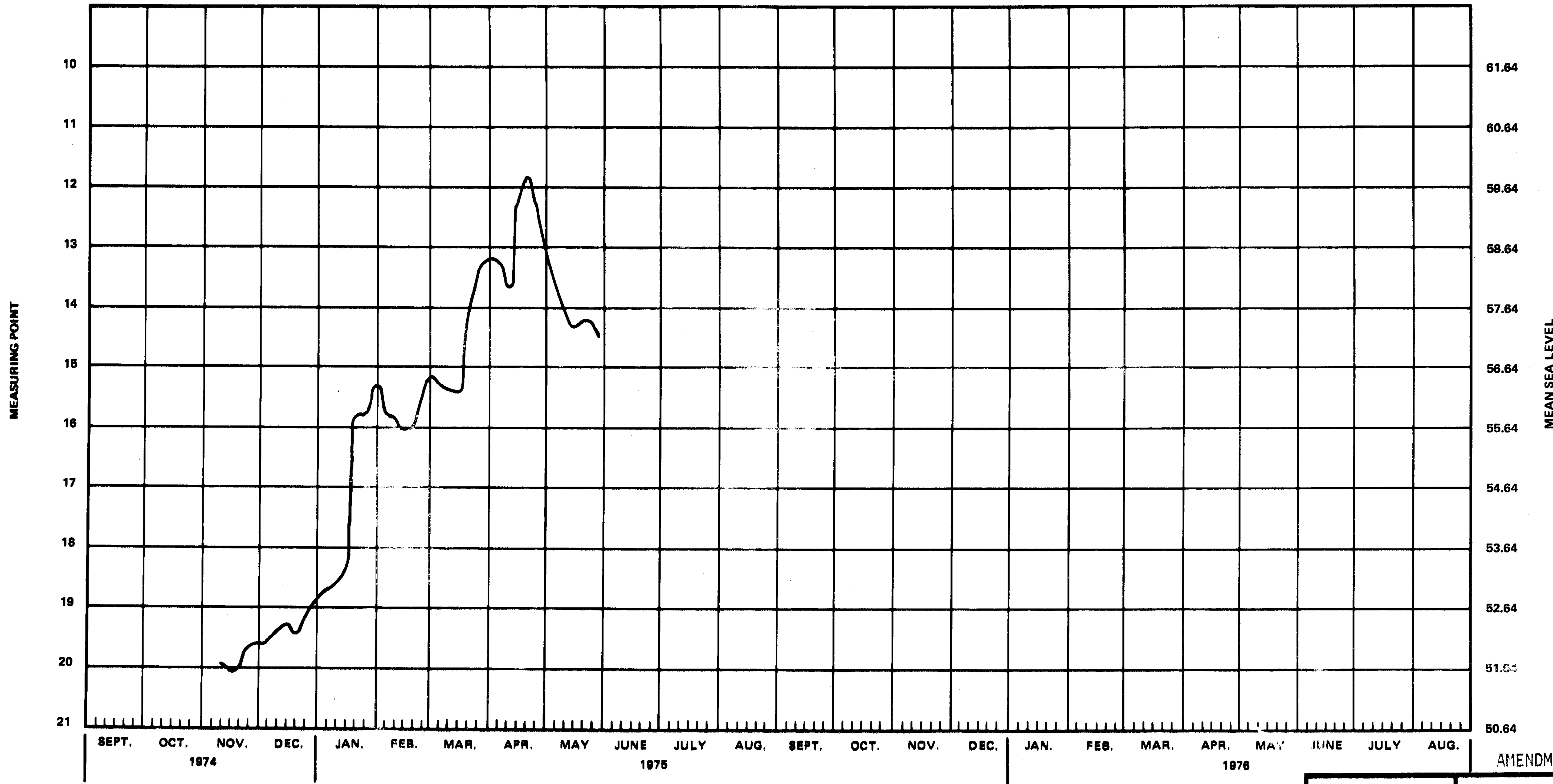
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 14-1

FIGURE 2.5B-27

WATER-LEVEL MEASUREMENTS: Chart Recorder
WELL NUMBER: 14-2
LOCATION: SE 1/4 NE 1/4 SEC. 2, T 4 N, R 16 W
WASHINGTON COUNTY, FLORIDA
COORDINATES:
1,589,686.251 E
651,522.330 N

DEPTH OF WELL: 32 FT.
FEET OF CASING: 32
AQUIFER: WATER TABLE
ELEV. OF M.P.: 71.64
ELEV. OF L.S.D:
RECORD BEGAN: 11/10/74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

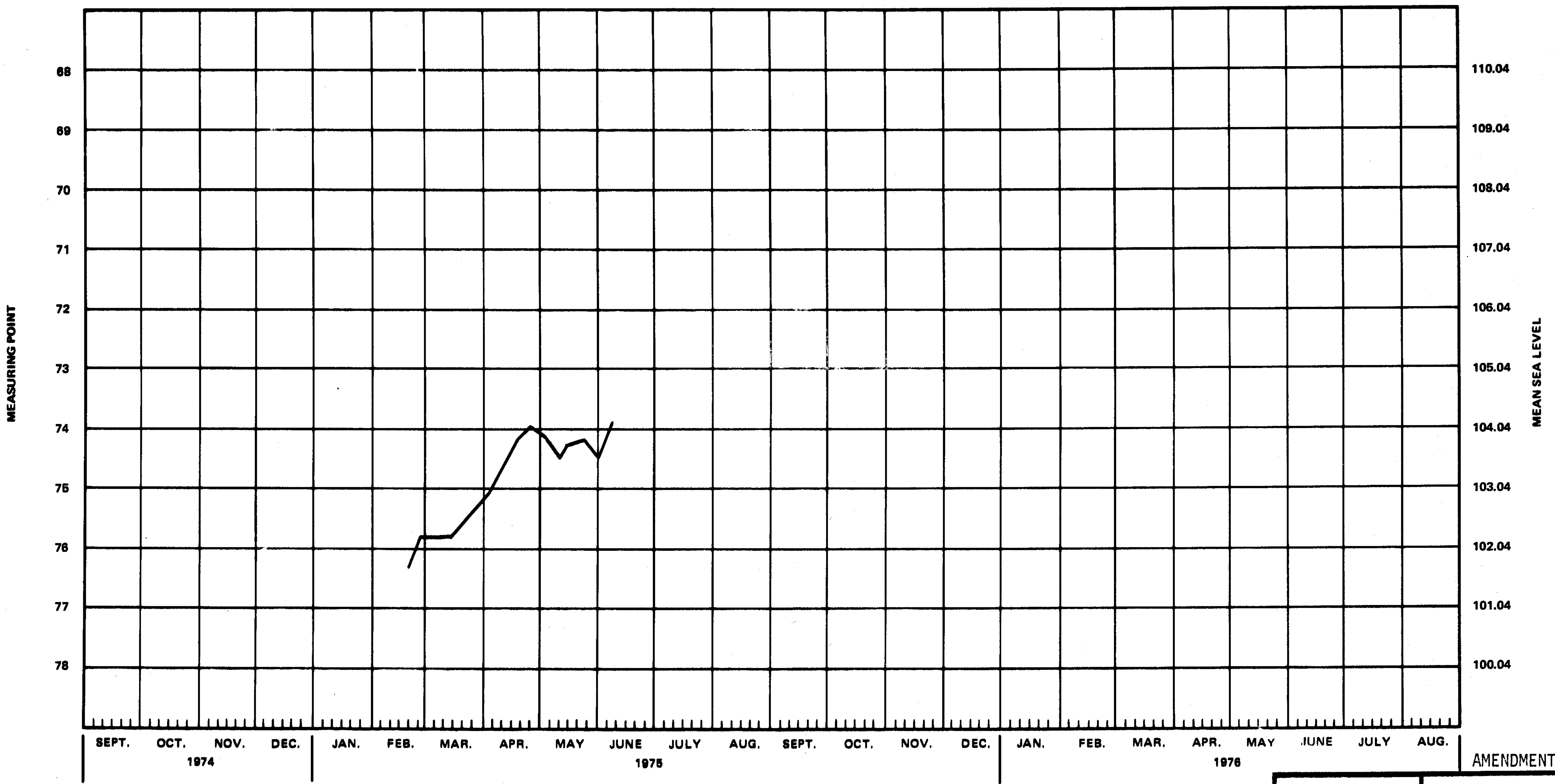
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 14-2

FIGURE 2.5B-28

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 15-1
LOCATION: SW 1/4 SE 1/4 SEC. 26, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,620,357.641 E
657,806.039 N

DEPTH OF WELL: 333 FT
FEET OF CASING: 290
AQUIFER: FLORIDAN
ELEV. OF M.P.: 178.04
ELEV. OF L.S.D:
RECORD BEGAN: 2/20/75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

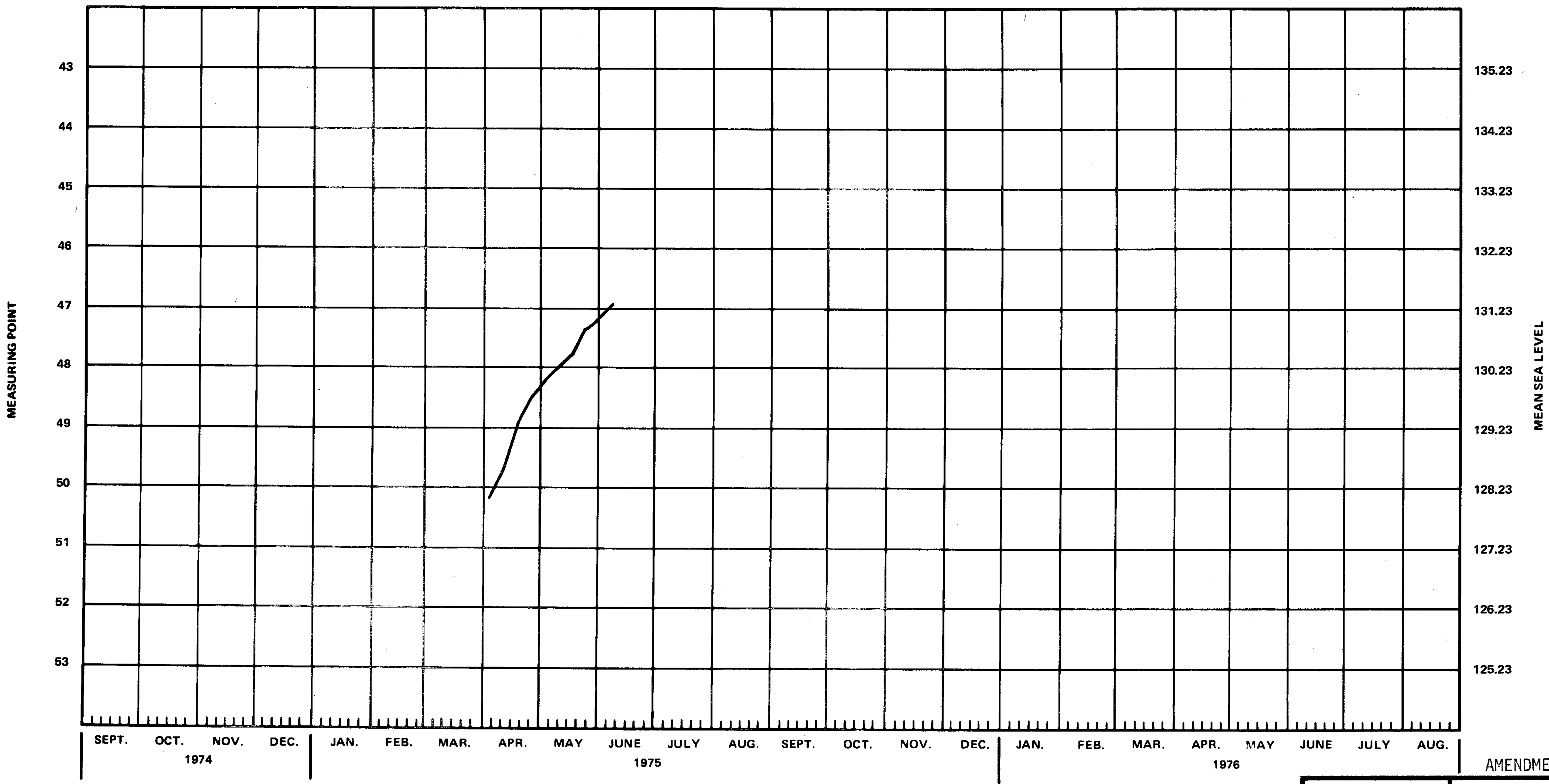
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 15-1

FIGURE 2.5B-29

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 15-2
LOCATION: SW 1/4 SE 1/4 SEC. 26, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,620,356.394 E
657,781.505 N

DEPTH OF WELL: 63 FT.
FEET OF CASING: 64
AQUIFER: WATER TABLE
ELEV. OF M.P.: 178.23
ELEV. OF L.S.D:
RECORD BEGAN: 2/20/75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

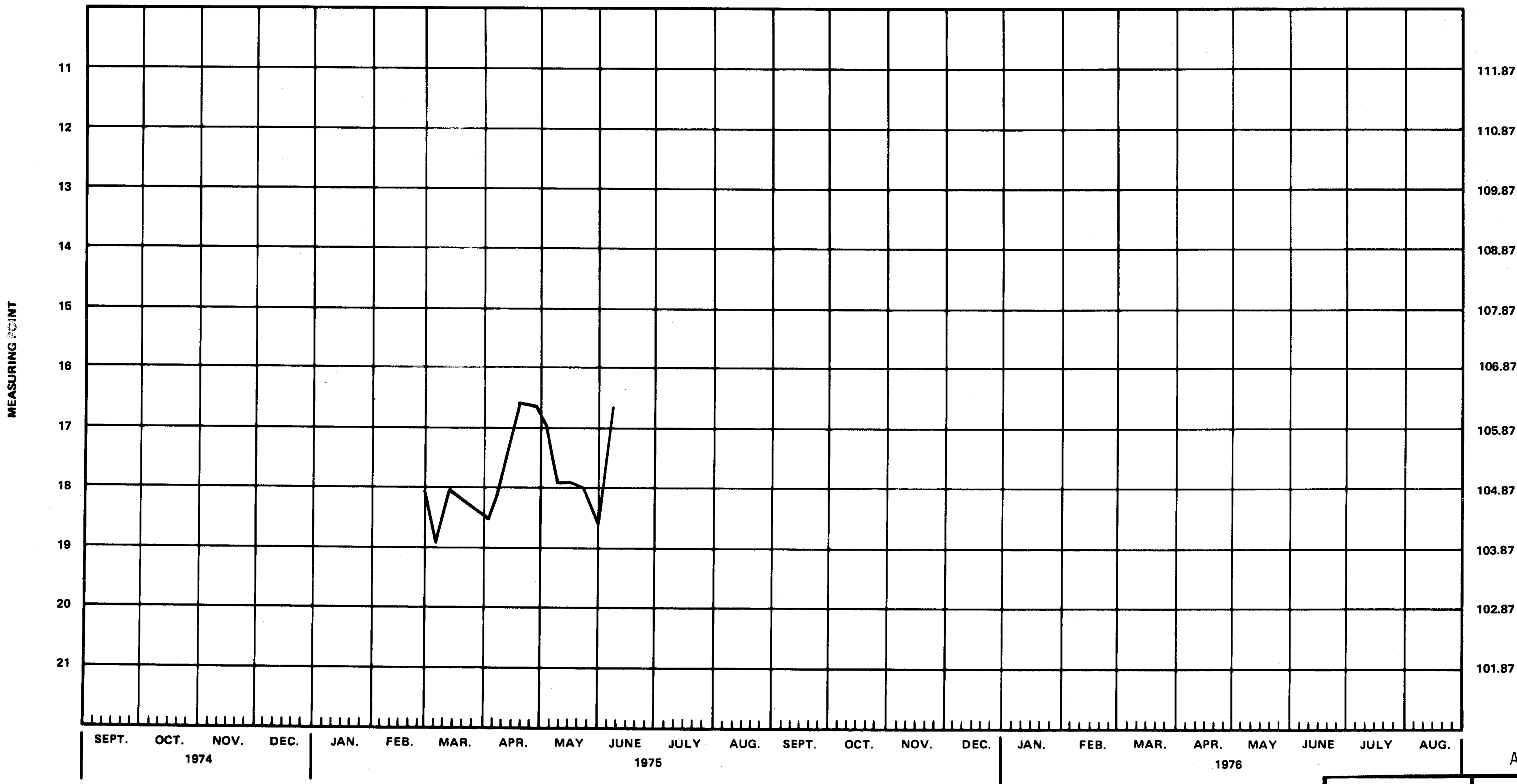
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 15-2

FIGURE 2.5B-30

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 16-1
LOCATION: NE 1/4, NW 1/4 SEC. 21, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,609,922.509 E
668,130.942 N

DEPTH OF WELL: 180 FT.
FEET OF CASING: 107
AQUIFER: FLORIDAN
ELEV. OF M.P.: 122.87
ELEV. OF L.S.D:
RECORD BEGAN: 2-28-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

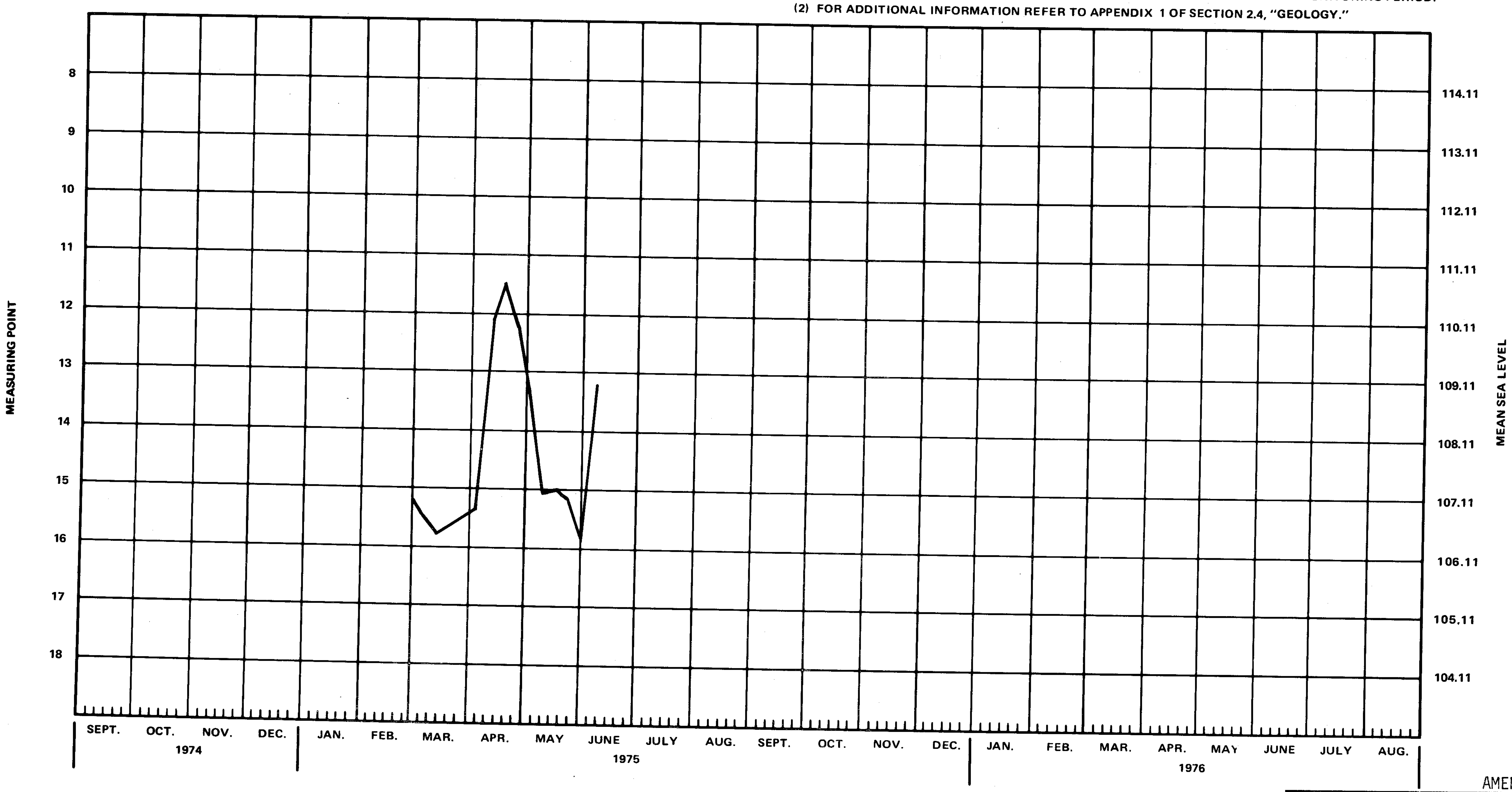
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 16-1

FIGURE 2.5B-31

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 16-2
LOCATION: NE 1/4, NW 1/4 SEC. 21, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,609,929.357 E
668,155.324 N

DEPTH OF WELL: 44 FT.
FEET OF CASING: 44
AQUIFER: WATER TABLE
ELEV. OF M.P.: 122.11
ELEV. OF L.S.D:
RECORD BEGAN: 2-28-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

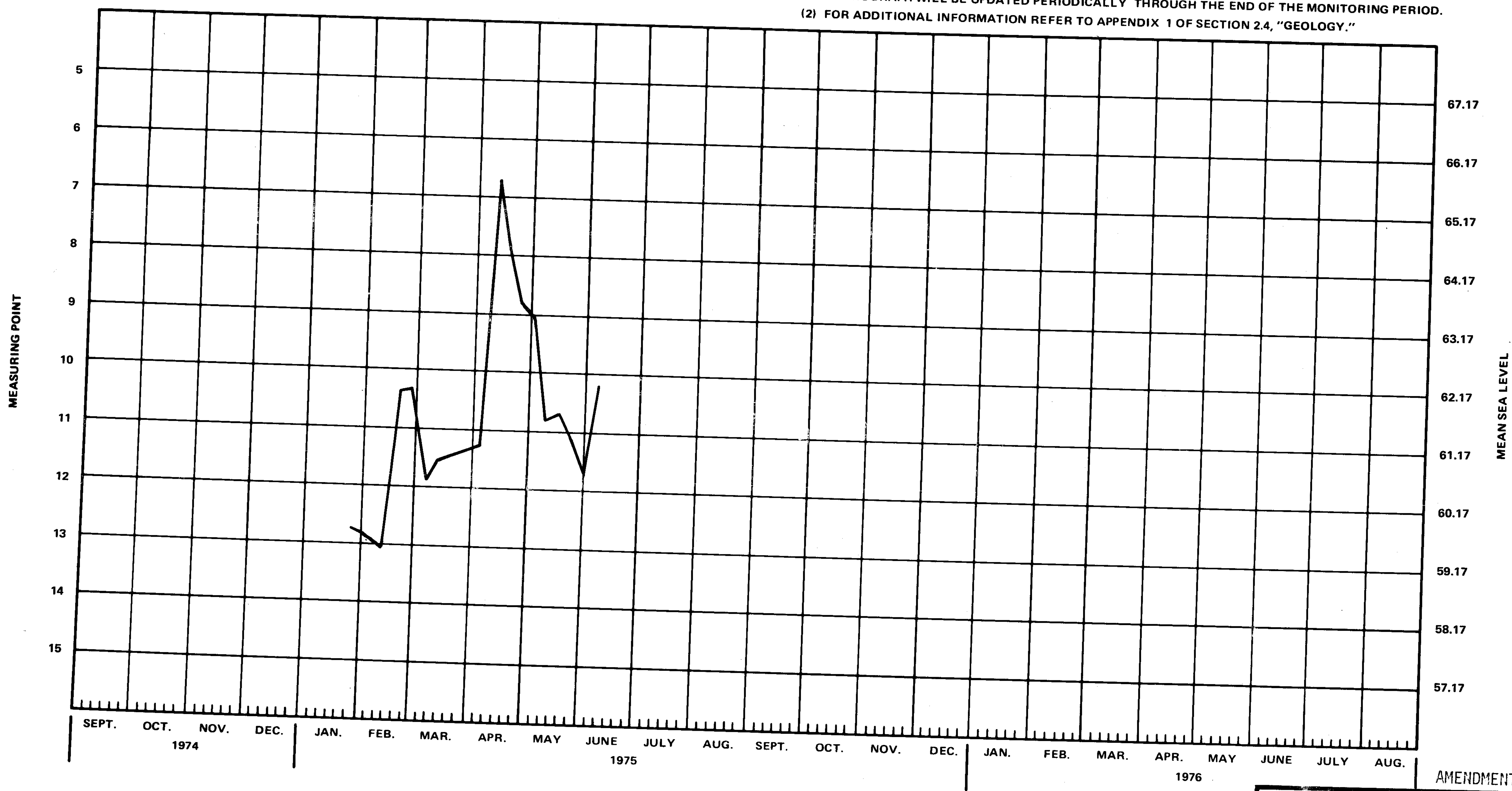
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 16-2

FIGURE 2.5B-32

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 17-1
LOCATION: SE 1/4, NE 1/4 SEC. 12, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,595,469.698 E
677,460.044 N

DEPTH OF WELL: 100 FT.
FEET OF CASING: 50
AQUIFER: FLORIDAN
ELEV. OF M.P.: 72.17
ELEV. OF L.S.D.:
RECORD BEGAN: 1-25-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

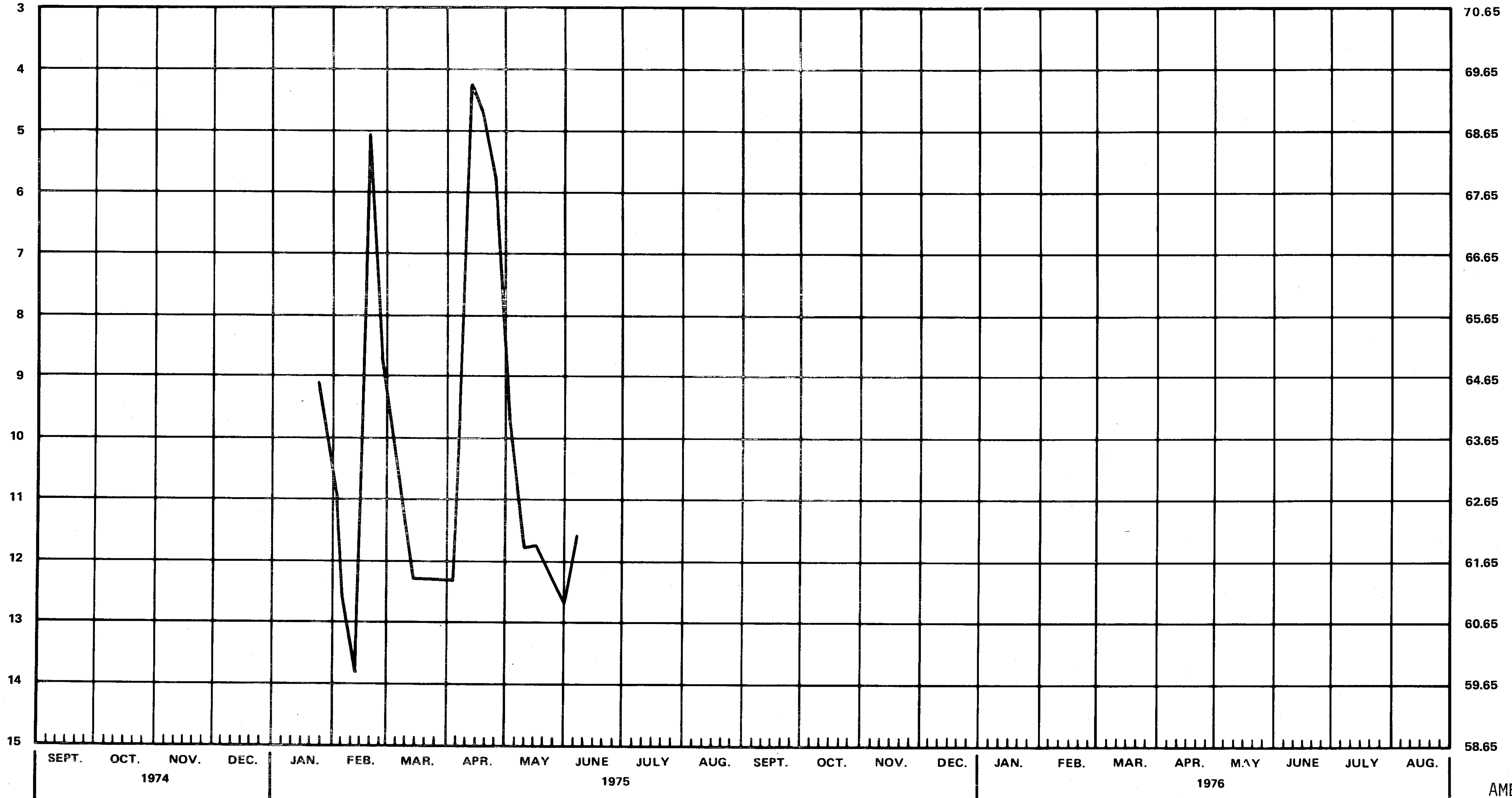
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 17-1

FIGURE 2.5B-33

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 17-2
LOCATION: SE 1/4, NE 1/4 SEC. 12, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,595,445.773 E
677,458,290 N

DEPTH OF WELL: 25 FT
FEET OF CASING: 26
AQUIFER: WATER TABLE
ELEV. OF M.P.: 73.65
ELEV. OF L.S.D:
RECORD BEGAN: 1-24-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

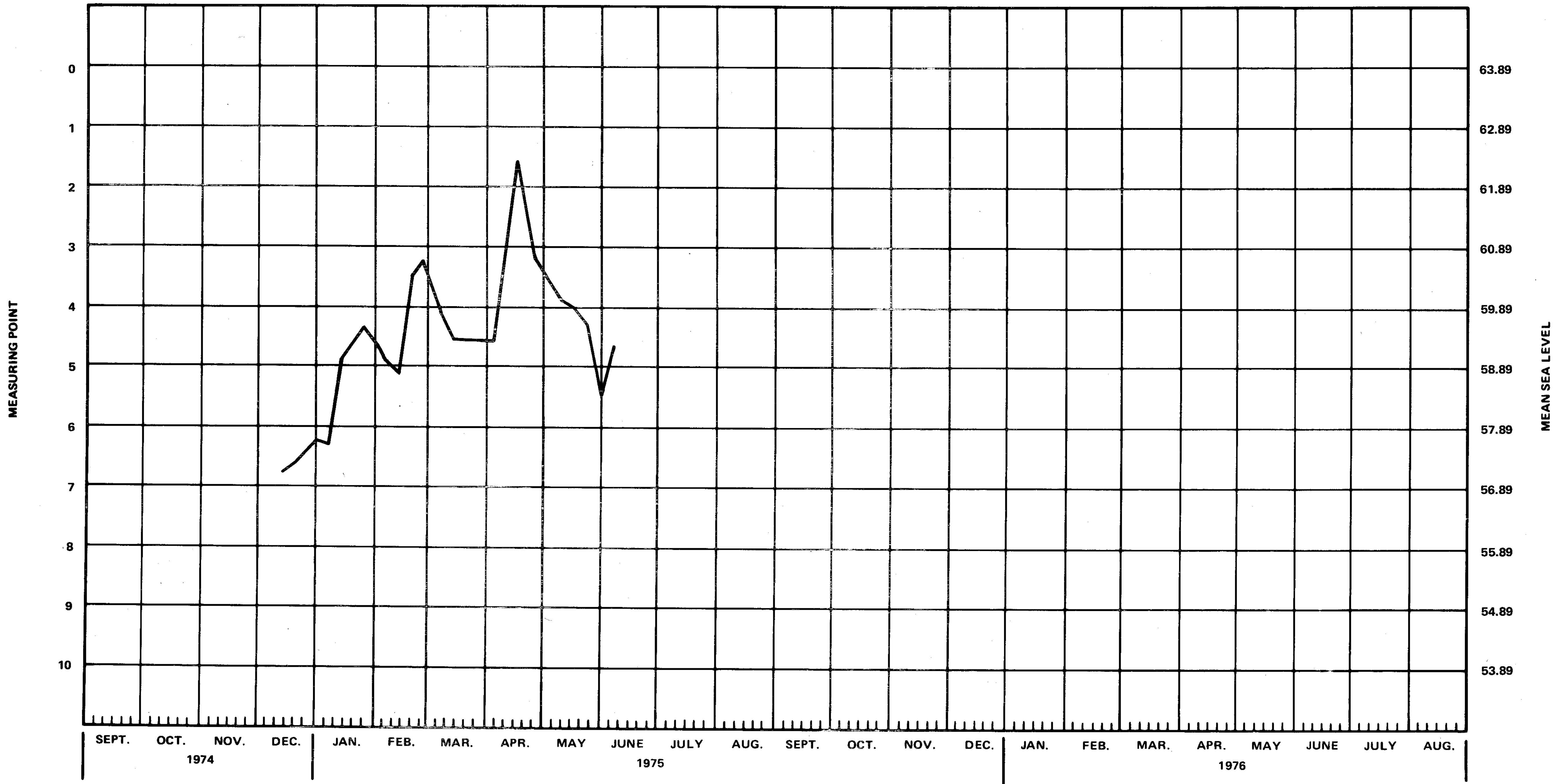
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 17-2

FIGURE 2.5B-34

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 18-1
LOCATION: NW 1/4, NE 1/4 SEC. 17, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,573,499.464 E
674,032.737 N

DEPTH OF WELL: 100 FT.
FEET OF CASING: 42
AQUIFER: FLORIDAN
ELEV. OF M.P.: 63.89
ELEV. OF L.S.D:
RECORD BEGAN: 12-14-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

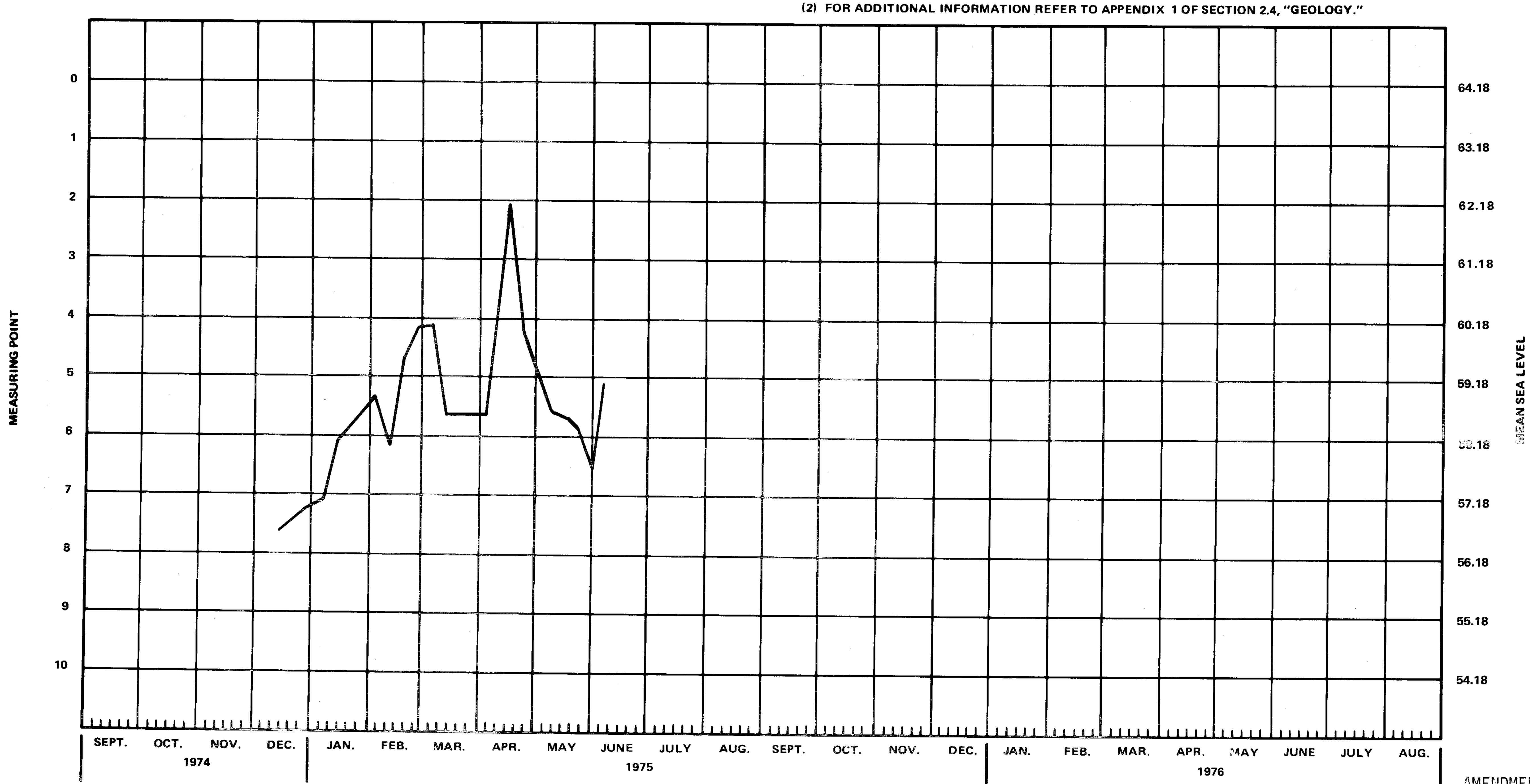
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 18-1

FIGURE 2.5B-35

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 18-2
LOCATION: NW 1/4, NE 1/4 SEC. 17, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,573,514.162 E
674,052.472 N

DEPTH OF WELL: 26 FT.
FEET OF CASING: 27
AQUIFER: WATER TABLE
ELEV. OF M.P.: 64.18
ELEV. OF L.S.D:
RECORD BEGAN: 12-14-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

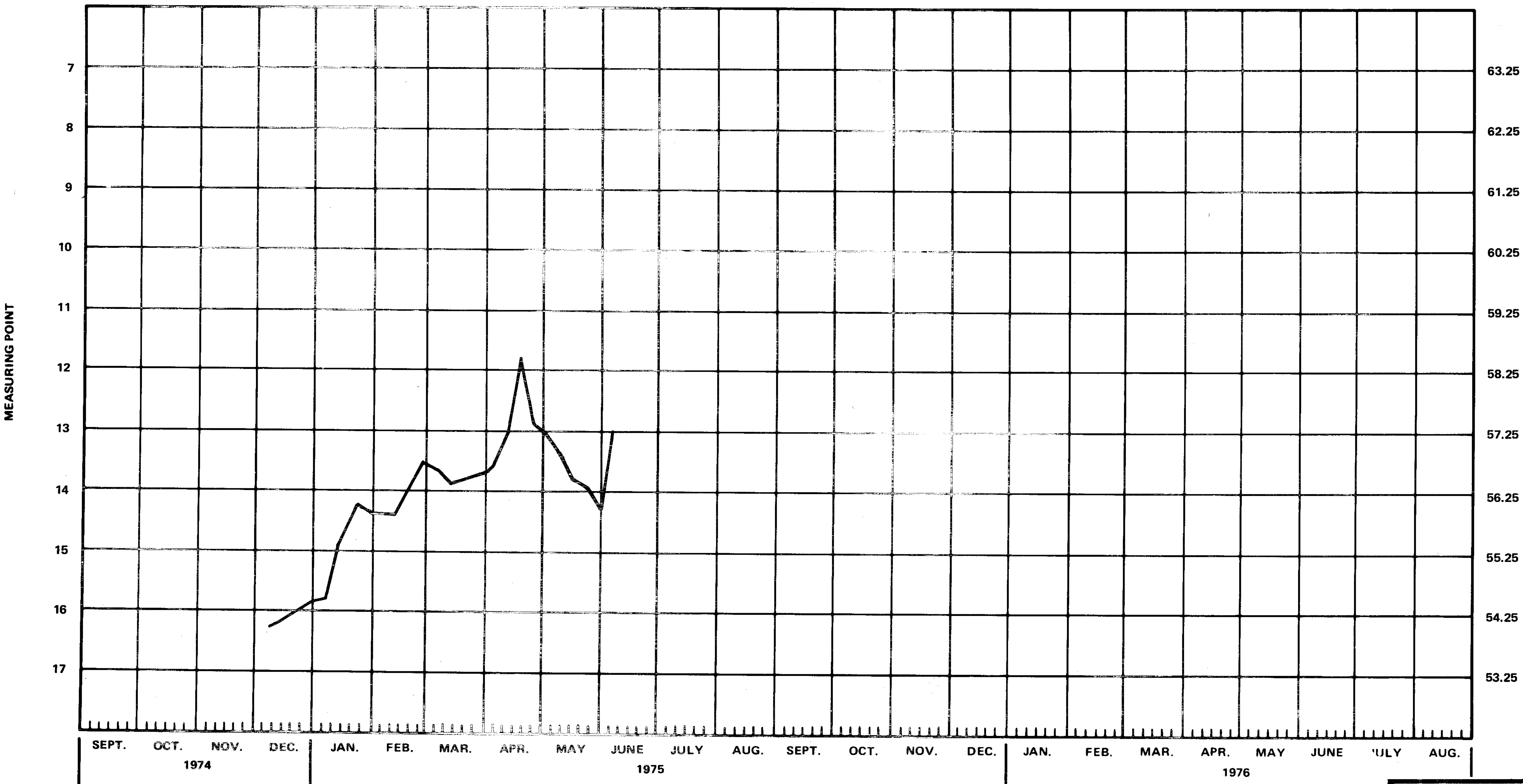
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 18-2

FIGURE 2.5B-36

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 19-1
LOCATION: SE 1/4, NE 1/4 SEC. 5, T 4 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,575,890.167 E
652,058.888 N

DEPTH OF WELL: 100 FT.
FEET OF CASING: 37
AQUIFER: FLORIDAN
ELEV. OF M.P.: 70.25
ELEV. OF L.S.D:
RECORD BEGAN: 12-8-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

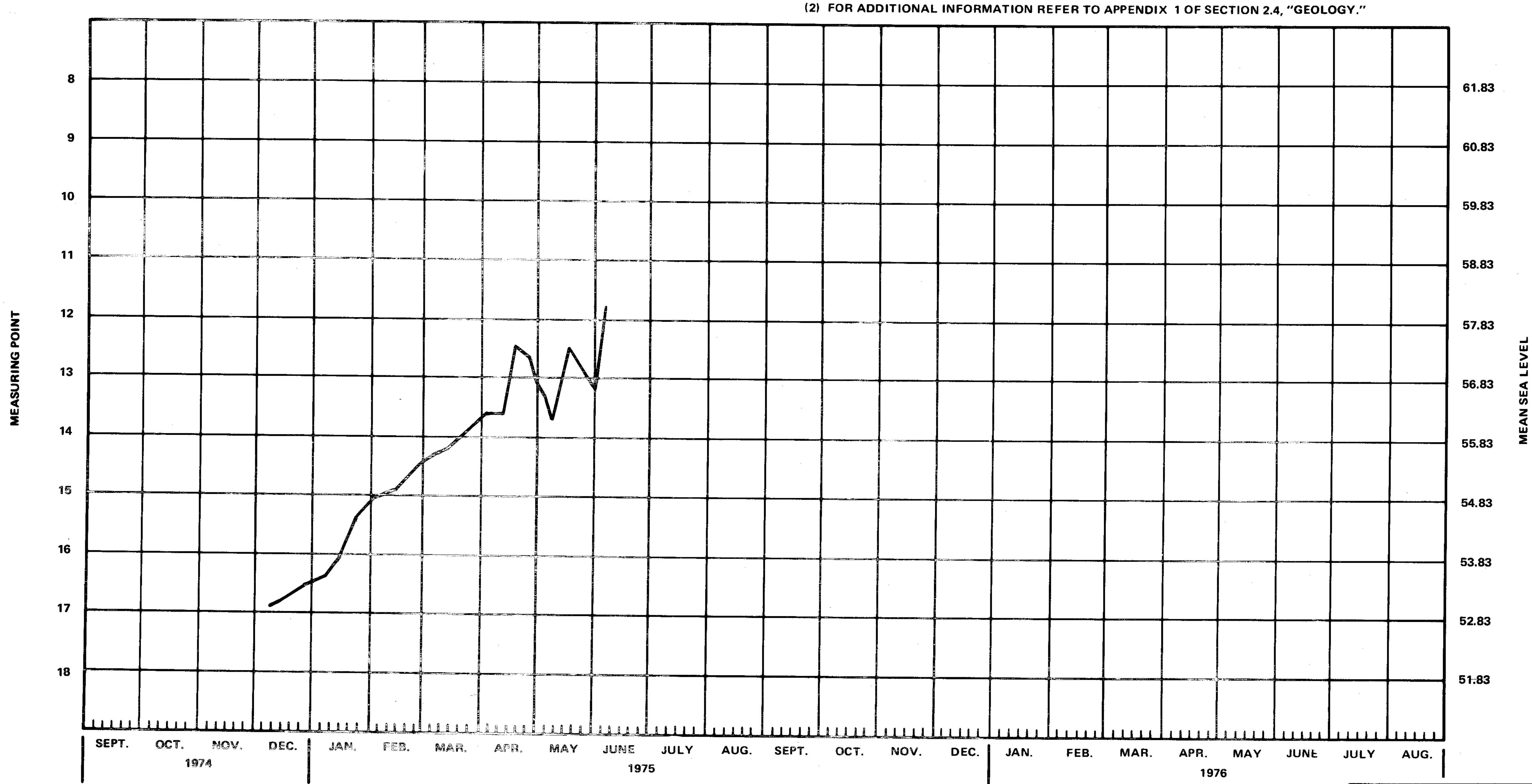
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 19-1

FIGURE 2.5B-37

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 19-2
LOCATION: SE 1/4, NE 1/4 SEC. 5, T 4 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,575,881.132 E
652,082.134 N

DEPTH OF WELL: 20 FT.
FEET OF CASING: 22
AQUIFER: WATER TABLE
ELEV. OF M.P.: 70.83
ELEV. OF L.S.D:
RECORD BEGAN: 12-8-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

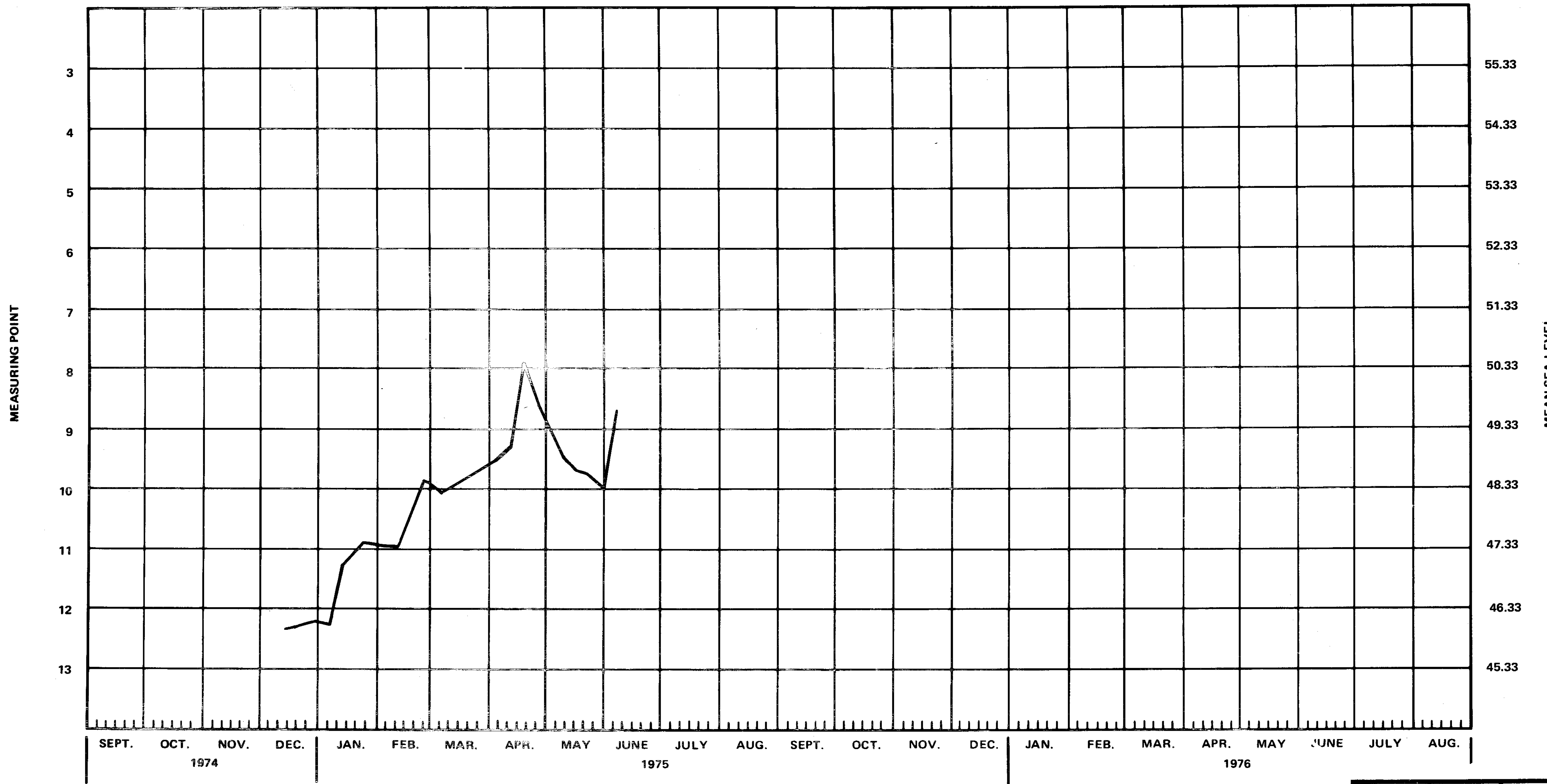
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL

FIGURE 2.5B-38

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 20-1
LOCATION: NE 1/4, NE 1/4 SEC. 20, T 4 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,575,244.691 E
636,268.559 N

DEPTH OF WELL: 100 FT.
FEET OF CASING: 50
AQUIFER: FLORIDAN
ELEV. OF M.P.: 58.33
ELEV. OF L.S.D:
RECORD BEGAN: 12-14-74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

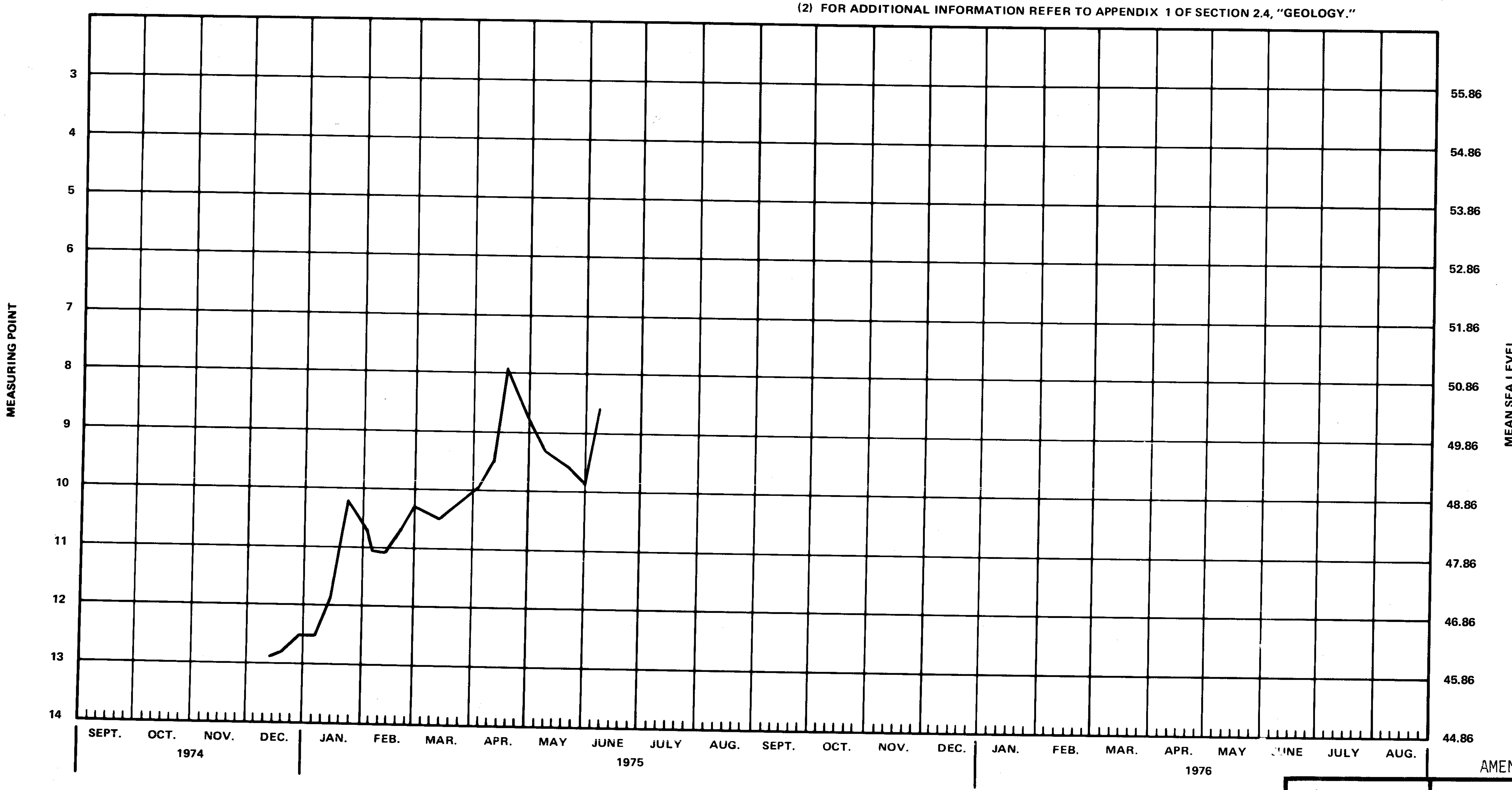
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL

FIGURE 2.5B-39

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 20-2
LOCATION: NE 1/4 NE 1/4 SEC. 20, T 4 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,575,221.804 E
636,267.453 N

DEPTH OF WELL: 30 FT.
FEET OF CASING: 30
AQUIFER: WATER TABLE
ELEV. OF M.P.: 58.86
ELEV. OF L.S.D:
RECORD BEGAN: 12/14/74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

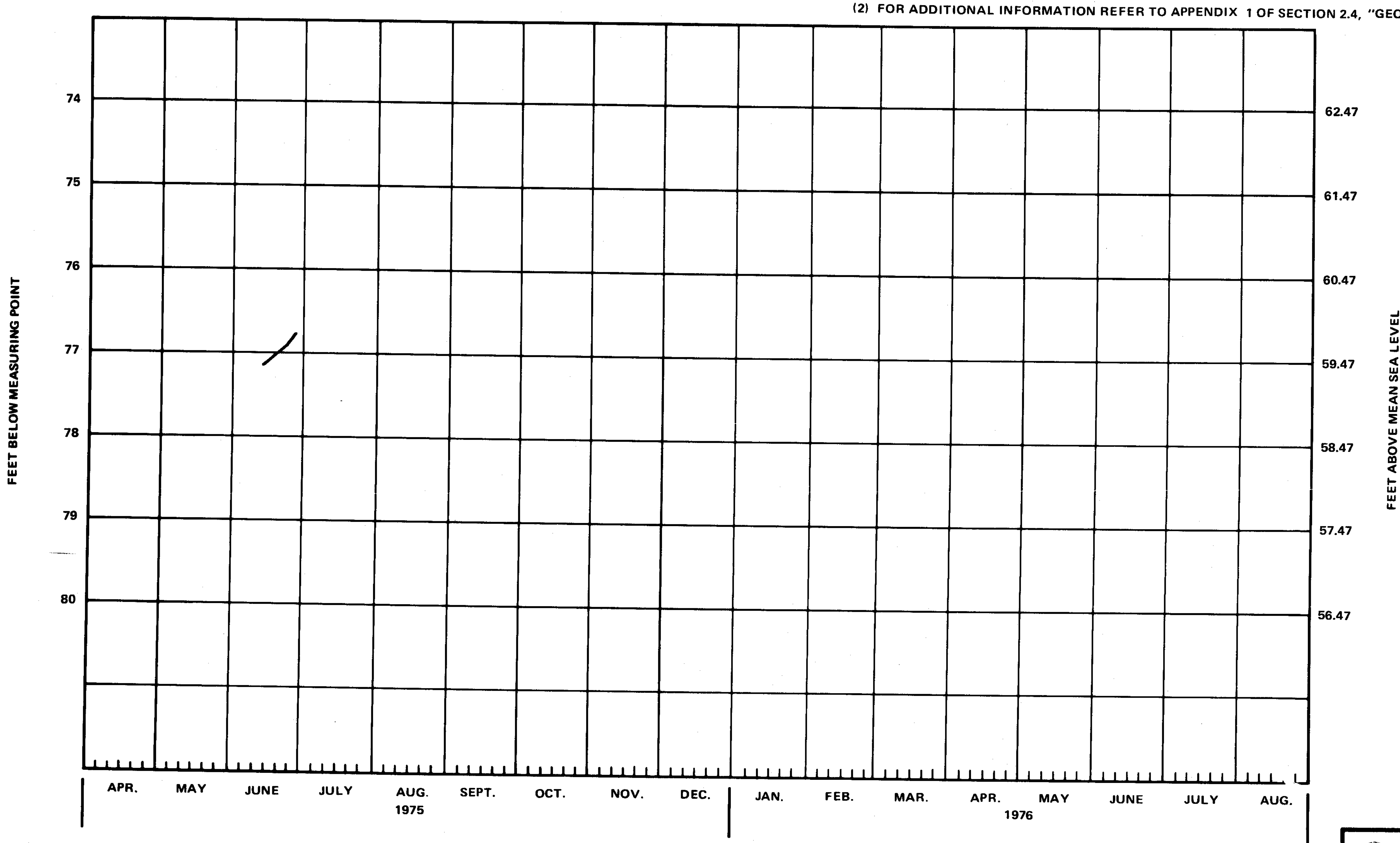
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 20-2

FIGURE 2.5B-40

WATER-LEVEL MEASUREMENTS: Chart Recorder
WELL NUMBER: 21-2
LOCATION: SW 1/4 NW 1/4 SEC. 30, T 4 N, R 15 W
WASHINGTON COUNTY, FLORIDA
COORDINATES: 1,596,677.297 E
629,986.284 N

DEPTH OF WELL: 110.5 FT
FEET OF CASING: 112
AQUIFER: WATER TABLE
ELEV. OF M.P.: 136.47
ELEV. OF L.S.D.: 134.97
RECORD BEGAN: 6-13-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

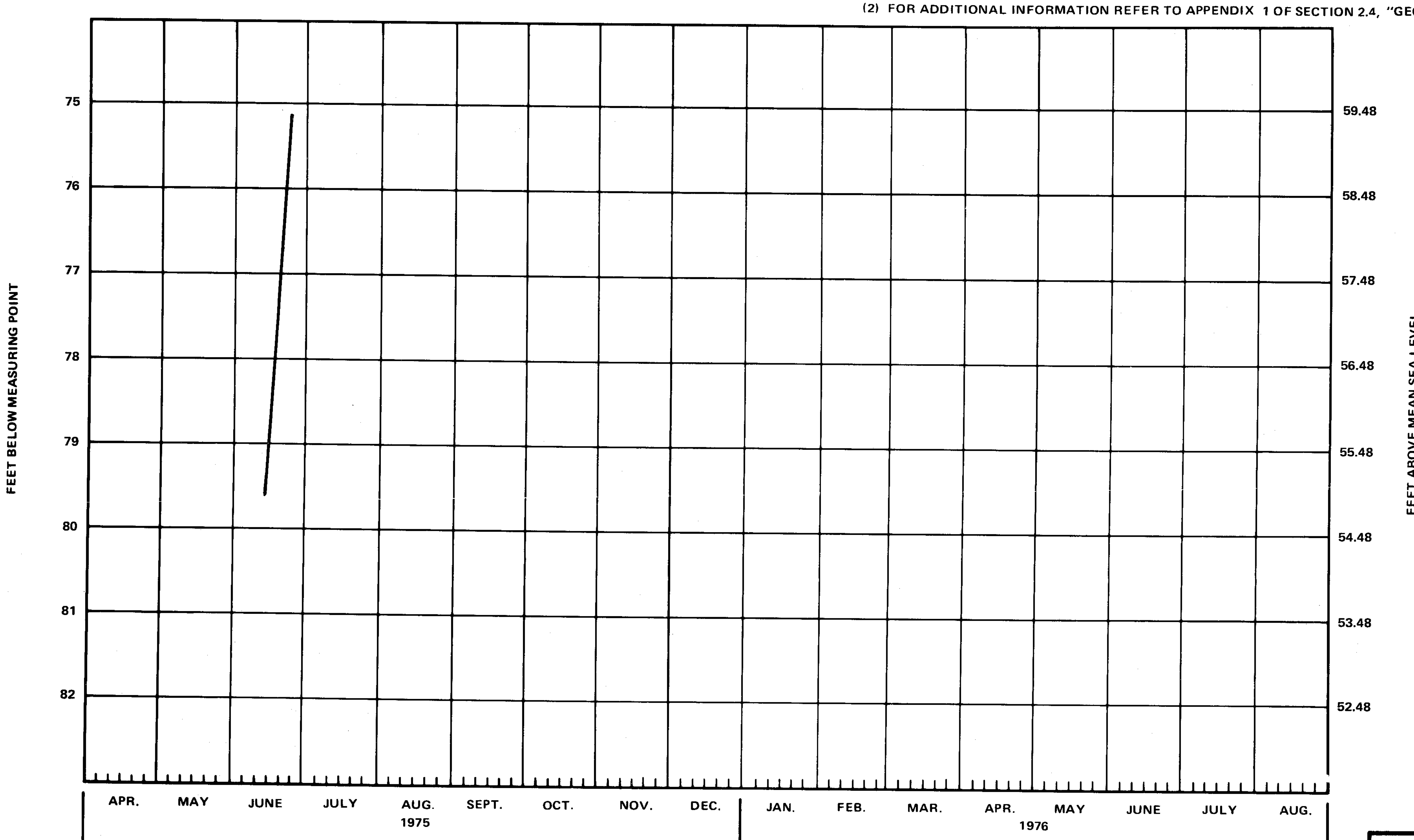
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 21-1

FIGURE 2.5B-41

WATER-LEVEL MEASUREMENTS: Chart Recorder
WELL NUMBER: 21-1
LOCATION: SW 1/4 NW 1/4 SEC. 30, T 4 N, R 15 W
WASHINGTON COUNTY, FLORIDA
COORDINATES: 1,596,692.497 E
629,974.717 N

DEPTH OF WELL: 401 FT
FEET OF CASING: 310.5
AQUIFER: FLORIDAN
ELEV. OF M.P.: 134.48
ELEV. OF L.S.D.: 133.67
RECORD BEGAN: 6-13-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

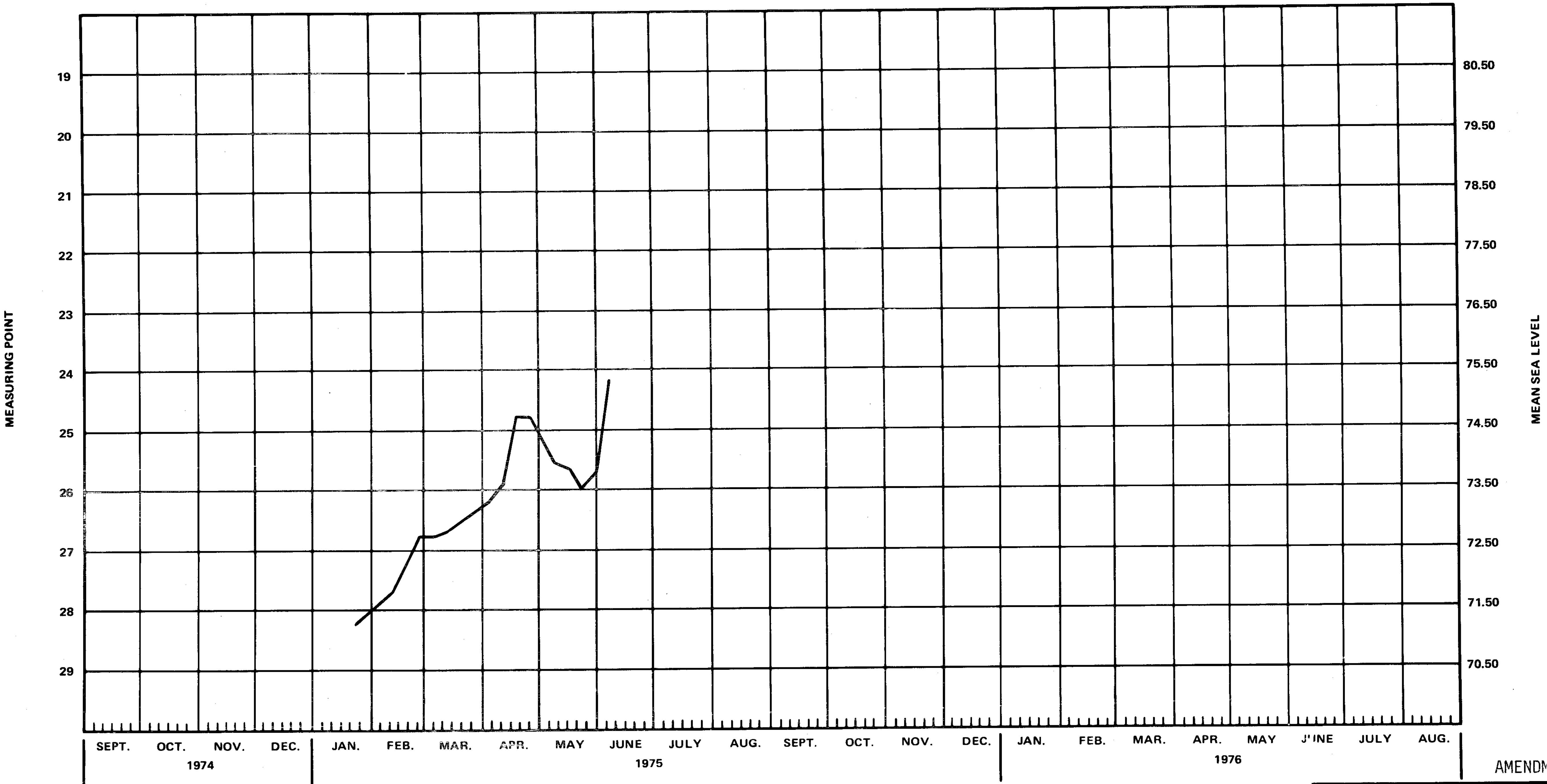
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 21-2

FIGURE 2.5B-42

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 22-1
LOCATION: NW 1/4, SE 1/4 SEC.21, T 4 N, R 15 W
WASHINGTON COUNTY, FLORIDA
COORDINATES: 1,609,533.366 E
634,280.478 N

DEPTH OF WELL: 320 FT.
FEET OF CASING: 264.5
AQUIFER: FLORIDAN
ELEV. OF M.P.: 99.50
ELEV. OF L.S.D:
RECORD BEGAN: 1-24-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

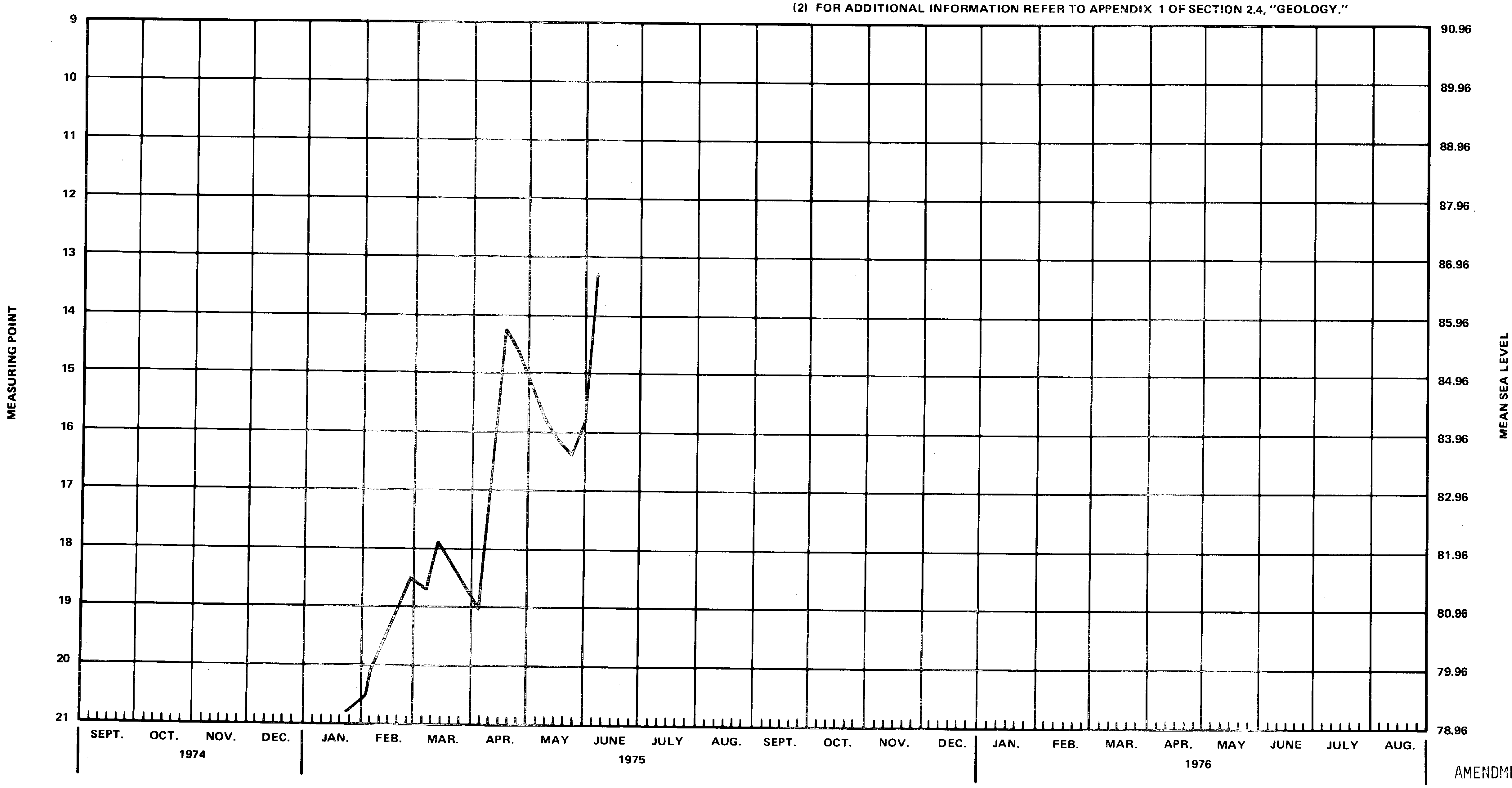
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 22-1

FIGURE 2.5B-43

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 22-2
LOCATION: NW 1/4, SE 1/4 SEC. 21, T 4 N, R 15 W
WASHINGTON COUNTY, FLORIDA
COORDINATES: 1,609,527.197 E
634,303.925 N

DEPTH OF WELL: 40 FT.
FEET OF CASING: 42
AQUIFER: WATER TABLE
ELEV. OF M.P.: 99.96
ELEV. OF L.S.D:
RECORD BEGAN: 1-24-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

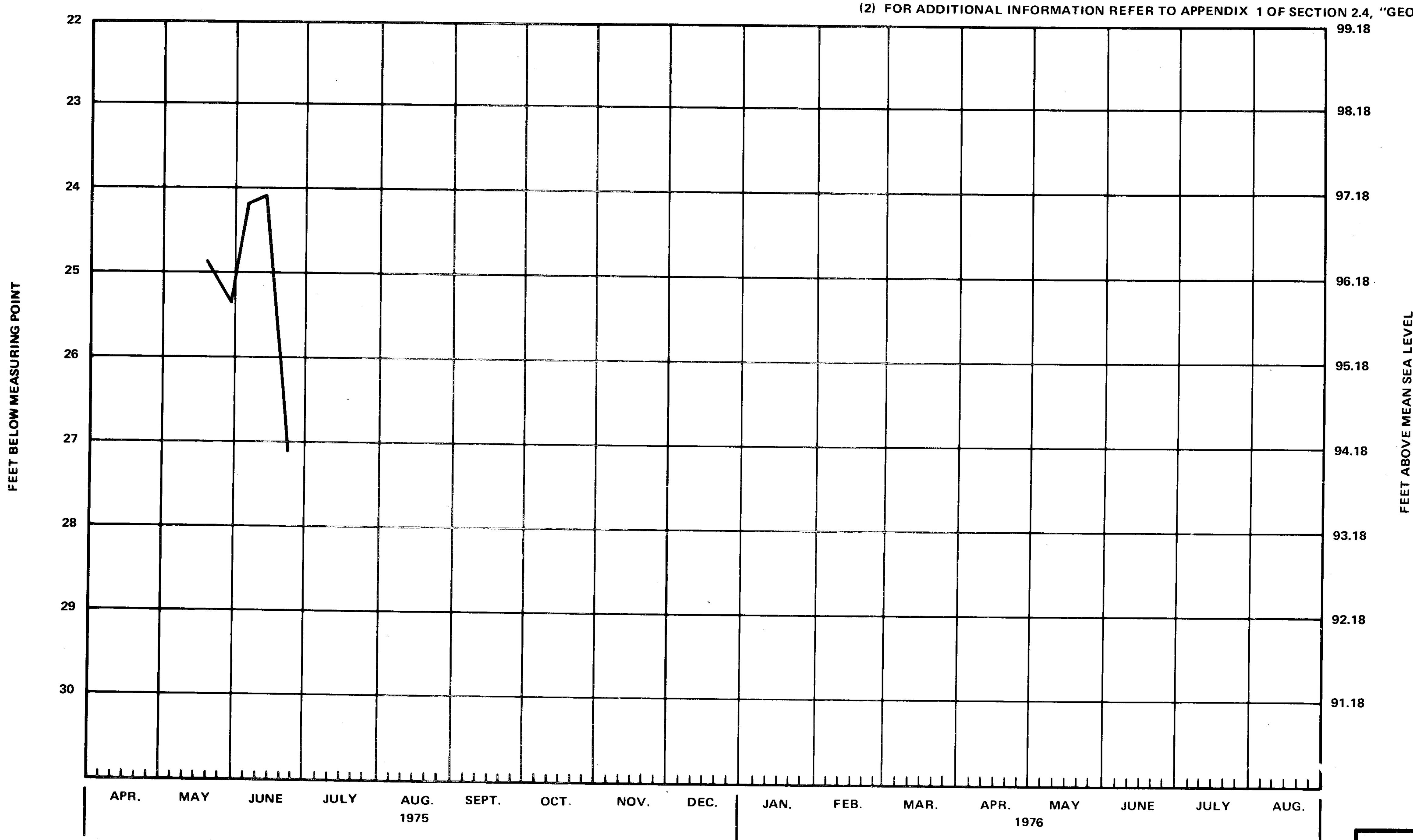
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 22-2

FIGURE 2.5B-44

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 23-1
LOCATION: NE 1/4, SW 1/4 SEC. 8, T 4 N, R 15 W
WASHINGTON COUNTY, FLORIDA
COORDINATES: 1,603,337.617 E
644,261.975 N

DEPTH OF WELL: 401 FT
FEET OF CASING: 233
AQUIFER: FLORIDAN
ELEV. OF M.P.: 121.18
ELEV. OF L.S.D.: 120.48
RECORD BEGAN: 5-18-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

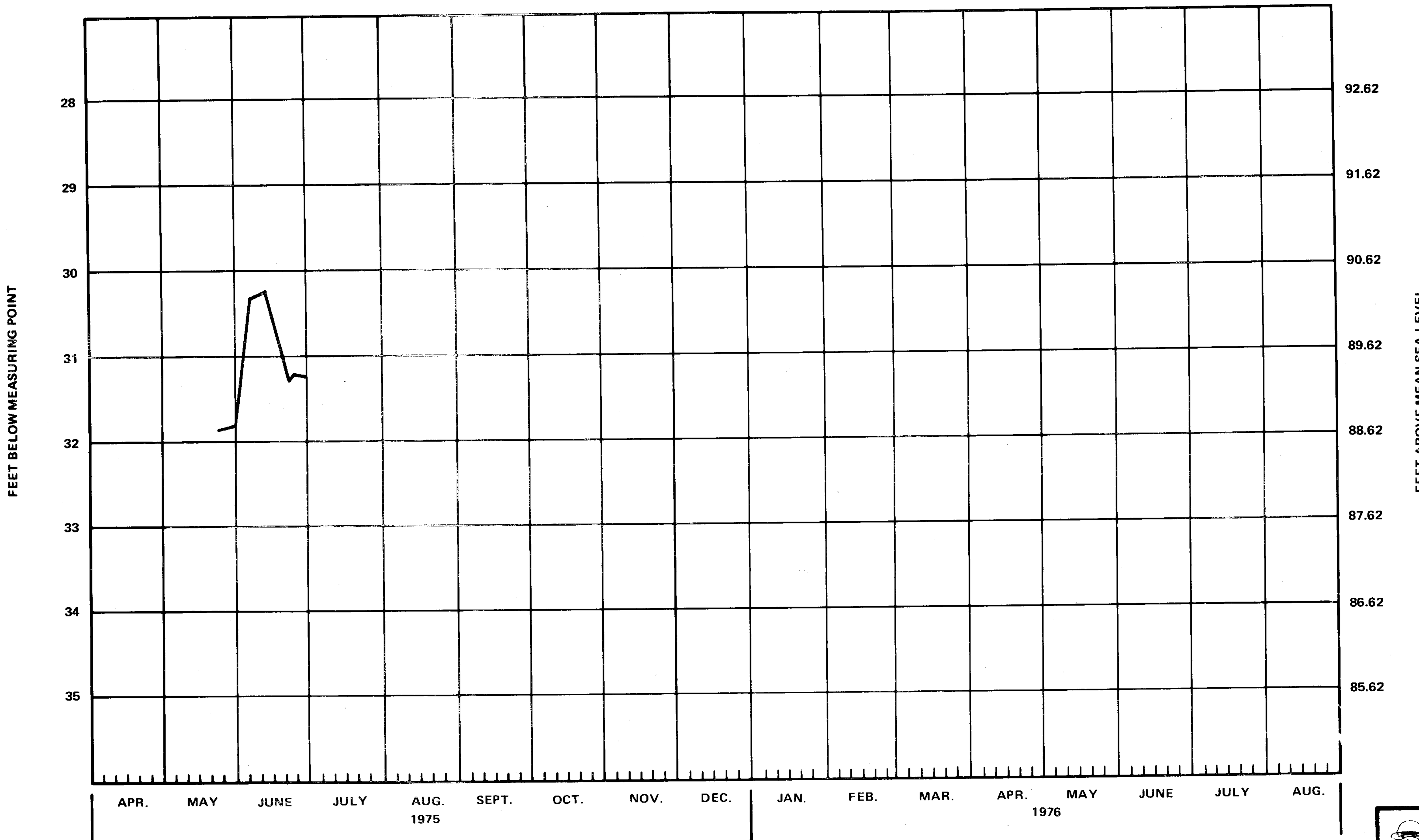
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 23-1

FIGURE 2.5B-45

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 23-2
LOCATION: NE 1/4 SW 1/4 SEC. 8 T 4 N, R 15 W
WASHINGTON COUNTY, FLORIDA
COORDINATES: 1,603,343.458 E
644,286.459 N

DEPTH OF WELL: 63 FT.
FEET OF CASING: 63
AQUIFER: WATER TABLE
ELEV. OF M.P.: 120.62
ELEV. OF L.S.D.: 119.08
RECORD BEGAN: 5-23-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

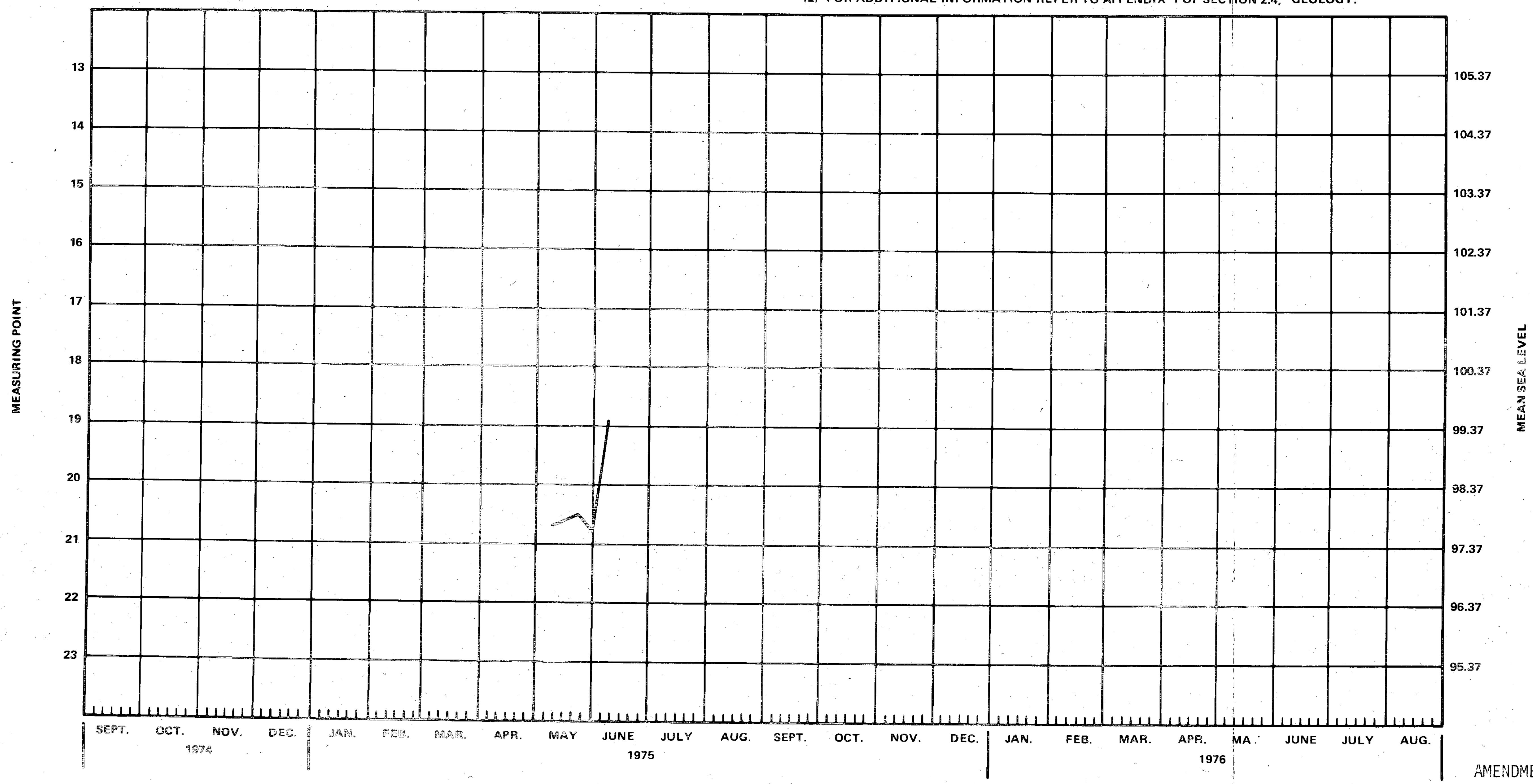
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 23-2

FIGURE 2.5B-46

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 24-1
LOCATION: SW 1/4, SW 1/4 SEC. 2, T 4 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES: 1,617,383.701 E
648,059.643 N

DEPTH OF WELL: 250 FT.
FEET OF CASING: 156
AQUIFER: FLORIDAN
ELEV. OF M.P.: 118.37
ELEV. OF L.S.D:
RECORD BEGAN: 5-9-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

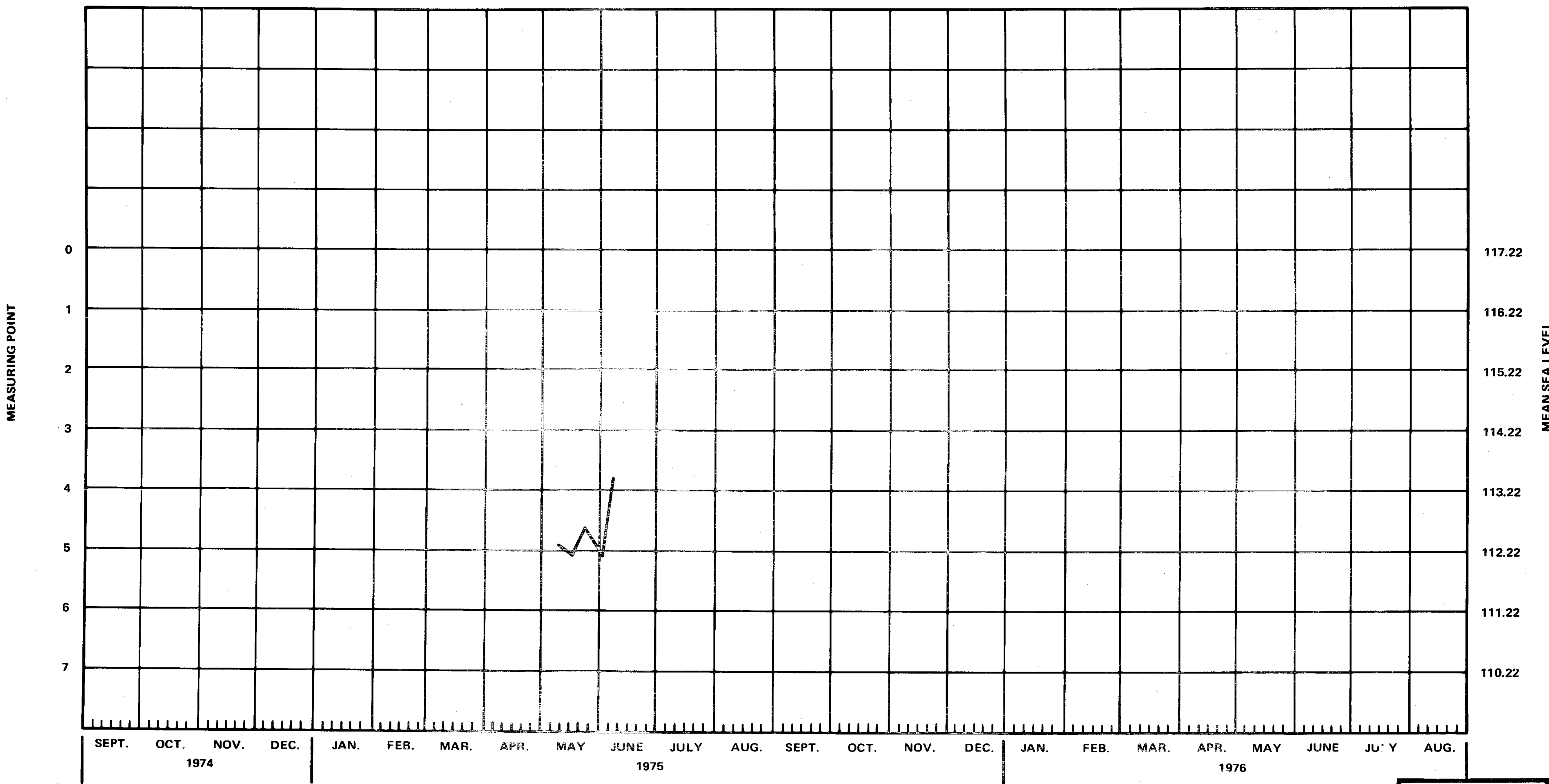
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 24-1

FIGURE 2.5B-47

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 24-2
LOCATION: SW 1/4, SW 1/4 SEC. 2, T 4 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,617,387.335 E
648,083.082 N

DEPTH OF WELL: 61 FT.
FEET OF CASING: 62
AQUIFER: WATER TABLE
ELEV. OF M.P.: 117.22
ELEV. OF L.S.D:
RECORD BEGAN: 5-9-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

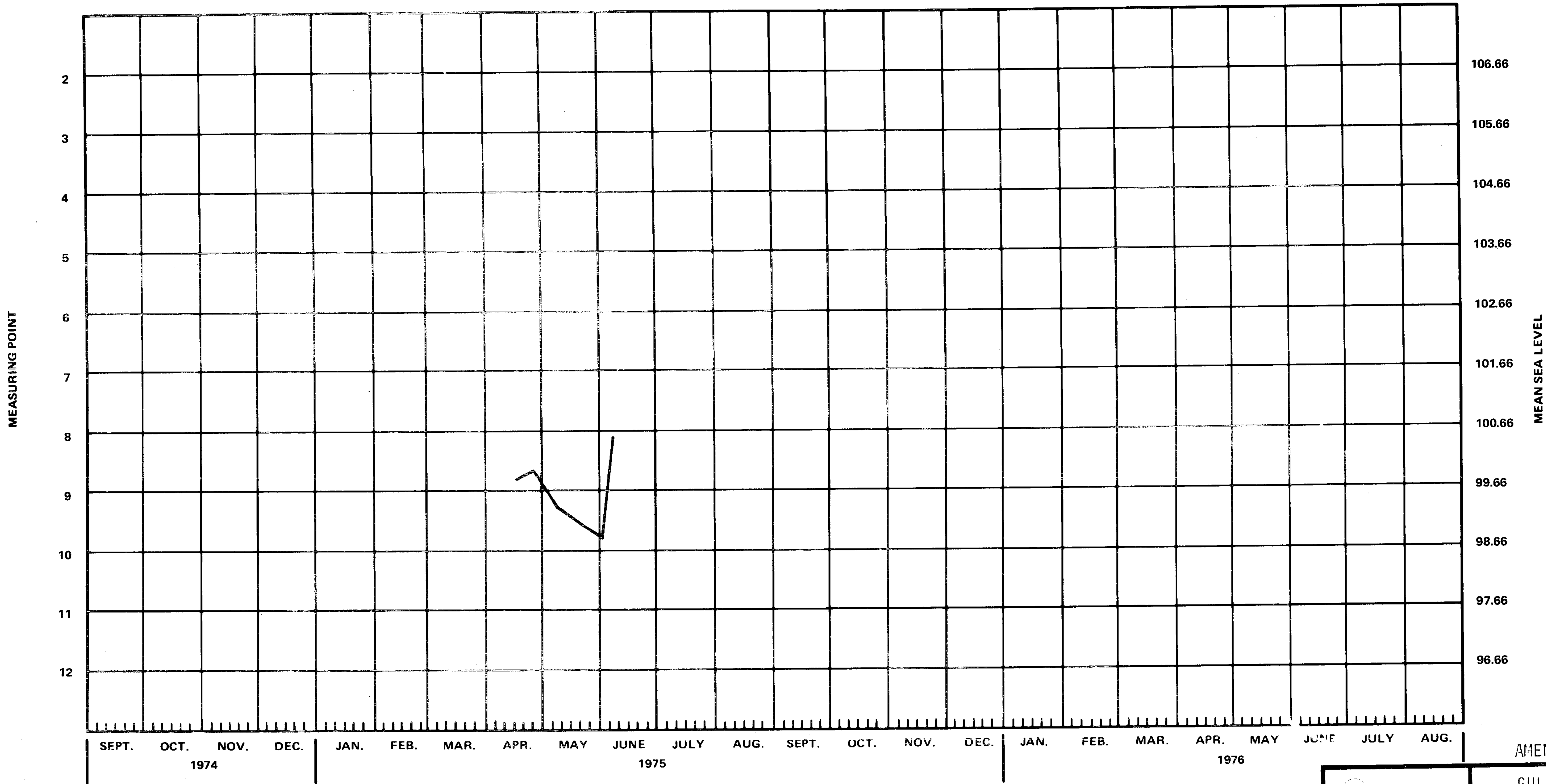
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 24-2

FIGURE 2.5B-48

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 25-1
LOCATION: SW 1/4, SW 1/4 SEC. 17, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,602,118.389 E
670,306.146 N

DEPTH OF WELL: 300 FT.
FEET OF CASING: 170
AQUIFER: FLORIDAN
ELEV. OF M.P.: 108.66
ELEV. OF L.S.D:
RECORD BEGAN: 4-18-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

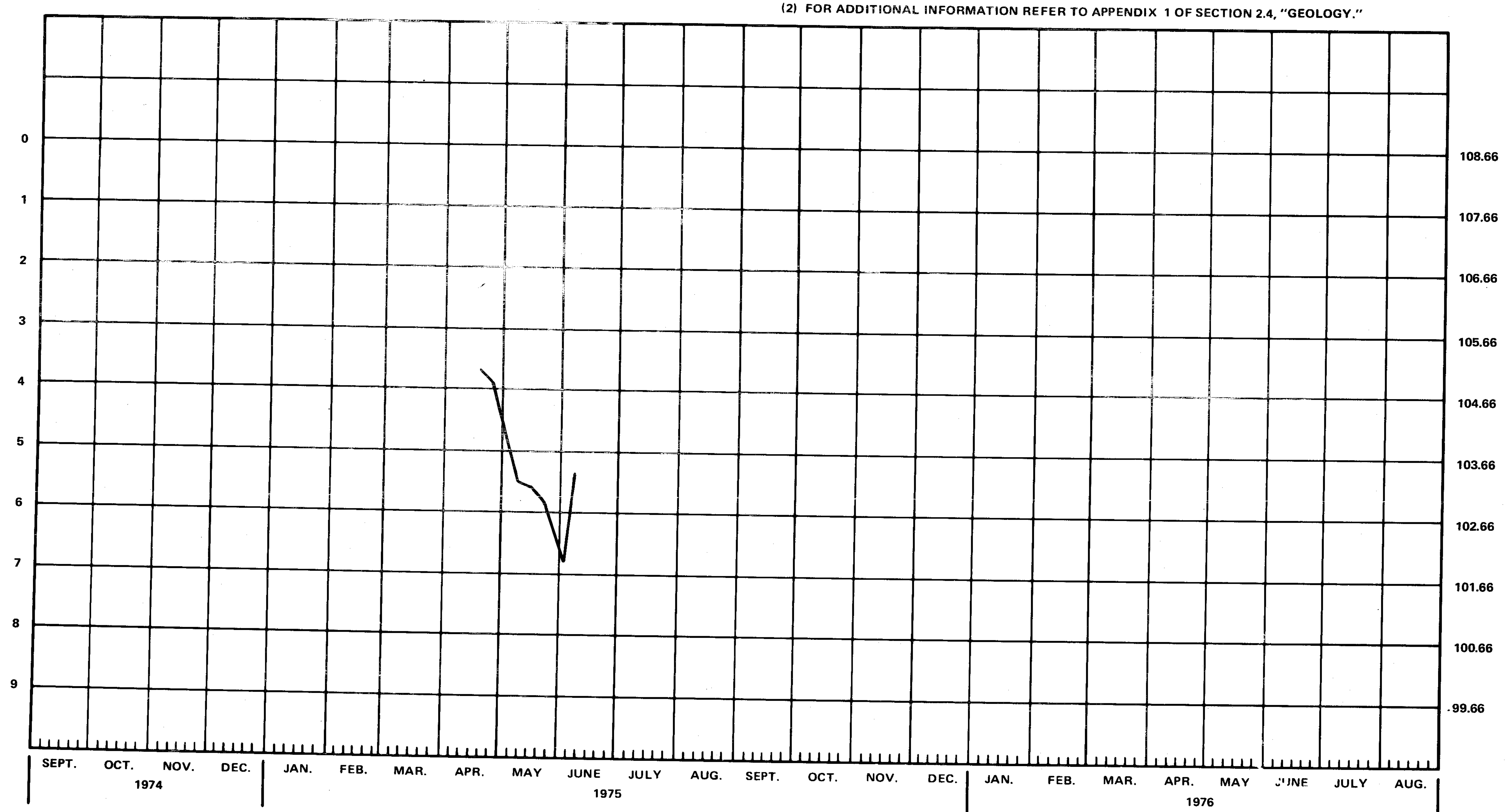
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 25-1

FIGURE 2.5B-49

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 25-2
LOCATION: SW 1/4, SW 1/4 SEC. 17, T 5 N, R 15 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,602,139.729 E
670,294.393 N

DEPTH OF WELL: 46 FT.
FEET OF CASING: 43
AQUIFER: WATER TABLE
ELEV. OF M.P.: 108.66
ELEV. OF L.S.D:
RECORD BEGAN: 4-18-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

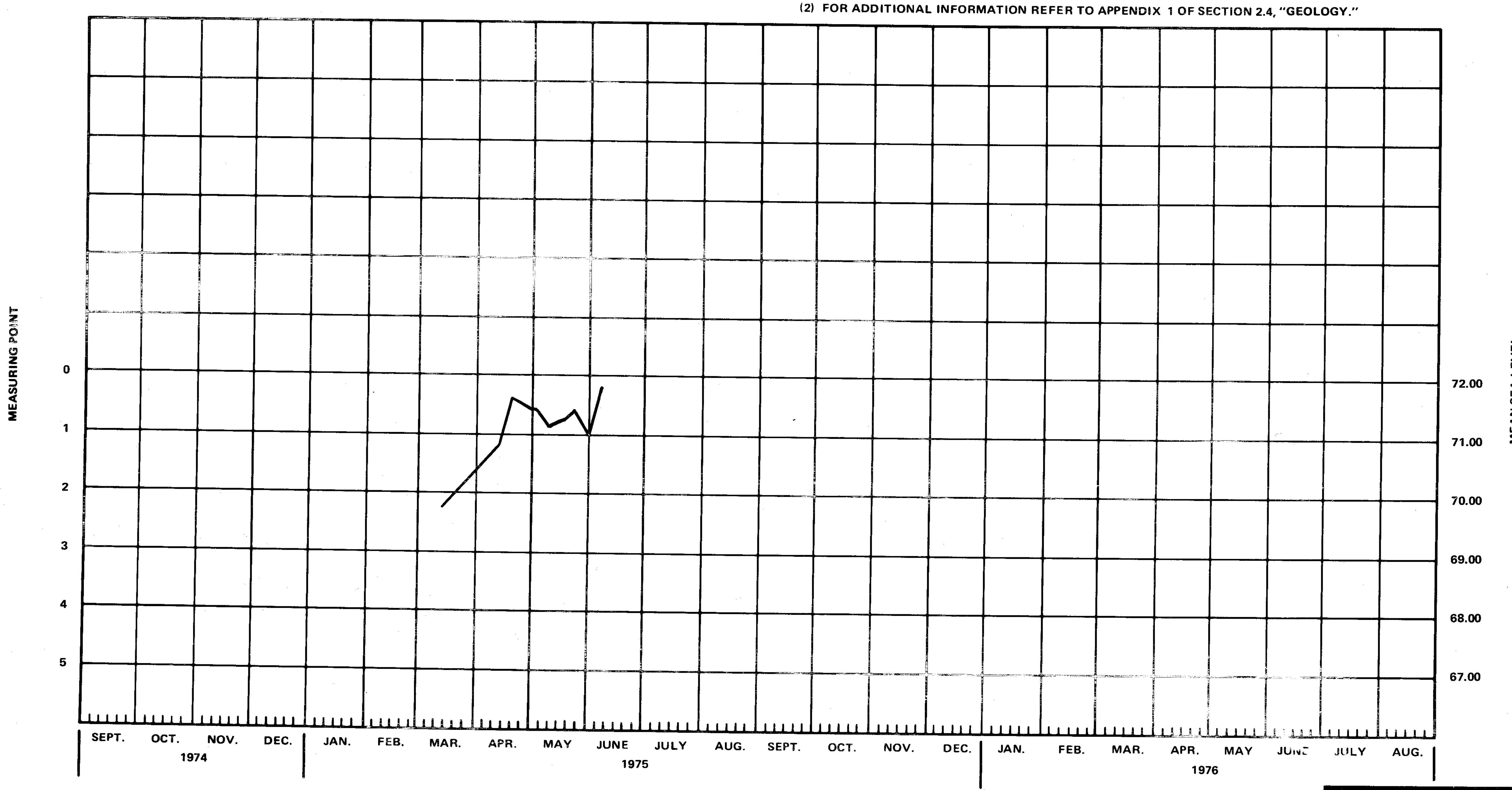
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 25-2

FIGURE 2.5B-50

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 26-1
LOCATION: NW 1/4, SW 1/4 SEC. 36, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,590,810.784 E
655,575.701 N

DEPTH OF WELL: 370 FT.
FEET OF CASING: 370
AQUIFER: FLORIDAN
ELEV. OF M.P.: 72.0
ELEV. OF L.S.D:
RECORD BEGAN: 3-13-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

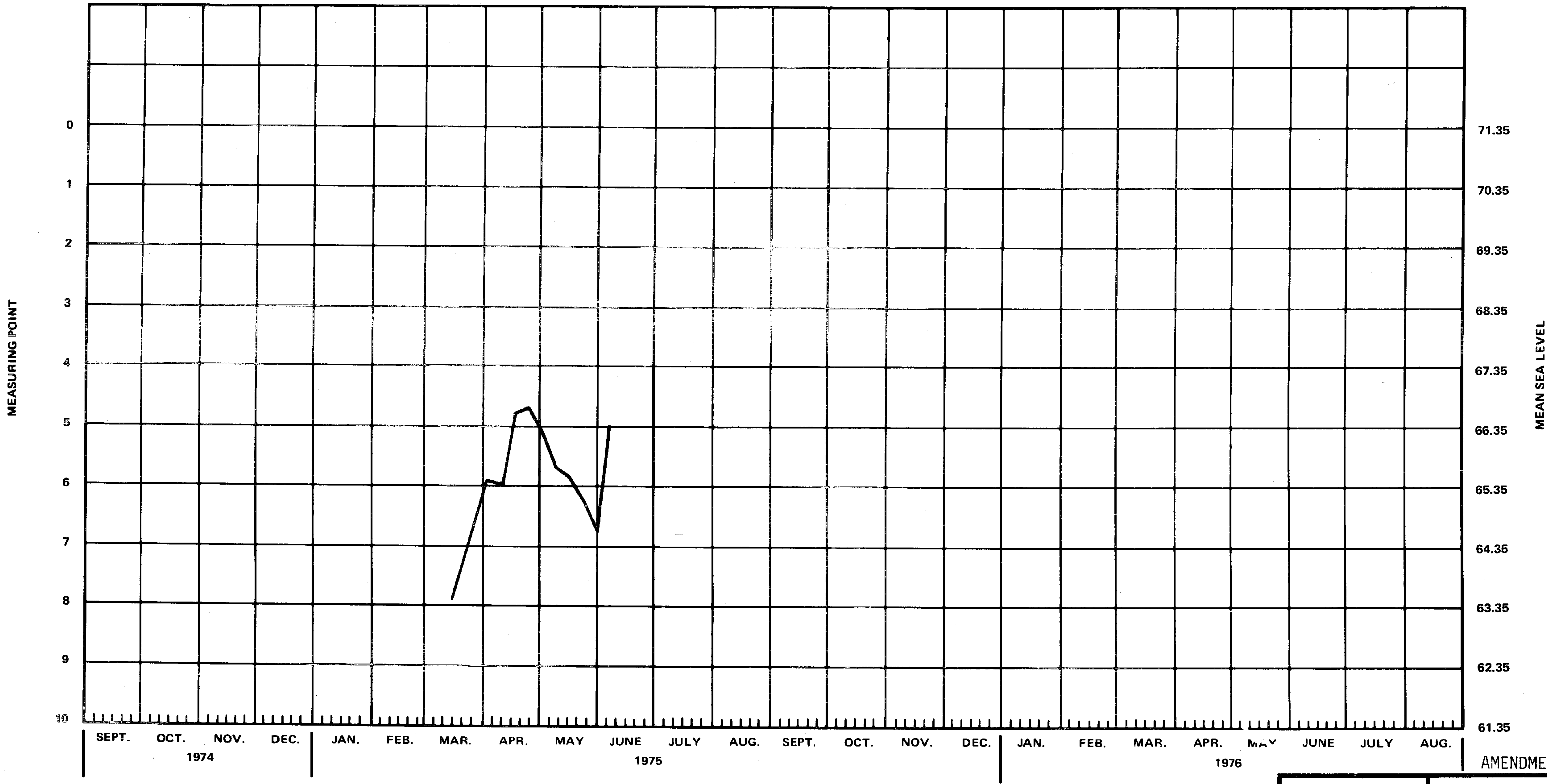
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 26-1

FIGURE 2.5B-51

WATER-LEVEL MEASUREMENTS: Periodic Tape Measurements
WELL NUMBER: 26-2
LOCATION: NW 1/4, SW 1/4 SEC. 36, T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES:
1,590,818.542 E
655,599.019 N

DEPTH OF WELL: 50 FT.
FEET OF CASING: 51
AQUIFER: WATER TABLE
ELEV. OF M.P.: 71.35
ELEV. OF L.S.D:
RECORD BEGAN: 3-15-75
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO MEASURING POINT (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

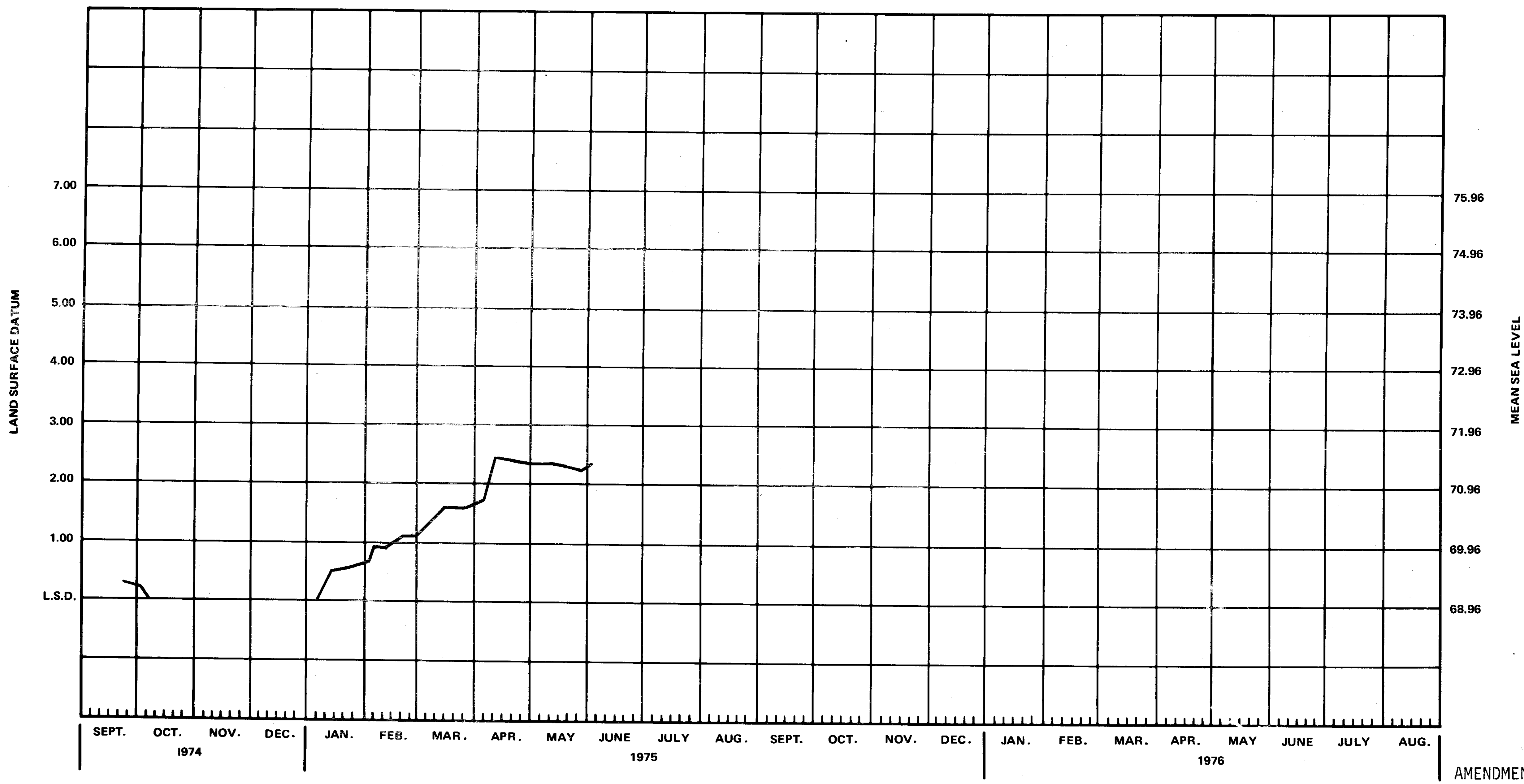
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF OBSERVATION WELL 26-2

FIGURE 2.5B-52

POND NO.: 1
LOCATION: SW 1/4 NW 1/4 SEC. 36 T 5 N, R 16 W
HOLMES COUNTY, FLORIDA
COORDINATES: 1,591,921.740 E
657,124.302 N

ELEV. OF M.P.:
ELEV. OF L.S.D.: 68.96
RECORD BEGAN: 9/23/74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO LAND SURFACE DATUM (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

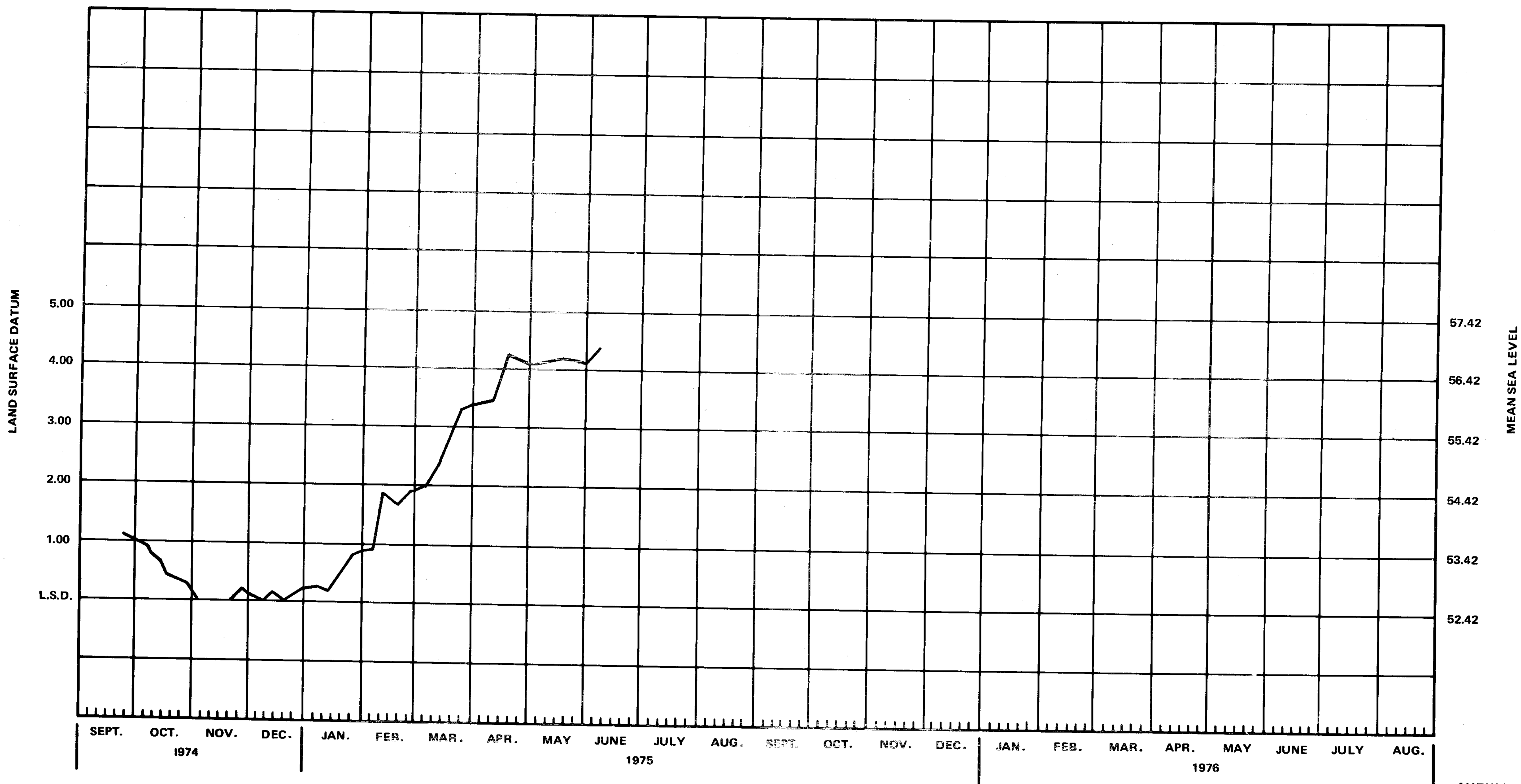
GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF POND NO. 1

FIGURE 2.5B-53

POND NO.: 3
LOCATION: NW 1/4 SE 1/4 SEC. 2, T 4 N, R 16 W
WASHINGTON COUNTY, FLORIDA
COORDINATES: 1,589,334.279 E
650,629.056 N

ELEV. OF M.P.:
ELEV. OF L.S.D.: 52.42
RECORD BEGAN: 9/23/74
REMARKS: (1) HYDROGRAPH WILL BE UPDATED PERIODICALLY THROUGH THE END OF THE MONITORING PERIOD.
(2) FOR ADDITIONAL INFORMATION REFER TO APPENDIX 1 OF SECTION 2.4, "GEOLOGY."



WATER LEVEL, IN FEET, WITH REFERENCE TO LAND SURFACE DATUM (LEFT SCALE), AND TO MEAN SEA LEVEL (RIGHT SCALE).

AMENDMENT 2 8/75

GULF POWER CO.
CARYVILLE STEAM PLANT

HYDROGRAPH OF POND NO. 3

FIGURE 2.5B-54

SECTION 2 OF APPENDIX C

This appendix contains the results of chemical analyses of water samples taken by Gulf. These results will be updated periodically as new data are obtained.

This appendix contains three tables, with each table consisting of multiple sheets: 2

Table 2.5A-1	United States Department of Interior Geological Survey-Water Resources Division
Table 2.5A-2	Station Number 02365500
Table 2.5A-3	Choctawhatchee River at Caryville, Fla. Process Date 07/01/75, District Code 12, 02365500

Image Quality
As you review the next group of images, Please note that the original documents
were of poor quality.

TABLE 2.5A-1

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

02365500
CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA.

TEMPERATURE (DEG. C) OF WATER , WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972
(ONCE-DAILY)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	25.0	21.0	13.0	20.0	14.0	16.0	20.0	---	---	---	---	---
2	24.0	20.0	13.0	20.0	14.0	16.0	20.0	24.0	---	---	---	---
3	---	20.0	13.0	---	14.0	15.0	21.0	24.0	---	---	---	---
4	22.0	19.0	13.0	20.0	14.0	15.0	21.0	24.0	---	---	---	---
5	22.0	19.0	14.0	21.0	14.0	15.0	21.0	24.0	---	---	---	---
6	22.0	19.0	14.0	20.0	15.0	15.0	21.0	24.0	---	---	---	---
7	22.0	19.0	15.0	20.0	15.0	15.0	21.0	25.0	---	---	---	---
8	22.0	---	17.0	20.0	15.0	---	21.0	---	---	---	---	---
9	22.0	14.0	18.0	20.0	15.0	15.0	22.0	25.0	---	---	---	---
10	22.0	14.0	18.0	19.0	16.0	15.0	22.0	---	---	---	---	---
11	21.0	14.0	18.0	19.0	16.0	16.0	22.0	25.0	---	---	---	---
12	20.0	14.0	18.0	19.0	16.0	---	22.0	24.0	---	---	---	---
13	19.0	14.0	20.0	19.0	15.0	16.0	22.0	25.0	---	---	---	---
14	20.0	14.0	21.0	19.0	15.0	16.0	22.0	25.0	---	---	---	---
15	21.0	14.0	21.0	18.0	15.0	17.0	23.0	25.0	---	---	---	---
16	22.0	14.0	21.0	11.0	16.0	17.0	23.0	26.0	---	---	---	---
17	22.0	14.0	21.0	17.0	16.0	18.0	23.0	26.0	---	---	---	---
18	21.0	14.0	20.0	17.0	16.0	19.0	23.0	26.0	---	---	---	---
19	21.0	14.0	20.0	16.0	16.0	20.0	23.0	26.0	---	---	---	---
20	21.0	14.0	20.0	15.0	16.0	21.0	23.0	25.0	---	---	---	---
21	21.0	14.0	19.0	16.0	16.0	21.0	24.0	---	---	---	---	---
22	21.0	14.0	19.0	16.0	16.0	20.0	24.0	26.0	---	---	---	---
23	20.0	14.0	18.0	15.0	15.0	20.0	24.0	25.0	---	---	---	---
24	20.0	14.0	19.0	15.0	15.0	21.0	24.0	27.0	---	---	---	---
25	20.0	14.0	19.0	---	16.0	21.0	24.0	27.0	---	---	---	---
26	21.0	14.0	19.0	15.0	16.0	21.0	24.0	27.0	---	---	---	---
27	21.0	14.0	18.0	15.0	16.0	21.0	24.0	27.0	---	---	---	---
28	21.0	13.0	18.0	---	16.0	---	24.0	27.0	---	---	---	---
29	21.0	13.0	18.0	14.0	16.0	21.0	24.0	27.0	---	---	---	---
30	21.0	13.0	16.0	14.0	---	21.0	24.0	27.0	---	---	---	---
31	21.0	---	18.0	14.0	---	21.0	---	27.0	---	---	---	---
MONTH	21.5	15.0	18.0	17.5	15.5	18.0	22.5	25.5	---	---	---	---
YEAR	MAX	27.0	MIN	11.0	MEAN	19.0						

NOTE: NUMBER OF MISSING DAYS OF RECORD EXCEEDED 20% OF YEAR

2

CSP-ER-2

1 of 8

Amendment 2 8/75

TABLE 2.5A-1 (Continued)

02365500
CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA.

TEMPERATURE (DEG. C) OF WATER , WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971
(ONCE-DAILY)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	21.0	20.0	14.0	---	12.0	---	---	20.0	20.0	27.0	25.0	26.0
2	22.0	18.0	15.0	14.0	12.0	---	15.0	19.0	22.0	26.0	24.0	26.0
3	22.0	17.0	15.0	15.0	12.0	14.0	15.0	19.0	23.0	27.0	25.0	26.0
4	21.0	18.0	17.0	13.0	13.0	14.0	15.0	18.0	23.0	27.0	25.0	26.0
5	23.0	14.0	16.0	13.0	13.0	14.0	16.0	18.0	25.0	26.0	25.0	25.0
6	22.0	16.0	16.0	13.0	12.0	14.0	15.0	20.0	26.0	26.0	25.0	25.0
7	23.0	17.0	14.0	12.0	12.0	14.0	15.0	20.0	27.0	25.0	25.0	25.0
8	23.0	17.0	13.0	12.0	10.0	15.0	14.0	21.0	27.0	25.0	25.0	25.0
9	22.0	17.0	14.0	10.0	8.0	15.0	14.0	21.0	27.0	26.0	25.0	25.0
10	23.0	17.0	14.0	10.0	8.0	15.0	15.0	22.0	27.0	26.0	25.0	24.0
11	24.0	17.0	14.0	11.0	8.0	15.0	18.0	22.0	27.0	26.0	26.0	24.0
12	24.0	17.0	15.0	12.0	8.0	15.0	18.0	22.0	27.0	26.0	26.0	25.0
13	24.0	15.0	15.0	15.0	9.0	15.0	18.0	22.0	27.0	27.0	26.0	25.0
14	24.0	17.0	13.0	16.0	9.0	15.0	19.0	21.0	27.0	28.0	---	26.0
15	24.0	16.0	13.0	12.0	9.0	15.0	19.0	---	27.0	28.0	26.0	26.0
16	22.0	14.0	14.0	17.0	10.0	5.0	19.0	21.0	27.0	26.0	27.0	25.0
17	20.0	14.0	14.0	15.0	10.0	15.0	19.0	21.0	27.0	27.0	27.0	25.0
18	20.0	13.0	9.0	11.0	10.0	15.0	20.0	21.0	27.0	26.0	27.0	25.0
19	20.0	15.0	14.0	9.0	10.0	16.0	20.0	22.0	27.0	27.0	26.0	25.0
20	19.0	16.0	13.0	8.0	9.0	15.0	20.0	22.0	27.0	28.0	26.0	25.0
21	20.0	14.0	14.0	10.0	10.0	15.0	20.0	22.0	27.0	27.0	26.0	25.0
22	20.0	15.0	16.0	12.0	11.0	15.0	20.0	22.0	27.0	25.0	26.0	25.0
23	19.0	15.0	16.0	12.0	11.0	15.0	20.0	22.0	---	25.0	26.0	26.0
24	21.0	12.0	15.0	14.0	11.0	15.0	21.0	22.0	28.0	26.0	---	26.0
25	21.0	12.0	15.0	14.0	13.0	15.0	21.0	22.0	28.0	26.0	26.0	26.0
26	20.0	12.0	13.0	13.0	15.0	15.0	21.0	22.0	28.0	27.0	27.0	25.0
27	20.0	13.0	12.0	13.0	17.0	16.0	24.0	22.0	28.0	26.0	26.0	25.0
28	20.0	12.0	10.0	14.0	17.0	16.0	25.0	22.0	28.0	---	26.0	25.0
29	21.0	13.0	15.0	15.0	---	16.0	25.0	22.0	28.0	---	26.0	25.0
30	21.0	13.0	13.0	14.0	---	15.0	---	22.0	28.0	---	26.0	---
31	20.0	---	12.0	17.0	---	14.0	---	21.0	---	25.0	26.0	---
MONTH	21.5	15.0	14.0	13.0	11.0	14.5	18.5	21.0	26.5	26.5	26.0	25.0

YEAR MAX 28.0 MIN 5.0 MEAN 19.5

2

TABLE 2.5A-1 (Continued)

02365500
CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA.

TEMPERATURE (DEG. C) OF WATER , WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970
(ONCE-DAILY)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	21.0	19.0	12.0	13.0	14.0	12.0	20.0	25.0	25.0	---	28.0	26.0
2	21.0	20.0	15.0	11.0	12.0	13.0	20.0	25.0	25.0	26.0	28.0	26.0
3	20.0	17.0	10.0	11.0	11.0	14.0	18.0	25.0	25.0	26.0	28.0	26.0
4	22.0	12.0	10.0	9.0	9.0	16.0	18.0	25.0	25.0	26.0	---	26.0
5	23.0	15.0	10.0	8.0	9.0	17.0	19.0	22.0	---	26.0	28.0	26.0
6	22.0	14.0	10.0	9.0	9.0	---	19.0	21.0	25.0	26.0	28.0	26.0
7	22.0	15.0	12.0	7.0	9.0	---	20.0	22.0	23.0	27.0	27.0	26.0
8	23.0	17.0	11.0	4.0	10.0	20.0	20.0	24.0	25.0	28.0	27.0	26.0
9	22.0	16.0	13.0	4.0	10.0	---	19.0	23.0	25.0	27.0	28.0	26.0
10	23.0	16.0	11.0	4.0	9.0	18.0	20.0	23.0	25.0	27.0	26.0	26.0
11	24.0	16.0	12.0	5.0	9.0	16.0	19.0	23.0	25.0	28.0	26.0	26.0
12	23.0	17.0	13.0	5.0	10.0	16.0	20.0	23.0	25.0	27.0	26.0	27.0
13	23.0	17.0	10.0	8.0	9.0	12.0	20.0	24.0	25.0	26.0	25.0	26.0
14	23.0	15.0	13.0	5.0	10.0	12.0	20.0	25.0	25.0	26.0	26.0	26.0
15	20.0	12.0	13.0	8.0	11.0	15.0	20.0	24.0	---	27.0	26.0	26.0
16	20.0	13.0	11.0	9.0	11.0	14.0	20.0	24.0	25.0	28.0	26.0	26.0
17	19.0	12.0	10.0	9.0	14.0	14.0	23.0	25.0	26.0	26.0	28.0	26.0
18	20.0	13.0	9.0	10.0	15.0	17.0	23.0	---	26.0	26.0	28.0	26.0
19	21.0	16.0	10.0	10.0	14.0	17.0	22.0	25.0	26.0	27.0	28.0	27.0
20	20.0	12.0	10.0	10.0	13.0	18.0	23.0	25.0	26.0	26.0	28.0	27.0
21	22.0	11.0	13.0	8.0	11.0	19.0	23.0	25.0	26.0	26.0	27.0	27.0
22	21.0	13.0	13.0	8.0	11.0	20.0	23.0	25.0	26.0	27.0	27.0	27.0
23	20.0	13.0	11.0	9.0	11.0	20.0	24.0	26.0	26.0	27.0	27.0	27.0
24	19.0	13.0	12.0	8.0	12.0	18.0	---	25.0	26.0	27.0	28.0	27.0
25	13.0	14.0	---	10.0	14.0	15.0	25.0	25.0	26.0	28.0	26.0	26.0
26	19.0	14.0	10.0	11.0	11.0	19.0	24.0	---	26.0	28.0	26.0	27.0
27	20.0	13.0	---	11.0	11.0	16.0	24.0	25.0	26.0	28.0	26.0	26.0
28	19.0	15.0	---	12.0	11.0	16.0	25.0	---	26.0	28.0	26.0	27.0
29	19.0	14.0	---	14.0	---	17.0	25.0	25.0	26.0	28.0	26.0	28.0
30	18.0	15.0	20.0	14.0	---	17.0	25.0	25.0	26.0	---	26.0	25.0
31	18.0	---	13.0	11.0	---	19.0	---	25.0	---	28.0	26.0	---
MONTH	21.0	14.5	11.5	9.0	11.0	16.5	21.5	24.5	25.5	27.0	27.0	26.5
YEAR	MAX	28.0	MIN	4.0	MEAN	19.5						

2

CSP-ER-2

TABLE 2.5A-1 (Continued)

02365500
CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA.

TEMPERATURE (DEG. C) OF WATER , WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969
(ONCE-DAILY)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	23.0	15.0	14.0	10.0	16.0	---	16.0	---	25.0	28.0	25.0	25.0
2	23.0	15.0	15.0	9.0	17.0	13.0	16.0	---	25.0	29.0	---	24.0
3	23.0	16.0	---	10.0	17.0	13.0	17.0	---	24.0	29.0	---	25.0
4	24.0	18.0	14.0	8.0	14.0	13.0	20.0	---	24.0	29.0	25.0	25.0
5	23.0	18.0	11.0	7.0	13.0	12.0	21.0	---	24.0	28.0	25.0	26.0
6	23.0	16.0	11.0	7.0	13.0	---	28.0	---	24.0	28.0	25.0	26.0
7	22.0	16.0	12.0	9.0	14.0	12.0	20.0	---	24.0	29.0	26.0	26.0
8	22.0	15.0	10.0	8.0	15.0	12.0	19.0	---	25.0	29.0	26.0	26.0
9	23.0	---	9.0	11.0	15.0	13.0	19.0	---	25.0	27.0	26.0	26.0
10	22.0	13.0	8.0	11.0	14.0	12.0	20.0	---	26.0	29.0	27.0	25.0
11	22.0	12.0	8.0	9.0	14.0	11.0	20.0	21.0	26.0	28.0	26.0	23.0
12	21.0	10.0	8.0	---	13.0	12.0	20.0	20.0	26.0	28.0	---	23.0
13	22.0	9.0	9.0	9.0	13.0	13.0	21.0	20.0	26.0	28.0	25.0	23.0
14	22.0	9.0	10.0	8.0	13.0	---	21.0	22.0	26.0	28.0	25.0	22.0
15	22.0	10.0	8.0	10.0	13.0	14.0	21.0	21.0	27.0	28.0	---	22.0
16	23.0	13.0	7.0	9.0	11.0	14.0	21.0	21.0	27.0	28.0	---	24.0
17	23.0	16.0	7.0	10.0	10.0	14.0	21.0	21.0	27.0	27.0	---	24.0
18	24.0	13.0	6.0	13.0	10.0	14.0	21.0	22.0	27.0	26.0	---	25.0
19	23.0	14.0	11.0	13.0	11.0	15.0	20.0	21.0	28.0	25.0	---	25.0
20	20.0	14.0	10.0	14.0	11.0	16.0	19.0	21.0	28.0	26.0	25.0	25.0
21	19.0	12.0	10.0	14.0	10.0	15.0	19.0	21.0	27.0	26.0	25.0	23.0
22	19.0	11.0	12.0	14.0	11.0	15.0	19.0	21.0	27.0	26.0	26.0	24.0
23	19.0	10.0	12.0	13.0	11.0	16.0	19.0	21.0	28.0	26.0	26.0	23.0
24	19.0	11.0	10.0	14.0	12.0	16.0	17.0	22.0	29.0	26.0	26.0	22.0
25	15.0	11.0	9.0	14.0	12.0	16.0	17.0	22.0	28.0	26.0	26.0	21.0
26	15.0	11.0	8.0	12.0	---	16.0	---	23.0	28.0	26.0	25.0	22.0
27	14.0	11.0	10.0	12.0	---	15.0	18.0	23.0	29.0	26.0	25.0	22.0
28	15.0	11.0	11.0	13.0	---	14.0	---	24.0	29.0	26.0	25.0	23.0
29	14.0	13.0	10.0	15.0	---	15.0	---	22.0	29.0	26.0	25.0	22.0
30	13.0	11.0	9.0	15.0	---	15.0	---	24.0	28.0	26.0	25.0	22.0
31	14.0	---	11.0	15.0	---	15.0	---	24.0	---	25.0	25.0	---
MONTH	20.0	13.0	10.0	11.0	13.0	14.0	19.5	---	26.5	27.0	---	24.0

YEAR MAX 29.0 MIN 6.0 MEAN 18.5

2

CSP-ER-2

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Amendment 2 8/75

TABLE 2.5A-1 (Continued)

02365500
CHOCTAWHATCHEE RIVER AT CARYVILLE.FLA.

TEMPERATURE (DEG. C) OF WATER , WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968
(ONCE-DAILY)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	18.0	17.0	16.0	13.0	13.0	11.0	20.0	20.0	26.0	28.0	28.0	24.0
2	21.0	16.0	16.0	11.0	15.0	10.0	20.0	21.0	27.0	28.0	28.0	24.0
3	20.0	15.0	17.0	13.0	16.0	11.0	21.0	21.0	27.0	28.0	27.0	25.0
4	19.0	15.0	16.0	16.0	14.0	11.0	21.0	22.0	27.0	28.0	26.0	24.0
5	20.0	14.0	13.0	13.0	13.0	13.0	22.0	22.0	27.0	28.0	26.0	26.0
6	21.0	13.0	13.0	12.0	13.0	12.0	21.0	20.0	27.0	27.0	---	26.0
7	21.0	12.0	13.0	14.0	11.0	12.0	21.0	20.0	27.0	27.0	26.0	25.0
8	22.0	11.0	14.0	10.0	10.0	12.0	21.0	22.0	27.0	27.0	26.0	25.0
9	22.0	12.0	16.0	10.0	10.0	13.0	21.0	22.0	27.0	28.0	27.0	25.0
10	20.0	11.0	16.0	12.0	10.0	16.0	22.0	22.0	27.0	28.0	27.0	25.0
11	19.0	11.0	19.0	11.0	11.0	17.0	21.0	22.0	27.0	27.0	28.0	24.0
12	20.0	13.0	16.0	12.0	9.0	19.0	19.0	23.0	28.0	27.0	27.0	23.0
13	18.0	13.0	17.0	10.0	9.0	15.0	20.0	24.0	28.0	27.0	27.0	24.0
14	18.0	14.0	16.0	10.0	10.0	15.0	20.0	24.0	28.0	27.0	26.0	24.0
15	18.0	14.0	18.0	9.0	11.0	13.0	21.0	25.0	28.0	27.0	25.0	24.0
16	19.0	13.0	19.0	11.0	11.0	16.0	19.0	26.0	28.0	27.0	26.0	24.0
17	21.0	13.0	16.0	10.0	9.0	14.0	19.0	25.0	28.0	27.0	27.0	24.0
18	19.0	14.0	20.0	7.0	12.0	15.0	21.0	26.0	28.0	27.0	27.0	24.0
19	17.0	13.0	18.0	8.0	9.0	15.0	21.0	26.0	28.0	---	27.0	25.0
20	17.0	12.0	19.0	11.0	10.0	16.0	22.0	26.0	28.0	26.0	26.0	25.0
21	16.0	12.0	19.0	9.0	9.0	18.0	23.0	25.0	28.0	26.0	27.0	25.0
22	16.0	14.0	19.0	11.0	10.0	17.0	24.0	25.0	28.0	26.0	27.0	24.0
23	17.0	14.0	18.0	11.0	9.0	16.0	24.0	25.0	27.0	26.0	27.0	23.0
24	18.0	17.0	15.0	12.0	11.0	14.0	24.0	25.0	27.0	26.0	27.0	23.0
25	18.0	17.0	12.0	12.0	10.0	13.0	20.0	25.0	27.0	27.0	27.0	23.0
26	17.0	16.0	12.0	11.0	10.0	13.0	21.0	25.0	27.0	27.0	27.0	24.0
27	17.0	19.0	12.0	10.0	11.0	14.0	21.0	26.0	28.0	28.0	26.0	24.0
28	16.0	18.0	12.0	9.0	10.0	16.0	---	26.0	27.0	27.0	25.0	23.0
29	15.0	16.0	10.0	11.0	11.0	17.0	22.0	25.0	28.0	28.0	24.0	23.0
30	16.0	15.0	9.0	12.0	---	17.0	20.0	25.0	28.0	27.0	24.0	23.0
31	18.0	---	13.0	12.0	---	18.0	---	25.0	---	27.0	24.0	---
MONTH	18.5	14.0	15.5	11.0	11.0	14.5	21.0	23.5	27.5	27.0	26.5	24.0
YEAR	MAX	28.0	MIN	7.0	MEAN	19.5						

TABLE 2.5A-1 (Continued)

02365500
CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA.

TEMPERATURE (DEG. C) OF WATER , WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967
(ONCE-DAILY)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	24.0	16.0	9.5	10.5	11.0	10.0	19.5	20.5	25.5	25.0	25.5	24.0
2	21.5	---	8.5	10.5	12.0	11.0	19.0	21.0	23.5	25.0	24.0	24.0
3	21.5	---	10.0	11.5	---	11.0	19.5	20.0	23.5	24.0	25.5	22.0
4	21.0	11.5	10.0	9.5	11.5	14.0	20.0	21.5	23.5	24.5	26.0	22.0
5	21.5	10.0	10.0	10.5	10.5	15.0	20.0	21.0	24.0	24.0	25.5	22.0
6	21.5	10.0	10.5	9.5	11.0	16.5	20.5	21.0	23.0	24.0	25.5	22.0
7	21.0	12.0	12.0	12.0	---	18.0	21.0	21.5	23.5	25.0	26.5	22.0
8	---	14.0	14.0	10.0	---	16.0	21.0	19.0	24.0	26.0	27.0	23.5
9	24.0	16.0	15.5	10.5	---	15.5	21.0	22.0	25.5	26.0	27.0	23.5
10	---	18.0	16.0	10.0	---	16.0	21.5	21.5	24.5	25.5	25.5	24.0
11	---	19.5	14.5	10.5	---	17.0	21.0	21.0	24.0	25.0	25.5	24.0
12	---	20.0	12.0	---	---	18.5	21.5	23.5	24.5	25.0	23.0	24.0
13	---	19.5	11.5	---	---	19.5	21.0	---	25.5	25.0	24.0	23.0
14	20.5	18.5	10.0	13.0	---	19.5	21.5	25.0	26.0	25.5	23.0	23.0
15	23.0	16.5	9.0	12.0	10.0	20.5	21.5	25.0	26.5	24.5	24.0	23.0
16	23.0	15.5	8.5	11.0	10.0	19.5	22.0	24.0	24.0	23.5	24.5	22.0
17	22.0	15.5	9.0	10.0	10.5	17.0	23.0	21.5	25.5	25.0	25.0	21.5
18	23.0	15.0	9.0	10.5	14.5	20.0	24.5	21.5	26.0	24.0	25.5	21.5
19	20.0	15.0	10.0	10.0	14.0	14.5	23.0	22.0	26.5	24.0	25.0	22.0
20	17.0	15.5	10.0	11.0	15.0	15.0	18.0	21.5	26.0	24.5	26.0	23.0
21	15.0	15.0	10.0	10.5	14.0	16.5	23.0	23.0	25.0	23.5	24.0	23.5
22	17.0	14.5	12.0	11.5	13.0	16.0	23.0	23.5	26.5	23.0	25.0	24.5
23	18.5	11.0	---	12.0	12.0	16.0	23.5	21.0	27.0	24.0	25.0	21.0
24	19.5	13.0	10.5	11.5	10.5	16.0	24.5	20.0	27.0	25.0	24.5	22.0
25	19.5	13.0	9.5	12.0	9.5	16.5	22.0	20.0	25.0	25.0	25.0	21.5
26	18.5	12.0	8.5	12.0	9.5	18.0	22.0	21.5	25.5	25.5	24.0	22.0
27	18.0	13.5	9.0	11.5	9.5	17.0	22.0	21.0	25.5	25.5	24.5	22.0
28	16.0	11.5	11.0	10.5	12.0	18.0	20.0	24.5	26.0	26.0	24.5	21.5
29	16.0	10.5	10.5	10.0	---	18.5	18.5	24.5	25.5	26.0	24.0	20.0
30	15.5	10.0	10.0	10.5	---	---	18.5	24.5	25.5	26.0	24.0	---
31	15.5	---	9.5	11.0	---	19.5	---	24.5	---	25.5	24.5	---
MONTH	20.0	14.5	10.5	11.0	---	16.5	21.0	22.0	25.0	25.0	25.0	22.5
YEAR	MAX	27.0	MIN	8.5	MEAN	19.0						

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CSP-ER-2

TABLE 2.5A-1 (Continued)

02365500
CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA.

TEMPERATURE (DEG. C) OF WATER , WATER YEAR OCTOBER 1965 TO SEPTEMBER 1966
(ONCE-DAILY)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	19.0	15.5	11.0	11.0	4.0	10.5	15.0	22.0	23.5	26.5	28.0	26.5
2	22.0	15.0	10.0	13.0	4.5	13.0	15.0	22.0	23.0	26.5	28.0	26.5
3	23.5	15.0	9.5	13.0	4.5	14.0	16.0	23.0	23.0	26.5	28.0	27.0
4	22.0	15.0	9.5	15.0	4.5	14.0	16.0	22.0	23.5	26.5	28.0	27.0
5	21.5	16.0	9.5	15.0	4.5	13.5	16.0	21.5	23.5	27.0	27.0	28.0
6	21.0	16.5	10.0	15.0	4.5	13.0	16.0	21.5	24.0	27.0	26.5	27.0
7	20.0	17.0	9.5	13.0	5.0	12.0	16.0	21.0	24.5	27.0	25.5	27.0
8	19.5	17.0	---	12.0	5.5	11.5	16.0	21.0	25.0	27.0	26.5	26.5
9	19.5	18.0	9.0	11.0	7.0	10.5	16.0	21.5	26.0	28.0	26.0	26.0
10	20.0	16.5	9.0	9.5	8.0	10.0	16.5	21.5	24.0	28.5	25.5	26.0
11	20.5	17.0	9.5	10.0	10.5	10.0	16.5	21.5	24.5	25.5	25.5	25.0
12	20.0	18.0	9.5	10.0	12.0	10.0	16.5	21.0	25.0	29.0	26.0	25.0
13	20.0	18.0	10.5	9.5	13.0	11.0	17.0	21.0	25.0	29.0	26.0	25.5
14	20.0	17.0	12.0	9.5	14.0	13.0	18.5	21.5	---	29.5	26.5	25.5
15	20.0	16.5	12.0	10.5	14.5	14.0	19.0	21.5	---	27.0	26.5	26.0
16	20.5	16.0	12.0	10.5	14.5	15.0	19.0	22.0	24.0	28.0	27.0	26.0
17	20.5	17.0	12.0	10.0	15.0	15.5	18.5	23.0	24.5	27.0	26.5	25.5
18	20.0	16.0	13.0	10.0	15.0	15.5	19.0	23.5	25.0	28.0	26.5	25.0
19	20.0	15.0	12.0	9.5	14.5	16.0	19.0	---	25.0	28.5	26.5	25.0
20	19.5	15.0	12.0	9.5	13.0	16.0	19.0	---	24.5	28.5	26.5	24.0
21	20.0	15.5	9.5	9.0	12.0	16.5	19.5	24.0	24.0	---	26.5	24.0
22	20.0	16.0	---	9.5	12.0	18.5	20.0	24.0	23.5	27.0	27.0	23.5
23	19.5	15.5	9.0	8.0	11.5	18.5	20.5	23.5	23.5	28.0	28.0	23.0
24	---	15.5	9.0	---	11.0	18.5	20.5	22.0	23.5	28.0	27.0	22.0
25	---	15.0	15.0	6.5	10.5	18.0	---	21.5	24.0	28.0	27.0	22.0
26	14.5	15.0	15.0	6.5	10.0	16.0	21.0	21.5	25.0	27.0	26.5	---
27	14.0	15.5	9.0	5.0	9.5	15.5	21.0	22.0	25.5	26.5	26.5	24.0
28	14.0	15.5	9.5	4.5	9.5	15.0	21.0	23.0	26.0	27.0	26.5	23.5
29	14.0	15.5	9.5	5.5	---	15.0	21.5	23.5	26.5	27.0	26.5	23.5
30	14.0	14.5	10.0	5.0	---	15.0	21.5	24.0	26.5	28.0	26.0	23.5
31	14.0	---	10.5	4.0	---	15.0	---	24.0	---	28.0	26.0	---
MONTH	19.0	16.0	10.5	9.5	10.0	14.0	18.0	22.5	24.5	27.5	27.0	25.0
YEAR	MAX	29.5	MIN	4.0	MEAN	18.5						

2 CSP-ER-2

TABLE 2.5A-1 (Continued)

02365500
CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA.

TEMPERATURE (DEG. C) OF WATER , WATER YEAR OCTOBER 1964 TO SEPTEMBER 1965
(ONCE-DAILY)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	24.0	17.0	10.0	14.5	9.0	11.5	19.0	19.0	25.0	26.5	26.0	26.0
2	24.0	17.0	9.0	14.5	9.0	13.0	18.5	19.0	25.0	27.0	25.5	25.5
3	24.0	16.5	9.5	15.0	8.5	14.5	18.5	19.5	25.5	27.0	25.5	25.5
4	23.5	16.5	11.0	14.5	7.0	15.0	18.5	19.5	26.5	25.5	26.5	25.0
5	23.0	17.0	12.0	14.5	7.0	14.0	18.5	19.5	26.0	25.5	26.0	25.0
6	21.0	16.5	13.0	13.0	8.0	13.0	19.5	21.0	26.5	26.5	25.5	25.0
7	19.5	16.5	11.0	13.0	9.0	11.5	20.0	22.0	26.0	28.0	25.5	25.0
8	18.0	17.0	10.0	13.0	11.5	9.5	20.5	22.0	25.5	26.0	25.0	24.5
9	17.0	16.5	9.0	14.0	13.0	10.0	---	22.0	25.5	25.5	25.0	24.5
10	16.5	16.0	9.0	14.5	14.0	10.5	22.0	23.0	---	25.0	24.0	24.5
11	16.0	15.5	10.0	14.5	15.0	11.0	23.0	23.5	---	25.0	24.0	25.5
12	16.0	16.0	12.0	13.0	16.5	11.0	23.0	23.5	---	25.5	24.0	26.0
13	16.5	16.5	13.5	12.0	16.5	11.5	23.0	24.0	---	25.5	25.5	26.5
14	16.0	17.0	14.0	11.0	14.5	11.5	23.0	23.5	---	25.5	25.0	26.5
15	16.5	18.0	13.0	11.0	11.5	11.5	23.0	23.5	---	25.5	25.5	27.0
16	16.5	18.5	11.0	11.0	11.0	13.0	22.0	23.5	---	25.5	24.0	26.5
17	17.0	18.5	11.0	9.0	10.0	14.0	21.0	23.5	24.0	26.0	26.0	26.0
18	16.5	18.5	11.0	7.0	9.5	15.5	20.5	23.5	23.5	26.5	26.0	26.0
19	17.0	18.5	10.0	5.5	10.0	16.0	20.5	24.0	23.0	27.0	25.5	25.5
20	16.0	18.5	10.0	5.5	11.0	15.5	19.5	24.5	23.0	28.0	25.0	25.5
21	15.0	16.5	10.5	7.0	11.0	14.0	19.0	24.5	23.0	28.0	25.5	25.5
22	14.5	14.5	11.0	9.0	11.0	13.0	19.0	24.5	23.5	28.5	25.5	25.0
23	14.5	13.0	11.5	10.5	11.0	13.5	19.0	24.5	24.5	28.0	25.5	25.0
24	14.5	11.0	12.0	12.0	11.5	14.0	20.0	24.5	25.0	28.0	26.5	25.0
25	14.5	11.0	12.0	12.0	11.0	15.0	21.0	25.0	25.0	21.5	26.5	24.0
26	14.5	11.0	18.0	13.0	9.0	17.0	21.0	25.5	25.5	27.0	27.0	23.5
27	15.5	11.5	18.5	13.5	9.5	18.5	21.0	25.5	25.5	26.5	28.0	23.5
28	16.0	11.5	16.5	12.0	10.0	18.5	20.5	25.5	25.0	26.5	28.5	23.0
29	16.5	12.0	16.0	10.5	---	18.5	20.0	25.5	26.0	26.5	26.5	21.0
30	16.5	12.0	15.0	10.5	---	19.0	19.5	25.5	26.5	25.5	26.0	21.5
31	17.0	---	14.5	9.5	---	19.5	---	24.5	---	25.5	26.0	---
MONTH	17.5	15.5	12.0	11.5	11.0	14.0	20.5	23.0	---	26.5	26.0	25.0
YEAR	MAX	24.5	MIN	5.5	MEAN	19.0						

2

TABLE 2.5A-2

STATION NUMBER 0236650*

CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA.

NUMBER OF DAYS IN CLASS

YEAR \ CLASS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	CFS_DAYS
1968		7	9	10	25	17	30	32	24	16	15	21	27	26	29	20	12	2	5	7	11	8	3	6	2	2										1211892.0
1969		12	18	6	17	8	13	17	33	23	31	34	20	23	25	19	11	8	12	13	3	5	8	2		1	2	1								1244086.0
1970								4	20	44	36	33	34	20	17	16	24	22	20	16	13	8	14	7	5		4	1	2	5						1977899.9
1971								3	3	11	15	31	18	31	35	38	31	22	14	20	17	15	20	11	14	9	3	4								2395000.0
1972				8	11	12	25	38	41	29	17	11	10	7	11	14	27	25	25	17	12	8	10	7	1											1493844.0
1973				12	9	2	15	2	3	17	22	15	24	27	9	9	13	16	13	16	20	21	33	13	22	6	8	7	5	4	2					2893722.0

CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT
0	0.00	0	16071	100.0	9	1800.00	1078	13193	82.1	18	6400.0	727	3983	24.8	27	22000	133	381	2.3
1	604.00	19	16071	100.0	10	2100.00	994	12115	75.4	19	7300.0	665	3256	20.3	28	26000	65	248	1.5
2	690.00	33	16052	99.9	11	2400.00	1165	11121	69.2	20	8400.0	599	2591	16.1	29	29000	107	183	1.1
3	800.00	140	16019	99.7	12	2800.00	991	9956	62.0	21	9700.0	401	1992	12.4	30	34000	38	76	.4
4	920.00	277	15879	98.8	13	3200.00	1130	8965	55.8	22	11000.0	461	1591	9.9	31	39000	23	38	.2
5	1100.00	258	15602	97.1	14	3700.00	995	7835	48.8	23	13000.0	264	1130	7.0	32	44000	7	15	.0
6	1200.00	668	15344	95.5	15	4200.00	948	6840	42.6	24	15000.0	212	866	5.4	33	51000	7	8	.0
7	1400.00	754	14676	91.3	16	4800.00	1145	5892	36.7	25	17000.0	131	654	4.1	34	59000	1	1	
8	1600.00	729	13922	86.6	17	5600.00	764	4747	29.5	26	19000.0	142	523	3.3					

*DURATION TABLE OF DAILY DISCHARGE FOR YEAR ENDING SEPTEMBER 30

TABLE 2.5A-2 (Continued)*

CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA.

NUMBER OF DAYS IN CLASS

YEAR / CLASS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	CFS_DAYS
1930						2	15	14	15	27	29	20	13	3	17	14	38	22	49	35	27	9	7			1		1	1	2		1	3			2073500.0
1931					19	11	15	20	15	23	18	18	22	21	29	27	37	24	20	20	13	2		1	1	1		2	2	4						1642885.0
1932				19	28	16	11	13	22	21	13	18	26	36	35	31	26	14	7	13	7	2	4		2		1	1								1295725.0
1933								8	8	16	14	32	15	32	25	36	37	10	17	19	26	17	24	9	6	2	3	3	3	2	1					2366980.0
1934						5	17	70	18	40	36	38	30	31	18	27	15	6	2	2	3		2	1		1	2	1								1096660.0
1935					7	12	17	18	22	44	27	45	30	39	23	20	20	15	13	3	3	2	5													1186020.0
1936					10	7	22	26	16	24	26	29	16	18	11	22	21	16	10	7	12	10	9	7	5	8	12	9	1	4	5	3				2433510.0
1937								15	15	14	16	19	26	38	43	34	40	23	15	8	11	5	14	6	5		4	2	1	2	4	2	1	2		2277190.0
1938							1	12	6	20	22	17	28	41	25	31	52	23	25	15	10	7	5	5	5	5	5	2	1	2						2003060.0
1939						4	29	30	16	8	5	20	11	25	30	28	32	27	19	20	15	6	7	4	6	1	5	2	3	6	2	3				2238530.0
1940							13	9	5	3	13	63	31	29	26	30	24	25	21	19	18	8	7	7	2	3	6	2	2							1970940.0
1941					14	14	47	22	13	26	22	24	22	31	31	21	33	20	7	9	6	3														1183170.0
1942					3	20	28	8	6	13	14	23	15	25	26	34	28	14	11	13	15	11	24	18	8	3	5									2045720.0
1943								12	19	29	19	45	25	29	25	20	21	22	19	15	12	12	10	4	4	6	7	2	3	5						2109600.0
1944							35	3	6	28	8	12	14	22	39	32	45	14	11	10	16	11	9	8	4	3	4	9	4	17	2					2640510.0
1945							1	9	9	28	30	29	30	47	37	22	44	25	20	13	11	4	5	1												1552360.0
1946								2	7	19	10	10	11	15	16	18	32	39	28	27	20	12	22	12	19	3	13	12	4	7	6	1				3344440.0
1947										8	9	19	43	41	34	30	24	19	24	16	14	17	10	9	16	7	6	6	2	7	1	3				2764490.0
1948									15	25	20	21	15	12	18	15	31	29	31	16	20	19	26	13	7	5	3	9	3	6	2	5				2962800.0
1949												17	17	16	26	28	33	25	18	39	28	30	33	11	10	10	7	9	4	4						3171470.0
1950						3	7	9	9	36	50	40	27	49	27	20	19	14	17	11	4	6	5	4	2	2	1	3								1523210.0
1951					14	7	18	23	41	54	37	36	35	39	18	7	5	6	6	1	5	4	6	1	2											1082765.0
1952					13	14	6	14	25	28	25	33	31	29	23	22	24	15	13	9	16	9	8	5	1	3										1522256.0
1953					9	16	40	18	21	23	19	21	23	23	17	11	22	19	13	20	15	12	10	5	2		2	2	1	1						1641950.0
1954			1	30	18	4	19	21	17	23	29	19	8	19	13	25	15	11	20	12	14	5	4	3	6	5	2	7	3	6	1	2	1	2		2126726.0
1955				29	19	13	41	62	40	45	22	20	13	14	6	8	7	4	3	2	3	3	1	1	2		2	2	2	1						990503.0
1956			2	19	33	32	69	37	16	13	23	17	10	19	16	16	12	7	3	4	3	4	4	3			1			1	2					1048698.0
1957			3	7	9	2	12	9	3	22	32	17	30	40	41	27	24	15	14	13	13	8	3	3	3	3	1	3	4	2	2					1850088.0
1958								1	13	27	28	30	23	26	20	31	51	22	28	17	23	11	6	3	3		2									1830840.0
1959							8	30	25	32	43	33	28	20	11	10	16	14	22	17	16	11	11	5	5	2	3	3								1737300.0
1960							5	6	11	21	21	24	37	27	23	25	29	18	25	28	23	11	8	7	4	2		1		2	1	1	2	3	1	2332990.0
1961							11	23	10	21	26	35	22	31	22	12	33	15	23	21	7	9	6	6	7	9	6	4	1	2	1	2				2152720.0
1962					4	3	30	25	37	45	34	26	11	5	12	14	18	12	17	14	10	2	13	10	6	3	5	2	1	3	3					1856750.0
1963				12	17	26	28	17	34	24	34	31	16	12	15	19	27	14	11	5	3	7	2	4	1	4	1	1								1441436.0
1964								4	22	12	6	12	21	23	20	15	19	17	17	27	36	20	32	19	6	11	7	7	6	7						3100360.0
1965								2	11	11	28	39	20	23	25	13	21	23	23	30	25	16	15	14	10	5	4	2	1	1	3					2452800.0
1966					2	8	12	23	10	39	30	32	28	24	20	13	28	9	9	17	12	13	6	3	4	6	2	8	3	4						1964300.0
1967					1	9	30	32	44	36	29	33	20	18	9	28	32	9	4	3	6	2	5	8	1	2		3	1							1342070.0

*DURATION TABLE OF DAILY DISCHARGE FOR YEAR ENDING SEPTEMBER 30

2

TABLE 2.5A-2 (Continued)

CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA. 2

YEAR	1	3	7	15	30	60	90	120	183	ANNUAL
1968	17200.0 39	16200.0 39	13000.0 40	9210.0 41	8490.0 36	7010.0 35	6310.0 35	5860.0 35	5180.0 35	3310.0 38
1969	22500.0 35	21000.0 34	16800.0 35	10600.0 37	7230.0 40	5840.0 42	5860.0 37	5310.0 37	4450.0 38	3410.0 37
1970	32700.0 20	31100.0 21	25300.0 22	17900.0 23	14000.0 20	11600.0 20	9870.0 22	8990.0 21	7870.0 21	5420.0 21
1971	24100.0 31	23300.0 31	20200.0 28	17900.0 24	14000.0 21	13700.0 13	11800.0 16	10700.0 15	9150.0 13	6560.0 10
1972	15600.0 41	14700.0 41	13200.0 39	10400.0 38	8860.0 34	8530.0 33	8140.0 27	7580.0 28	6340.0 30	4080.0 33
1973	37100.0 12	35500.0 12	31500.0 12	26000.0 9	20400.0 8	16000.0 7	14300.0 6	13800.0 3	12700.0 1	7930.0 5

*HIGHEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPTEMBER 30 2

TABLE 2.5A-2 (Continued)*

CHOCTAWHATCHEE RIVER AT CARYVILLE, FLA.

YEAR	1	3	7	15	30	60	90	120	183	ANNUAL
1930	49100.0 4	46400.0 4	38700.0 5	24200.0 11	14300.0 17	10600.0 23	9380.0 23	8750.0 22	8450.0 16	5680.0 1
1931	30800.0 23	30500.0 22	28400.0 17	20300.0 19	14000.0 22	9600.0 28	8390.0 26	7880.0 26	6790.0 27	4500.0 2-
1932	22600.0 34	19900.0 36	15400.0 37	12100.0 35	8540.0 35	6620.0 36	5720.0 38	5050.0 39	4670.0 37	3540.0 36
1933	34800.0 17	32900.0 17	27000.0 20	19000.0 20	18900.0 10	13600.0 15	12300.0 13	11100.0 12	9220.0 12	6480.0 11
1934	23200.0 32	21600.0 33	17400.0 34	11500.0 36	8120.0 38	6310.0 41	5470.0 39	4920.0 40	4130.0 40	3000.0 41
1935	12200.0 43	11900.0 43	11400.0 43	8930.0 43	6560.0 44	5690.0 43	5240.0 42	4530.0 44	3850.0 43	3250.0 39
1936	40800.0 9	39100.0 9	35000.0 8	25700.0 10	24400.0 3	19800.0 2	15300.0 3	13800.0 4	10000.0 8	6650.0 9
1937	55500.0 2	51500.0 2	42500.0 3	28100.0 7	16800.0 15	11200.0 22	10400.0 18	9070.0 20	8110.0 20	6240.0 13
1938	30100.0 24	28900.0 24	23900.0 23	15900.0 25	13400.0 24	9520.0 30	7730.0 33	7120.0 31	7100.0 25	5490.0 20
1939	43800.0 5	43100.0 5	38700.0 6	29800.0 4	18500.0 11	12100.0 18	10200.0 19	9280.0 19	8960.0 14	6130.0 14
1940	28300.0 27	27400.0 25	23800.0 24	18400.0 22	13300.0 25	9920.0 25	8800.0 24	7990.0 25	7240.0 23	5390.0 22
1941	10200.0 44	9710.0 44	8310.0 44	7200.0 44	6930.0 43	5540.0 44	5010.0 43	5110.0 38	4230.0 39	3240.0 40
1942	20800.0 36	20000.0 35	18000.0 33	15000.0 27	13100.0 26	11900.0 19	10100.0 20	9780.0 18	7740.0 22	5600.0 19
1943	33800.0 18	32200.0 18	26400.0 21	20400.0 18	16200.0 16	12200.0 17	12600.0 11	11100.0 13	8730.0 15	5780.0 17
1944	35800.0 14	34500.0 15	32100.0 11	28900.0 5	23000.0 4	20200.0 1	15500.0 1	12900.0 7	10400.0 7	7210.0 7
1945	13300.0 42	12800.0 42	11700.0 42	9150.0 42	7230.0 39	6620.0 37	5880.0 36	5900.0 34	5330.0 32	4250.0 30
1946	39800.0 10	38500.0 10	33100.0 10	23200.0 15	18100.0 12	15100.0 10	14200.0 7	12900.0 8	12500.0 2	9160.0 1
1947	43800.0 6	42500.0 7	36800.0 7	28800.0 6	20800.0 6	17500.0 5	15000.0 4	13200.0 6	11600.0 5	7570.0 6
1948	43800.0 7	43100.0 6	40500.0 4	32300.0 3	25800.0 2	18600.0 3	15300.0 2	14100.0 1	12000.0 4	8100.0 4
1949	31800.0 21	31100.0 19	28400.0 18	26000.0 8	20100.0 9	16700.0 6	14600.0 5	13400.0 5	12200.0 3	8690.0 2
1950	24500.0 30	23600.0 30	18700.0 31	13000.0 31	9500.0 33	7740.0 34	6440.0 34	5720.0 36	5020.0 36	4170.0 31
1951	16200.0 40	15000.0 40	12100.0 41	9250.0 40	8470.0 37	6610.0 38	5360.0 41	4840.0 41	4100.0 41	2970.0 42
1952	17900.0 38	16600.0 38	14000.0 38	12300.0 33	10900.0 31	9680.0 26	8000.0 29	7160.0 30	6080.0 31	4160.0 32
1953	31000.0 22	25200.0 27	20300.0 26	13700.0 30	11400.0 29	9030.0 31	8790.0 25	8340.0 24	6680.0 28	4500.0 29
1954	51900.0 3	49400.0 3	43500.0 2	34200.0 2	27400.0 1	18100.0 4	14000.0 9	12100.0 9	9620.0 10	5830.0 16
1955	29400.0 26	27000.0 26	20200.0 27	12100.0 34	7060.0 42	6340.0 40	4790.0 44	4540.0 43	3860.0 42	2710.0 44
1956	35600.0 15	33900.0 16	19200.0 30	10000.0 39	7190.0 41	6380.0 39	5450.0 40	4680.0 42	3780.0 44	2870.0 43
1957	37100.0 11	35200.0 13	28000.0 19	18600.0 21	14100.0 18	10100.0 24	7990.0 30	7710.0 27	6900.0 26	5070.0 25
1958	19500.0 37	18500.0 37	15900.0 36	12500.0 32	10200.0 32	8980.0 32	8120.0 28	7280.0 29	6470.0 29	5020.0 26
1959	22900.0 33	21900.0 32	18000.0 32	14100.0 28	12600.0 27	11500.0 21	9860.0 21	8450.0 23	7220.0 24	4760.0 27
1960	59800.0 1	57700.0 1	51000.0 1	36000.0 1	22100.0 5	15800.0 8	13300.0 10	11500.0 10	9490.0 11	6370.0 12
1961	41300.0 8	39700.0 8	33500.0 9	23300.0 13	17700.0 14	14800.0 11	12000.0 14	10200.0 17	8340.0 17	5900.0 15
1962	35400.0 16	34700.0 14	28600.0 16	20900.0 16	14000.0 19	13700.0 14	10900.0 17	10400.0 16	8340.0 18	5090.0 24
1963	27200.0 28	24000.0 29	19700.0 29	13700.0 29	11900.0 28	9570.0 29	7940.0 31	6830.0 32	5260.0 34	3950.0 34
1964	33000.0 19	31100.0 20	30000.0 14	23900.0 12	18100.0 13	14300.0 12	14200.0 8	14000.0 2	11300.0 6	8470.0 3
1965	36600.0 13	35900.0 11	30300.0 13	20500.0 17	13500.0 23	12300.0 16	12000.0 15	11200.0 11	9880.0 9	6720.0 8
1966	29700.0 25	29400.0 23	29000.0 15	23200.0 14	20700.0 7	15200.0 9	12500.0 12	10700.0 14	8280.0 19	5380.0 23
1967	26300.0 29	25100.0 28	21500.0 25	15900.0 26	11000.0 30	9610.0 27	7910.0 32	6780.0 33	5280.0 33	3680.0 35

*HIGHEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPTEMBER 30

2

TABLE 2.5A-2 (Continued)

CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA.

YEAR	1		3		7		14		30		60		90		120		183		ANNUAL	
1969	604.00	1	607.00	1	632.00	1	687.00	1	722.00	1	807.00	1	924.00	1	1010.00	2	1170.00	1	2330.00	2
1970	924.00	9	940.00	9	955.00	8	1030.00	8	1280.00	16	1960.00	28	2680.00	32	2690.00	25	2770.00	22	4630.00	19
1971	1560.00	34	1570.00	34	1600.00	33	1710.00	34	2070.00	36	2530.00	36	2780.00	33	3070.00	33	3160.00	29	6110.00	33
1972	1510.00	33	1510.00	32	1530.00	32	1590.00	32	1650.00	28	1700.00	21	2250.00	24	2970.00	32	3660.00	33	5930.00	31
1973	883.00	5	884.00	5	887.00	5	903.00	5	991.00	4	1040.00	4	1160.00	4	1310.00	5	1760.00	5	5290.00	23

*LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

2

TABLE 2.5A-2 (Continued)*

CHOCTAWHATCHEE RIVER AT CARYVILLE,FLA.

YEAR	1	3	7	14	30	60	90	120	183	ANNUAL
1931	1180.00 23	1210.00 24	1220.00 22	1320.00 22	1580.00 24	1860.00 26	2060.00 21	2220.00 21	2550.00 18	4610.00 18
1932	895.00 6	895.00 6	895.00 6	899.00 4	918.00 3	1020.00 3	1090.00 3	1250.00 3	1640.00 4	3110.00 4
1933	1060.00 16	1130.00 19	1240.00 24	1460.00 29	1840.00 33	3050.00 40	3450.00 40	3380.00 36	3530.00 32	5440.00 26
1934	1320.00 28	1350.00 29	1360.00 28	1380.00 26	1440.00 20	1450.00 13	1580.00 9	1730.00 11	2160.00 11	4390.00 14
1935	1080.00 19	1090.00 17	1140.00 18	1250.00 20	1450.00 22	1780.00 24	1940.00 20	2070.00 18	2220.00 12	3070.00 3
1936	920.00 7	933.00 7	1020.00 9	1070.00 10	1180.00 10	1430.00 12	1720.00 15	2070.00 19	2410.00 16	5850.00 30
1937	1240.00 26	1240.00 25	1270.00 25	1330.00 23	1580.00 25	2060.00 29	2310.00 27	2740.00 26	3450.00 30	4800.00 21
1938	1870.00 40	1920.00 39	2250.00 40	2640.00 41	3040.00 41	3240.00 41	3380.00 39	4060.00 40	5460.00 40	7040.00 38
1939	1140.00 21	1170.00 21	1200.00 19	1240.00 19	1270.00 14	1400.00 10	1500.00 8	1630.00 7	2220.00 13	4360.00 13
1940	2360.00 42	2390.00 42	2460.00 42	2500.00 40	2650.00 40	2720.00 37	3150.00 37	3830.00 39	5890.00 42	7030.00 37
1941	1180.00 22	1190.00 22	1200.00 20	1210.00 17	1250.00 12	1320.00 8	1630.00 11	1850.00 13	2800.00 23	4290.00 12
1942	1010.00 12	1010.00 12	1050.00 13	1090.00 11	1170.00 9	1260.00 7	1440.00 6	1700.00 10	2240.00 14	4470.00 15
1943	1680.00 35	1700.00 36	1730.00 36	1760.00 35	1950.00 34	2290.00 32	2900.00 35	3090.00 34	3980.00 35	6410.00 34
1944	1210.00 24	1210.00 23	1220.00 23	1230.00 18	1250.00 13	1580.00 16	1780.00 16	1930.00 15	2410.00 17	4520.00 16
1945	1730.00 37	1760.00 37	1940.00 37	2050.00 37	2200.00 38	2820.00 38	3200.00 38	3710.00 38	4530.00 37	6850.00 36
1946	1380.00 30	1410.00 31	1460.00 31	1560.00 31	1790.00 29	2460.00 35	2910.00 36	3140.00 35	3050.00 27	5970.00 32
1947	2700.00 43	2750.00 43	2820.00 43	2860.00 43	3060.00 42	3640.00 42	3750.00 41	4320.00 41	5640.00 41	9100.00 42
1948	1680.00 36	1680.00 35	1720.00 35	1760.00 36	1800.00 30	2310.00 33	2640.00 31	2870.00 30	4670.00 39	8700.00 41
1949	1840.00 38	1990.00 40	2130.00 39	2280.00 39	2440.00 39	2830.00 39	4010.00 42	4840.00 42	4640.00 38	8340.00 40
1950	1860.00 39	1890.00 38	1970.00 38	2080.00 38	2110.00 37	2260.00 30	2430.00 28	2820.00 29	3130.00 28	5310.00 24
1951	1120.00 20	1140.00 20	1210.00 21	1390.00 27	1830.00 32	1860.00 27	2150.00 23	2430.00 23	2620.00 20	3720.00 7
1952	922.00 8	934.00 8	948.00 7	992.00 7	1130.00 7	1490.00 14	1490.00 7	1560.00 6	1780.00 6	4060.00 11
1953	1070.00 17	1080.00 16	1110.00 15	1130.00 15	1200.00 11	1380.00 9	1610.00 10	1910.00 14	1990.00 8	3770.00 8
1954	1010.00 13	1010.00 13	1040.00 10	1120.00 14	1440.00 21	1760.00 23	2300.00 25	2330.00 22	3450.00 31	7120.00 39
1955	796.00 4	813.00 4	819.00 4	832.00 2	899.00 2	913.00 2	944.00 2	989.00 1	1190.00 2	1970.00 1
1956	961.00 11	1000.00 11	1050.00 11	1050.00 9	1140.00 8	1150.00 5	1240.00 5	1250.00 4	1600.00 3	3270.00 5
1957	775.00 3	789.00 3	811.00 3	944.00 6	1070.00 6	1230.00 6	1680.00 14	1680.00 9	2740.00 21	4010.00 10
1958	752.00 2	765.00 2	803.00 2	860.00 3	1050.00 5	1620.00 17	2140.00 22	2530.00 24	2980.00 25	5270.00 22
1959	1390.00 31	1400.00 30	1430.00 30	1500.00 30	1580.00 26	1690.00 20	1910.00 17	2060.00 17	2570.00 19	4730.00 20
1960	1220.00 25	1280.00 26	1380.00 29	1440.00 28	1810.00 31	2310.00 34	2590.00 30	2880.00 31	3750.00 34	5500.00 27
1961	1290.00 27	1310.00 27	1330.00 26	1370.00 25	1430.00 19	1650.00 18	1910.00 18	2000.00 16	2290.00 15	5330.00 25
1962	1330.00 29	1330.00 28	1340.00 27	1350.00 24	1470.00 23	1810.00 25	2300.00 26	3480.00 37	4120.00 36	6700.00 35
1963	1040.00 15	1060.00 15	1130.00 16	1210.00 16	1370.00 18	1570.00 15	1650.00 13	1650.00 8	1820.00 7	4540.00 17
1964	940.00 10	961.00 10	1050.00 12	1100.00 12	1280.00 15	1680.00 19	2530.00 29	2810.00 28	2900.00 24	5650.00 28
1965	2150.00 41	2250.00 41	2400.00 41	2770.00 42	3220.00 43	4120.00 43	5770.00 43	6510.00 43	6750.00 43	9120.00 43
1966	1510.00 32	1550.00 33	1640.00 34	1690.00 33	1990.00 35	2260.00 31	2820.00 34	2760.00 27	3010.00 26	5820.00 29
1967	1080.00 18	1110.00 18	1140.00 17	1280.00 21	1310.00 17	1430.00 11	1640.00 12	1800.00 12	2080.00 9	3990.00 9
1968	1020.00 14	1030.00 14	1060.00 14	1110.00 13	1590.00 27	1720.00 22	1930.00 19	2090.00 20	2130.00 10	3610.00 6

*LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

TABLE 2.5A-3
CHOCTAWHATCHEE RIVER AT CARYVILLE, FLA.
PROCESS DATE 07/01/75, DISTRICT CODE 12, 02365500

WATER QUALITY DATA

DATE	DIS-SOLVED SOLIDS (TONS PER AC-FT) (70303)	TOTAL ORTHO PHOS-PHORUS (P) (MG/L) (70507)	TOTAL NITRO-GEN (NO3) (MG/L) (71887)	TOTAL MERCURY (HG) (UG/L) (71900)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE MSL) (72000)
MAR., 1973					
05...	--	--	--	--	39
JUNE					
22...	.06	.03	--	--	39
22...	--	--	--	--	39
SEP.					
25...	.09	.01	--	--	39
25...	--	--	--	--	39
OCT.					
23...	--	.01	--	--	39
DEC.					
10...	--	.02	--	--	39
FEB., 1974					
08...	--	.08	2.2	--	39
APR.					
11...	--	.04	--	--	39
11...	--	--	--	--	39
MAY					
14...	.06	.04	--	.0	39
JULY					
23...	--	.03	2.3	--	39
23...	--	--	--	--	39
SEP.					
11...	--	.04	2.3	--	39
11...	--	--	--	--	39
OCT.					
23...	.07	.04	1.8	.0	39
NOV.					
11...	--	.03	1.6	--	39
DEC.					
17...	--	.02	2.5	--	39
MAR., 1975					
11...	--	.03	2.6	--	39
MAY					
08...	.07	.02	2.7	.1	39

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	TOTAL LEAD (PB) (UG/L) (01051)	SUS-PENDED MAN-GANESE (MN) (UG/L) (01054)	TOTAL MAN-GANESE (MN) (UG/L) (01055)	DIS-SOLVED MAN-GANESE (MN) (UG/L) (01056)	TOTAL NICKEL (NI) (UG/L) (01067)	DIS-SOLVED STRON-TIUM (SR) (UG/L) (01080)	DIS-SOLVED ZINC (ZN) (UG/L) (01090)	TOTAL ALUM-INUM (AL) (UG/L) (01105)	SUS-PENDED SOLIDS (MG/L) (70299)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L) (70300)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L) (70301)	DIS-SOLVED SOLIDS (TONS PER DAY) (70302)
MAR., 1973												
05...	--	--	--	--	--	--	--	--	--	--	--	--
JUNE												
22...	--	--	--	50	--	0	0	540	10	47	34	1020
22...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
25...	--	--	--	60	--	100	0	220	8	65	53	333
25...	--	--	--	--	--	--	--	--	--	--	--	--
OCT.												
23...	--	--	--	--	--	--	--	--	--	--	--	--
DEC.												
10...	--	--	--	--	--	--	--	--	--	--	--	--
FEB., 1974												
08...	--	--	--	--	--	--	--	--	--	--	--	--
APR.												
11...	--	--	--	--	--	--	--	--	--	--	--	--
11...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
14...	3	70	120	50	5	70	10	1200	34	47	39	481
JULY												
23...	--	--	--	--	--	--	--	--	--	--	--	--
23...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
11...	--	--	--	--	--	--	--	--	--	--	--	--
11...	--	--	--	--	--	--	--	--	--	--	--	--
OCT.												
23...	3	43	60	17	0	60	0	150	16	53	51	216
NOV.												
11...	--	--	--	--	--	--	--	--	--	--	--	--
DEC.												
17...	--	--	--	--	--	--	--	--	--	--	--	--
MAR., 1975												
11...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
08...	0	90	120	30	3	70	4	550	25	50	40	809

2

WATER QUALITY DATA

DATE	DIS-SOLVED PO-TAS-SIUM (K) (MG/L) (00935)	DIS-SOLVED CHLO-RIDE (CL) (MG/L) (00940)	DIS-SOLVED SULFATE (SO4) (MG/L) (00945)	DIS-SOLVED FLUO-RIDE (F) (MG/L) (00950)	DIS-SOLVED SILICA (SIO2) (MG/L) (00955)	TOTAL ARSENIC (AS) (UG/L) (01002)	TOTAL CAD-MIUM (CD) (UG/L) (01027)	DIS-SOLVED COPPER (CU) (UG/L) (01040)	TOTAL IRON (FE) (UG/L) (01045)	DIS-SOLVED IRON (FE) (UG/L) (01046)	DIS-SOLVED LEAD (PB) (UG/L) (01049)	SUS-PENDED LEAD (PB) (UG/L) (01050)
MAR., 1973												
05...	--	--	--	--	--	--	--	--	--	--	--	--
JUNE												
22...	.8	4.0	.4	.2	6.0	5	0	3	2400	90	3	--
22...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
25...	1.1	5.5	.0	.4	7.3	5	0	3	1400	0	0	--
25...	--	--	--	--	--	--	--	--	--	--	--	--
OCT.												
23...	--	--	--	--	6.8	--	--	--	--	--	--	--
DEC.												
10...	--	--	--	--	--	--	--	--	--	--	--	--
FEB., 1974												
08...	--	--	--	--	--	--	--	--	--	--	--	--
APR.												
11...	--	--	--	--	--	--	--	--	--	--	--	--
11...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
14...	.9	4.1	2.0	.1	6.3	0	1	3	2200	190	0	3
JULY												
23...	--	--	--	--	--	--	--	--	--	--	--	--
23...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
11...	--	--	--	--	--	--	--	--	--	--	--	--
11...	--	--	--	--	--	--	--	--	--	--	--	--
OCT.												
23...	1.1	4.0	2.3	.1	7.5	0	0	1	1100	80	1	2
NOV.												
11...	--	--	--	--	--	--	--	--	--	--	--	--
DEC.												
17...	--	--	--	--	--	--	--	--	--	--	--	--
MAR., 1975												
11...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
08...	.7	3.4	2.6	.1	6.4	[illegible]	1	1	2700	500	0	0

2

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	TOTAL NITRITE PLUS NITRATE (N) (MG/L) (00630)	TOTAL PHOS-PHORUS (P) (MG/L) (00665)	TOTAL ORGANIC CARBON (C) (MG/L) (00680)	TOTAL IN-ORGANIC CARBON (C) (MG/L) (00685)	TOTAL CARBON (C) (MG/L) (00690)	HARD-NESS (CA,MG) (MG/L) (00900)	NON-CAR-BONATE HARD-NESS (MG/L) (00902)	DIS-SOLVED CAL-CIUM (CA) (MG/L) (00915)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L) (00925)	DIS-SOLVED SODIUM (NA) (MG/L) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)
MAR.. 1973												
05...	--	--	--	--	--	--	--	--	--	--	--	--
JUNE												
22...	--	.03	4.0	5.5	9.5	24	5	7.6	1.1	2.6	.2	19
22...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
25...	--	.05	2.5	8.5	11	38	4	13	1.4	3.3	.2	15
25...	--	--	--	--	--	--	--	--	--	--	--	--
OCT.												
23...	--	.02	3.0	9.0	12	--	--	--	--	--	--	--
DEC.												
10...	--	.05	5.5	4.5	10	--	--	--	--	--	--	--
FEB.. 1974												
08...	.16	.08	8.0	4.0	12	--	--	--	--	--	--	--
APR.												
11...	--	.06	9.0	2.0	11	--	--	--	2.0	--	--	--
11...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
14...	--	.06	5.0	5.0	10	25	2	8.1	1.1	2.7	.2	19
JULY												
23...	.28	.08	3.0	7.0	10	--	--	--	--	--	--	--
23...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
11...	.20	.06	8.0	4.0	12	--	--	--	--	--	--	--
11...	--	--	--	--	--	--	--	--	--	--	--	--
OCT.												
23...	.22	.04	1.0	8.0	9.0	36	2	12	1.4	2.6	.2	13
NOV.												
11...	.18	.03	4.0	8.0	12	--	--	--	--	--	--	--
DEC.												
17...	.22	.04	3.0	4.0	7.0	--	--	--	--	--	--	--
MAR.. 1975												
11...	.17	[illegible]	4.0	4.0	8.0	--	--	--	--	--	--	--
MAY												
08...	.27	[illegible]	4.0	7.0	11	23	0	7.7	.9	2.4	.2	18

2

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	BIO-CHEM-ICAL OXYGEN DEMAND 5 DAY (MG/L) (00310)	PH (UNITS) (00400)	CARBON DIOXIDE (CO2) (MG/L) (00405)	ALKA-LINITY AS CACO3 (MG/L) (00410)	BICAR-BONATE (HCO3) (MG/L) (00440)	CAR-BONATE (CO3) (MG/L) (00445)	TOTAL NITRO-GEN (N) (MG/L) (00600)	TOTAL ORGANIC NITRO-GEN (N) (MG/L) (00605)	AMMONIA NITRO-GEN (N) (MG/L) (00610)	TOTAL NITRITE (N) (MG/L) (00615)	TOTAL NITRATE (N) (MG/L) (00620)	TOTAL KJEL-DAHL NITRO-GEN (N) (MG/L) (00625)
MAR., 1973												
05...	--	5.9	--	--	--	--	--	--	--	--	--	--
JUNE												
22...	1.9	7.0	3.7	19	23	0	--	.38	.04	.01	.20	--
22...	--	7.0	--	--	--	--	--	--	--	--	--	--
SEP.												
25...	.2	7.1	5.3	34	42	0	--	.68	.03	.00	.25	--
25...	--	--	--	--	--	--	--	--	--	--	--	--
OCT.												
23...	.0	7.2	4.2	35	42	0	--	.03	.04	.01	.01	--
DEC.												
10...	.5	6.2	22	18	22	0	--	.42	.03	.01	.13	--
FEB., 1974												
08...	1.8	6.6	6.4	13	16	0	.49	.20	.13	.01	.15	.33
APR.												
11...	1.0	6.0	22	11	14	0	.98	.77	.06	.01	.14	--
11...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
14...	.3	7.2	2.8	23	28	--	.34	.22	.04	.02	.06	--
JULY												
23...	.8	7.4	2.4	31	38	0	.51	.20	.03	.02	.26	.23
23...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
11...	.4	6.7	6.7	17	21	0	.51	.28	.03	.02	.18	.31
11...	--	--	--	--	--	--	--	--	--	--	--	--
OCT.												
23...	.1	7.2	4.1	34	41	--	.40	.15	.03	.01	.21	.18
NOV.												
11...	.5	7.4	2.9	37	45	0	.37	.17	.02	.01	.17	.19
DEC.												
17...	2.5	7.2	2.1	17	21	0	.56	.30	.04	.02	.20	.34
MAR., 1975												
11...	.1	7.0	3.5	18	22	0	.58	.38	.03	.02	.15	.41
MAY												
08...	1.2	7.0	5.0	25	31	0	.60	.30	.03	.02	.25	.33

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	TIME	TYPE	DEPTH (FT) (00003)	TEMPER-ATURE (DEG C) (00010)	SURFACE AREA (SQUARE MILES) (00049)	INSTAN-TANEOUS DIS-CHARGE (CFS) (00061)	STAGE (FT ABOVE DATUM) (00065)	TUR-BID-ITY (JTU) (00070)	COLOR (PLAT-INUM-COBALT UNITS) (00080)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS) (00095)	DIS-SOLVED OXYGEN (MG/L) (00300)	PER-CENT SATUR-ATION (00301)
MAR., 1973												
05...	1440	3	--	17.5	3499	6230	8.07	--	--	65	8.3	--
JUNE												
22...	1300	2	--	26.0	3499	8000	8.81	35	110	78	6.2	--
22...	1300	3	--	26.0	3499	8000	8.81	--	--	--	6.2	--
SEP.												
25...	1100	2	--	25.5	3499	1900	3.49	20	45	92	5.2	--
25...	1100	3	--	25.5	3499	1900	3.49	--	--	--	5.2	--
OCT.												
23...	1150	2	5.0	20.5	3499	1520	2.52	10	--	98	7.4	--
DEC.												
10...	1130	2	5.0	10.5	3499	3760	6.31	20	--	66	9.5	--
FEB., 1974												
08...	1130	2	5.0	15.0	3499	10500	10.29	61	--	42	6.2	61
APR.												
11...	1345	2	5.0	17.0	3499	16100	11.80	44	--	42	7.2	73
11...	1350	2	--	17.0	3499	--	--	--	--	--	--	--
MAY												
14...	1140	2	--	23.0	3499	3790	6.33	32	50	74	7.4	--
JULY												
23...	1230	2	15	29.0	3499	1580	2.66	18	--	100	6.4	82
23...	1255	2	--	29.0	3499	--	--	--	--	--	--	--
SEP.												
11...	1615	2	10	26.0	3499	3850	6.51	26	--	71	6.9	84
11...	1645	2	--	26.0	3499	--	--	--	--	--	--	--
OCT.												
23...	1325	2	--	16.5	3499	1510	2.54	12	20	84	8.8	--
NOV.												
11...	1530	2	--	15.0	3499	1290	2.08	8	--	145	8.8	86
DEC.												
17...	1400	2	--	10.0	3499	3760	6.30	29	--	46	10.6	93
MAR., 1975												
11...	1110	2	--	13.5	3499	6090	8.24	20	110	51	9.0	85
MAY												
08...	1130	2	--	20.5	3499	5990	8.18	25	65	63	7.3	80

2

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	DIS_ SOLVED AMMONIA (NH4) (MG/L) (71846)	DIS_ SOLVED NITRATE (NO3) (MG/L) (71851)	DIS_ SOLVED NITRITE (NO2) (MG/L) (71856)	TOTAL PHOS- PHORUS (PO4) (MG/L) (71886)	TOTAL MERCURY (HG) (UG/L) (71900)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE MSL) (72000)
MAR., 1971						
03...	.05	.20	.04	--	--	--
MAY						
20...	.06	.70	.05	.17	.0	--
20...	--	--	--	--	--	--
JUNE						
22...	--	1.0	.04	.10	--	--
AUG.						
18...	.08	.80	.03	.09	--	--
18...	--	--	--	--	--	--
SEP.						
27...	.06	.90	.03	.12	.0	--
27...	--	--	--	--	--	--
DEC.						
17...	.07	.60	.03	.10	--	--
17...	--	--	--	--	--	--
JAN., 1972						
31...	.06	--	--	--	--	--
31...	--	--	--	--	--	--
MAR.						
28...	--	--	--	--	--	--
28...	--	--	--	--	--	--
APR.						
26...	--	--	--	--	.0	--
26...	--	--	--	--	--	--
MAY						
22...	--	--	--	--	--	--
22...	--	--	--	--	--	--
JULY						
17...	--	--	--	--	--	--
17...	--	--	--	--	--	--
SEP.						
13...	--	--	--	--	.0	--
13...	--	--	--	--	--	--
NOV.						
13...	--	--	--	--	--	39
13...	--	--	--	--	--	39
JAN., 1973						
08...	--	--	--	--	--	39
08...	--	--	--	--	--	39
MAR.						
05...	--	--	--	--	--	39

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	DIS-SOLVED MAN-GANESE (MN) (UG/L) (01056)	DIS-SOLVED STRON-TIUM (SR) (UG/L) (01080)	DIS-SOLVED ZINC (ZN) (UG/L) (01090)	TOTAL ZINC (ZN) (UG/L) (01092)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L) (70300)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L) (70301)	DIS-SOLVED SOLIDS (TONS PER DAY) (70302)	DIS-SOLVED SOLIDS (TONS PER AC-FT) (70303)	TOTAL ORTHO PHOS-PHORUS (P) (MG/L) (70507)
MAR., 1971									
03...	--	--	--	--	50	26	2090	.07	--
MAY									
20...	30	20	60	--	36	28	1630	.05	--
20...	--	--	--	--	--	--	--	--	--
JUNE									
22...	--	--	--	--	70	43	675	.10	--
AUG.									
18...	--	--	--	--	112	42	1180	.15	--
18...	--	--	--	--	--	--	--	--	--
SEP.									
27...	40	80	30	--	52	46	395	.07	--
27...	--	--		--	--	--	--	--	--
DEC.									
17...	--	60	--	--	48	42	559	.07	.02
17...	--	--	--	--	--	--	--	--	--
JAN., 1972									
31...	--	--	--	--	43	34	678	.06	.01
31...	--	--	--	--	--	--	--	--	--
MAR.									
28...	--	60	--	--	70	38	862	.10	--
28...	--	--	--	--	--	--	--	--	--
APR.									
26...	40	200	--	10	70	52	603	.10	.02
26...	--	--	--	--	--	--	--	--	--
MAY									
22...	--	--	--	--	--	--	--	--	.02
22...	--	--	--	--	--	--	--	--	--
JULY									
17...	--	--	--	--	--	--	--	--	.01
17...		--	--	--	--	--	--	--	--
SEP.									
13...	40	130	--	0	74	62	211	.10	.01
13...	--	--	--	--	--	--		--	--
NOV.									
13...	--	--	--	--	--	--	--	--	.02
13...	--	--	--	--	--	--	--	--	--
JAN., 1973									
08...	--	--	--	--	--	--	--	--	.02
08...	--	--	--	--	--	--	--	--	--
MAR.									
05...	--	--		--	--	--		--	.01

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	TOTAL CAD-MIUM (CD) (UG/L) (01027)	HEXA-VALENT CHRO-MIUM (CR6) (UG/L) (01032)	TOTAL CHRO-MIUM (CR) (UG/L) (01034)	DIS-SOLVED COBALT (CO) (UG/L) (01035)	TOTAL COBALT (CO) (UG/L) (01037)	DIS-SOLVED COPPER (CU) (UG/L) (01040)	TOTAL COPPER (CU) (UG/L) (01042)	TOTAL IRON (FE) (UG/L) (01045)	DIS-SOLVED IRON (FE) (UG/L) (01046)	DIS-SOLVED LEAD (PB) (UG/L) (01049)	TOTAL LEAD (PB) (UG/L) (01051)	TOTAL MAN-GANESE (MN) (UG/L) (01055)
MAR., 1971												
03...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
20...	--	0	--	1	--	0	--	--	650	8	--	--
20...	--	--	--	--	--	--	--	--	--	--	--	--
JUNE												
22...	--	--	--	--	--	--	--	--	500	--	--	--
AUG.												
18...	--	--	--	--	--	--	--	--	--	--	--	--
18...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
27...	--	0	--	1	--	0	--	--	170	1	--	--
27...	--	--	--	--	--	--	--	--	--	--	--	--
DEC.												
17...	--	--	--	--	--	--	--	--	--	--	--	--
17...	--	--	--	--	--	--	--	--	--	--	--	--
JAN., 1972												
31...	--	--	--	--	--	--	--	--	--	--	--	--
31...	--	--	--	--	--	--	--	--	--	--	--	--
MAR.												
28...	--	--	--	--	--	--	--	--	--	--	--	--
28...	--	--	--	--	--	--	--	--	--	--	--	--
APR.												
26...	0	--	--	--	1	--	0	2000	80	3	5	100
26...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
22...	--	--	--	--	--	--	--	--	--	--	--	--
22...	--	--	--	--	--	--	--	--	--	--	--	--
JULY												
17...	--	--	--	--	--	--	--	--	--	--	--	--
17...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
13...	0	--	0	--	0	--	0	750	300	1	2	80
13...	--	--	--	--	--	--	--	--	--	--	--	--
NOV.												
13...	--	--	--	--	--	--	--	--	--	--	--	--
13...	--	--	--	--	--	--	--	--	--	--	--	--
JAN., 1973												
08...	--	--	--	--	--	--	--	--	--	--	--	--
08...	--	--	--	--	--	--	--	--	--	--	-	--
MAR.												
05...	--	--		-	--	--	--	--	--	--		--

2

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	DIS-SOLVED MAGNE-SIUM (MG) (MG/L) (00925)	DIS-SOLVED SODIUM (NA) (MG/L) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L) (00935)	DIS-SOLVED CHLO-RIDE (CL) (MG/L) (00940)	DIS-SOLVED SULFATE (SO4) (MG/L) (00945)	DIS-SOLVED FLUO-RIDE (F) (MG/L) (00950)	DIS-SOLVED SILICA (SIO2) (MG/L) (00955)	DIS-SOLVED ARSENIC (AS) (UG/L) (01000)	TOTAL ARSENIC (AS) (UG/L) (01002)	DIS-SOLVED CAD-MIUM (CD) (UG/L) (01025)
MAR., 1971												
03...	.7	2.0	.2	19	.9	3.5	.3	.1	5.0	--	--	--
MAY												
20...	.9	1.9	.2	18	.8	2.8	1.2	.2	5.4	0	--	1
20...	--	--	--	--	--	--	--	--	--	--	--	--
JUNE												
22...	1.2	2.4	.2	14	.9	3.5	2.0	.2	6.8	--	--	--
AUG.												
18...	1.4	2.3	.2	14	1.0	3.2	.8	.1	7.2	--	--	--
18...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
27...	1.5	2.6	.2	15	1.1	3.5	.6	.1	7.8	0	--	0
27...	--	--	--	--	--	--	--	--	--	--	--	--
DEC.												
17...	1.2	2.8	.2	19	1.1	5.0	1.2	.1	8.0	--	--	--
17...	--	--	--	--	--	--	--	--	--	--	--	--
JAN., 1972												
31...	1.0	2.7	.3	22	.8	4.0	.0	.2	7.0	--	--	--
31...	--	--	--	--	--	--	--	--	--	--	--	--
MAR.												
28...	1.2	3.0	.3	19	.8	3.5	.8	.1	5.4	--	--	--
28...	--	--	--	--	--	--	--	--	--	--	--	--
APR.												
26...	1.3	3.0	.2	17	.9	3.0	11	.2	6.2	--	0	--
26...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
22...	--	--	--	--	--	--	--	--	--	--	--	--
22...	--	--	--	--	--	--	--	--	--	--	--	--
JULY												
17...	--	--	--	--	--	--	--	--	6.6	--	--	--
17...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
13...	1.9	3.5	.2	14	.9	6.0	2.4	.1	6.9	--	10	--
13...	--	--	--	--	--	--	--	--	--	--	--	--
NOV.												
13...	--	--	--	--	--	--	--	--	7.4	--	--	--
13...	--	--	--	--	--	--	--	--	--	--	--	--
JAN., 1973												
08...	--	--	--	--	--	--	--	--	5.6	--	--	--
08...	--	--	--	--	--	--	--	--	--	--	--	--
MAR.												
05...	--	--	--	--	--	--	--	--	4.8	--	--	--

2

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	TOTAL NITRITE (N) (MG/L) (00615)	DIS-SOLVED NITRATE (N) (MG/L) (00618)	TOTAL NITRATE (N) (MG/L) (00620)	PHOS-PHATE (PO4) (MG/L) (00650)	DIS-SOLVED ORTHO PHOS-PHATE (PO4) (MG/L) (00660)	TOTAL PHOS-PHORUS (P) (MG/L) (00665)	TOTAL ORGANIC CARBON (C) (MG/L) (00680)	TOTAL IN-ORGANIC CARBON (C) (MG/L) (00685)	TOTAL CARBON (C) (MG/L) (00690)	HARD-NESS (CA,MG) (MG/L) (00900)	NON-CAR-BONATE HARD-NESS (MG/L) (00902)	DIS-SOLVED CAL-CIUM (CA) (MG/L) (00915)
MAR., 1971												
03...	--	--	--	.13	.08	--	--	--	--	17	4	5.6
MAY												
20...	--	--	--	--	.08	--	7.0	--	--	18	5	5.6
20...	--	--	--	--	--	--	--	--	--	--	--	--
JUNE												
22...	--	--	--	--	.07	--	--	--	--	30	6	10
AUG.												
18...	--	--	--	--	--	--	6.0	--	--	30	4	9.5
18...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
27...	--	--	--	--	.05	--	2.0	--	--	30	0	9.4
27...	--	--	--	--	--	--	--	--	--	--	--	--
DEC.												
17...	.00	.10	.10	--	.07	.03	4.0	--	--	25	2	8.1
17...	--	--	--	--	--	--	--	--	--	--	--	--
JAN., 1972												
31...	.00	.20	.20	--	--	.02	2.0	--	--	20	2	6.3
31...	--	--	--	--	--	--	--	--	--	--	--	--
MAR.												
28...	.00	.27	.30	--	--	--	--	--	--	27	4	8.8
28...	--	--	--	--	--	--	--	--	--	--	--	--
APR.												
26...	.00	.26	.30	--	--	.03	3.0	7.0	10	30	4	10
26...	--	--	--	--	--	--	--	--	--	--	--	--
MAY												
22...	.00	--	.24	--	--	.02	3.0	--	--	--	--	--
22...	--	--	--	--	--	--	--	--	--	--	--	--
JULY												
17...	.00	.31	.30	--	--	.01	5.5	3.5	9.0	--	--	--
17...	--	--	--	--	--	--	--	--	--	--	--	--
SEP.												
13...	.00	.25	.30	--	--	.02	3.0	12	15	46	4	15
13...	--	--	--	--	--	--	--	--	--	--	--	--
NOV.												
13...	.00	--	.20	--	--	.02	5.0	9.0	14	--	--	--
13...	--	--	--	--	--	--	--	--	--	--	--	--
JAN., 1973												
08...	.00	--	.03	--	--	.02	6.0	4.0	10	--	--	--
08...	--	--	--	--	--	--	--	--	--	--	--	--
MAR.												
05...	.00	--	.10	--	--	.01	7.0	7.0	14	--	--	--

2

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	PER-CENT SATUR-ATION (00301)	BIO-CHEM-ICAL OXYGEN DEMAND 5 DAY (MG/L) (00310)	PH (UNITS) (00400)	CARBON DIOXIDE (CO2) (MG/L) (00405)	ALKA-LINITY AS CACO3 (MG/L) (00410)	BICAR-BONATE (HCO3) (MG/L) (00440)	CAR-BONATE (CO3) (MG/L) (00445)	TOTAL ORGANIC NITRO-GEN (N) (MG/L) (00605)	DIS-SOLVED ORGANIC NITRO-GEN (N) (MG/L) (00607)	DIS-SOLVED AMMONIA NITRO-GEN (N) (MG/L) (00608)	AMMONIA NITRO-GEN (N) (MG/L) (00610)	DIS-SOLVED NITRITE (N) (MG/L) (00613)
MAR., 1971												
03...	--	--	6.6	--	13	16	0	.07	--	--	--	--
MAY												
20...	77	--	6.3	--	13	16	0	.33	--	--	--	--
20...	77	--	6.2	--	--	--	--	--	--	--	--	--
JUNE												
22...	--	--	6.8	--	25	30	0	--	--	--	--	--
AUG.												
18...	78	1.0	6.9	--	26	32	--	.85	--	--	--	--
18...	78	--	7.0	--	--	--	--	--	--	--	--	--
SEP.												
27...	80	.7	6.5	--	30	3	0	.68	--	.05	--	--
27...	80	--	7.3	--	--	--	--	--	--	--	--	--
DEC.												
17...	73	--	6.6	--	23	28	0	.26	--	.05	.05	.00
17...	73	--	7.1	--	--	--	--	--	--	--	--	--
JAN., 1972												
31...	81	.8	6.6	--	18	22	--	.85	.00	.05	.05	.00
31...	81	--	6.9	--	--	--	--	--	--	--	--	--
MAR.												
28...	--	--	7.1	--	23	28	0	--	--	--	--	.00
28...	--	--	--	--	--	--	--	--	--	--	--	--
APR.												
26...	93	.5	7.3	--	26	32	0	.66	--	.08	.08	.00
26...	90	--	6.6	--	--	--	--	--	--	--	--	--
MAY												
22...	77	.7	7.4	2.3	30	36	0	.26	--	--	.02	--
22...	77	--	6.7	--	--	--	--	--	--	--	--	--
JULY												
17...	71	.2	--	--	--	--	--	.32	--	.04	.04	.00
17...	71	--	7.1	--	--	--	--	--	--	--	--	--
SEP.												
13...	81	1.1	7.6	--	42	51	0	.50	--	.03	.03	.00
13...	81	--	7.6	--	--	--	--	--	--	--	--	--
NOV.												
13...	--	.4	--	--	--	--	--	.40	--	--	.03	--
13...	--	--	7.2	--	--	--	--	--	--	--	--	--
JAN., 1973												
08...	--	2.1	--	--	--	--	--	.41	--	--	.01	--
08...	--	--	6.8	--	--	--	--	--	--	--	--	--
MAR.												
05...	--	.8	--	--	--	--	--	.49	--	--	.03	--

2

2

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	TIME	TYPE	DEPTH (FT) (00003)	TEMPER-ATURE (DEG C) (00010)	SURFACE AREA (SQUARE MILES) (00049)	DIS-CHARGE (CFS) (00060)	INSTAN-TANEOUS DIS-CHARGE (CFS) (00061)	STAGE (FT ABOVE DATUM) (00065)	TUR-BID-ITY (JTU) (00070)	COLOR (PLAT-INUM-COBALT UNITS) (00080)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS) (00095)	DIS-SOLVED OXYGEN (MG/L) (00300)
MAR., 1971												
03...	1440	2	--	15.0	--	15500	--	11.82	40	80	46	--
MAY												
20...	0805	2	--	20.5	--	16800	--	11.57	40	30	43	7.0
20...	0805	3	--	20.5	--	16800	--	11.57	--	--	43	7.0
JUNE												
22...	1130	2	--	27.0	--	3570	--	6.05	--	45	75	--
AUG.												
18...	1300	2	--	26.0	--	3900	--	6.36	2	200	82	6.4
18...	1300	3	--	26.0	--	3900	--	6.36	--	--	76	6.4
SEP.												
27...	0905	2	--	25.0	--	2810	--	4.67	15	55	80	6.7
27...	0905	3	--	25.0	--	2810	--	4.67	--	--	77	6.7
DEC.												
17...	1250	2	--	20.0	--	4310	--	6.61	15	40	67	6.7
17...	1250	3	--	20.0	--	4310	--	6.61	--	--	64	6.7
JAN., 1972												
31...	1515	2	--	15.5	--	5840	--	7.78	25	50	55	8.2
31...	1515	3	--	15.5	--	5840	--	7.78	--	--	47	8.2
MAR.												
28...	1045	2	--	18.5	--	4560	--	6.77	--	30	69	--
28...	1045	3	--	18.5	--	4560	--	6.77	--	--	--	--
APR.												
26...	0910	2	--	21.0	--	3190	--	5.64	20	60	77	8.4
26...	0910	3	--	21.0	--	3190	--	5.64	--	--	67	8.4
MAY												
22...	1100	2	--	23.0	--	2690	--	4.91	15	60	82	6.7
22...	1100	3	1.0	23.0	--	2690	--	4.91	--	--	82	6.7
JULY												
17...	1310	2	--	27.5	--	1865	--	3.05	15	--	--	5.7
17...	1310	3	--	27.5	--	1865	--	3.05	--	--	101	5.7
SEP.												
13...	1100	2	--	25.0	--	1056	--	.99	9	20	110	6.8
13...	1100	3	--	25.0	--	1056	--	.99	--	--	105	6.8
NOV.												
13...	1415	2	--	18.0	3499	--	1270	1.73	0	--	--	7.5
13...	1415	3	--	18.0	3499	--	1270	1.73	--	--	65	7.5
JAN., 1973												
08...	1600	2	--	11.0	3499	--	13300	10.93	15	--	--	8.1
08...	1600	3	--	11.0	3499	--	13300	10.93	--	--	--	8.1
MAR.												
05...	1440	2	--	17.5	3499	--	6230	8.07	2	--	--	8.3

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TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L) (70300)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L) (70301)	DIS-SOLVED SOLIDS (TONS PER DAY) (70302)	DIS-SOLVED SOLIDS (TONS PER AC-FT) (70303)	TOTAL AMMONIA (NH4) (MG/L) (71845)	DIS_SOLVED AMMONIA (NH4) (MG/L) (71846)	TOTAL NITRATE (NO3) (MG/L) (71850)	DIS_SOLVED NITRATE (NO3) (MG/L) (71851)	TOTAL NITRITE (NO2) (MG/L) (71855)	DIS_SOLVED NITRITE (NO2) (MG/L) (71856)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE MSL) (72000)
OCT., 1969											
31...	--	--	--	--	--	--	--	.90	--	.01	--
NOV.											
29...	--	--	--	--	--	--	--	.80	--	.03	--
DEC.											
03...	60	--	--	.08	--	--	--	.30	--	--	--
03...	--	--	--	--	--	--	--	--	--	--	--
10...	47	41	419	.06	--	--	--	.00	--	.01	--
31...	--	--	--	--	--	--	--	.90	--	.04	--
JAN., 1970											
31...	--	--	--	--	--	--	--	1.2	--	.03	39
FEB.											
04...	49	30	--	.07	--	--	--	.50	--	--	39
04...	--	--	--	--	--	--	--	--	--	--	--
04...	41	29	1090	.06	--	--	--	.80	--	.02	--
28...	--	--	--	--	--	--	--	.50	--	.03	39
MAR.											
30...	41	29	976	.06	--	--	--	.00	--	.00	--
31...	--	--	--	--	--	--	--	.70	--	.06	39
APR.											
02...	42	--	--	.06	--	--	--	.10	--	.02	39
02...	--	--	--	--	--	--	--	--	--	--	--
30...	--	--	--	--	--	--	--	1.2	--	.03	39
MAY											
27...	47	39	201	.06	--	.14	--	.70	--	.04	--
31...	--	--	--	--	--	--	--	1.3	--	.02	--
JUNE											
03...	80	--	--	.11	--	--	--	.80	--	.02	--
03...	--	--	--	--	--	--	--	--	--	--	--
30...	--	--	--	--	--	--	--	1.3	--	.03	39
JULY											
28...	54	--	437	.07	--	.26	--	.30	--	.01	--
28...	--	--	--	--	--	--	--	--	--	--	--
31...	--	--	--	--	--	--	--	1.0	--	.01	39
SEP.											
23...	68	52	943	.09	--	.05	--	.90	--	.03	--
DEC.											
11...	62	52	--	.08	--	.05	--	1.5	--	.03	39
JAN., 1971											
07...	50	29	1650	.07	.08	--	.30	--	.17	--	--
07...	--	--	--	--	--	--	--	--	--	--	--

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	DIS-SOLVED CHRO-MIUM (CR) (UG/L) (01030)	TOTAL CHRO-MIUM (CR) (UG/L) (01034)	DIS-SOLVED COPPER (CU) (UG/L) (01040)	DIS-SOLVED IRON (FE) (UG/L) (01046)	DIS-SOLVED LEAD (PB) (UG/L) (01049)	DIS-SOLVED MAN-GANESE (MN) (UG/L) (01056)	DIS-SOLVED STRON-TIUM (SR) (UG/L) (01080)	DIS-SOLVED ZINC (ZN) (UG/L) (01090)	TOTAL ALUM-INUM (AL) (UG/L) (01105)	DIS-SOLVED ALUM-INUM (AL) (UG/L) (01106)	IMME-DIATE COLI-FORM (COL. PER 100 ML) (31501)
OCT.. 1969											
31...	--	--	--	--	--	--	--	--	--	--	--
NOV.											
29...	--	--	--	--	--	--	--	--	--	--	--
DEC.											
03...	--	--	--	80	--	--	--	--	--	--	1700
03...	--	--	--	--	--	--	--	--	--	--	--
10...	--	--	--	--	--	--	--	--	--	--	--
31...	--	--	--	--	--	--	--	--	--	--	--
JAN.. 1970											
31...	--	--	--	--	--	--	--	--	--	--	--
FEB.											
04...	--	--	--	80	--	--	--	--	--	--	6600
04...	--	--	--	--	--	--	--	--	--	--	--
04...	--	--	--	--	--	--	--	--	--	--	--
28...	--	--	--	--	--	--	--	--	--	--	--
MAR.											
30...	--	--	--	--	--	--	--	--	--	--	--
31...	--	--	--	--	--	--	--	--	--	--	--
APR.											
02...	--	--	--	30	--	--	--	--	--	--	3500
02...	--	--	--	--	--	--	--	--	--	--	--
30...	--	--	--	--	--	--	--	--	--	--	--
MAY											
27...	0	--	10	600	10	20	110	300	100	--	--
31...	--	--	--	--	--	--	--	--	--	--	--
JUNE											
03...	--	0	10	420	10	--	--	300	--	410	1800
03...	--	--	--	--	--	--	--	--	--	--	--
30...	--	--	--	--	--	--	--	--	--	--	--
JULY											
28...	--	--	--	0	--	--	--	--	--	--	--
28...	--	--	--	--	--	--	--	--	--	--	--
31...	--	--	--	--	--	--	--	--	--	--	--
SEP.											
23...	10	10	10	90	--	80	20	80	--	--	--
DEC.											
11...	--	--	--	--	--	--	--	--	--	--	--
JAN.. 1971											
07...	--	--	--	--	--	--	--	--	--	--	--
07...	--	--	--	--	--	--	--	--	--	--	--

2

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	DIS-SOLVED CAL-CIUM (CA) (MG/L) (00915)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L) (00925)	DIS-SOLVED SODIUM (NA) (MG/L) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L) (00935)	DIS-SOLVED CHLO-RIDE (CL) (MG/L) (00940)	DIS-SOLVED SULFATE (SO4) (MG/L) (00945)	DIS-SOLVED FLUO-RIDE (F) (MG/L) (00950)	DIS-SOLVED SILICA (SIO2) (MG/L) (00955)	DIS-SOLVED ARSENIC (AS) (UG/L) (01000)
OCT., 1969											
31...	--	--	--	--	--	--	--	--	--	--	--
NOV.											
29...	--	--	--	--	--	--	--	--	--	--	--
DEC.											
03...	13	1.4	2.9	.2	14	.8	3.0	.0	.2	8.1	--
03...	--	--	--	--	--	--	--	--	--	--	--
10...	8.6	1.2	3.0	.3	19	1.0	4.5	.8	.1	5.7	--
31...	--	--	--	--	--	--	--	--	--	--	--
JAN., 1970											
31...	--	--	--	--	--	--	--	--	--	--	--
FEB.											
04...	5.6	.8	2.3	.2	21	.8	4.0	1.6	.2	5.5	--
04...	--	--	--	--	--	--	--	--	--	--	--
04...	4.8	.8	2.2	.2	23	.8	4.0	2.4	.1	5.8	--
28...	--	--	--	--	--	--	--	--	--	--	--
MAR.											
30...	5.6	.8	2.2	.2	21	.7	3.4	2.2	.1	5.0	--
31...	--	--	--	--	--	--	--	--	--	--	--
APR.											
02...	4.6	.7	1.8	.2	20	.9	3.0	9.2	.0	3.8	--
02...	--	--	--	--	--	--	--	--	--	--	--
30...	--	--	--	--	--	--	--	--	--	--	--
MAY											
27...	8.4	1.1	2.8	.2	19	1.0	4.0	.4	.1	6.2	0
31...	--	--	--	--	--	--	--	--	--	--	--
JUNE											
03...	7.5	1.1	2.5	.2	18	1.0	3.0	.8	.1	5.8	0
03...	--	--	--	--	--	--	--	--	--	--	--
30...	--	--	--	--	--	--	--	--	--	--	--
JULY											
28...	10	1.2	3.1	.2	18	.9	4.0	.0	.2	7.4	--
28...	--	--	--	--	--	--	--	--	--	--	--
31...	--	--	--	--	--	--	--	--	--	--	--
SEP.											
23...	13	1.5	3.1	.2	15	.9	3.2	1.6	.2	7.6	10
DEC.											
11...	12	1.5	2.9	.2	15	.8	4.5	1.0	.2	7.6	--
JAN., 1971											
07...	4.8	1.8	1.9	.2	16	1.4	3.5	4.0	.1	5.2	--
07...	--	--	--	--	--	--	--	--	--	--	--

2

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	PH (UNITS) (00400)	CARBON DIOXIDE (CO2) (MG/L) (00405)	ALKA-LINITY AS CACO3 (MG/L) (00410)	BICAR-BONATE (HCO3) (MG/L) (00440)	CAR-BONATE (CO3) (MG/L) (00445)	TOTAL ORGANIC NITRO-GEN (N) (MG/L) (00605)	PHOS-PHATE (PO4) (MG/L) (00650)	DIS-SOLVED ORTHO PHOS-PHATE (PO4) (MG/L) (00660)	TOTAL ORGANIC CARBON (C) (MG/L) (00680)	HARD-NESS (CA,MG) (MG/L) (00900)	NON-CAR-BONATE HARD-NESS (MG/L) (00902)
OCT., 1969											
31...	--	--	--	--	--	--	.09	.07	--	--	--
NOV.											
29...	--	--	--	--	--	--	.07	--	--	--	--
DEC.											
03...	--	--	--	--	0	--	--	--	--	37	--
03...	6.9	--	34	41	--	--	--	--	--	--	--
10...	7.3	--	26	32	--	--	--	--	--	27	1
31...	--	--	--	--	--	--	.13	.10	--	--	--
JAN., 1970											
31...	--	--	--	--	--	--	.06	.04	--	--	--
FEB.											
04...	--	--	15	--	--	--	--	--	--	18	3
04...	6.4	--	16	20	0	--	--	--	--	--	--
04...	6.6	--	12	15	--	--	--	--	--	16	3
28...	--	--	--	--	--	--	.06	.04	--	--	--
MAR.											
30...	6.8	--	15	18	--	--	--	--	--	18	3
31...	--	--	--	--	--	--	.10	.08	--	--	--
APR.											
02...	--	--	--	--	--	--	--	--	--	12	--
02...	5.9	--	8	10	0	--	--	--	--	--	--
30...	--	--	--	--	--	--	.10	.07	--	--	--
MAY											
27...	7.4	--	23	28	0	.29	.15	.11	6.0	26	3
31...	--	--	--	--	--	--	.07	.02	--	--	--
JUNE											
03...	--	--	--	--	--	--	--	--	--	24	--
03...	7.2	--	22	27	0	--	--	--	--	--	--
30...	--	--	--	--	--	--	.10	.06	--	--	--
JULY											
28...	--	--	--	--	--	.13	.14	.08	--	--	--
28...	7.5	--	--	--	--	--	--	--	--	--	--
31...	--	--	--	--	--	--	.08	.04	--	--	--
SEP.											
23...	6.9	--	33	40	0	.12	.23	.23	--	39	6
DEC.											
11...	7.0	--	33	40	0	.10	.08	.08	--	36	3
JAN., 1971											
07...	7.0	1.8	9	11	0	.33	.23	.23	12	15	6
07...	5.7	--	--	--	--	--	--	--	--	--	--

2

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	TIME	TYPE	TEMPERATURE (DEG C) (00010)	SURFACE AREA (SQUARE MILES) (00049)	DISCHARGE (CFS) (00060)	STAGE (FT ABOVE DATUM) (00065)	TURBIDITY (JTU) (00070)	COLOR (PLATINUM-COBALT UNITS) (00080)	SPECIFIC CONDUCTANCE (MICROMHOS) (00095)	DISSOLVED OXYGEN (MG/L) (00300)	PERCENT SATURATION (00301)	BIOCHEMICAL OXYGEN DEMAND 5 DAY (MG/L) (00310)
OCT., 1969												
31...	0645	2	--	--	--	--	--	--	--	--	--	--
NOV.												
29...	0730	2	--	--	--	--	--	--	--	--	--	--
DEC.												
03...	0930	2	10.0	--	1840	2.65	--	10	--	8.8	78	.4
03...	0930	3	10.0	--	1840	2.65	--	--	50	8.8	78	--
10...	1225	2	10.0	--	3300	5.38	--	5	72	--	--	--
31...	0730	2	--	--	--	--	--	--	--	--	--	--
JAN., 1970												
31...	0730	2	--	3499	5070	--	--	--	--	--	--	--
FEB.												
04...	1100	2	8.0	3499	9390	9.41	--	90	--	9.7	82	.2
04...	1100	3	8.0	--	--	9.41	--	--	30	9.7	82	--
04...	1410	2	7.8	--	9880	9.49	--	40	45	9.7	81	--
28...	0700	2	--	3499	7500	--	--	--	--	--	--	--
MAR.												
30...	1140	2	16.5	--	8820	9.30	--	20	47	7.2	73	--
31...	0645	2	--	3499	10700	--	--	--	--	--	--	--
APR.												
02...	1130	2	17.5	3499	19900	11.99	--	35	--	5.0	52	1.5
02...	1130	3	17.5	--	--	11.99	--	--	33	5.0	5	--
30...	0630	2	--	3499	3450	--	--	--	--	--	--	--
MAY												
27...	1440	2	26.0	--	1580	1.96	28	0	104	--	--	--
31...	0630	2	--	--	--	--	--	--	--	--	--	--
JUNE												
03...	0845	2	23.5	--	5000	7.30	--	35	--	6.5	76	1.5
03...	0845	3	23.5	--	5000	7.30	--	--	64	6.5	76	--
30...	0630	2	--	3499	3960	--	--	--	--	--	--	--
JULY												
28...	1045	2	28.0	--	3000	4.96	--	--	77	6.7	85	--
28...	1045	3	28.0	--	3000	4.96	--	--	86	6.7	85	--
31...	0730	2	--	3499	2360	--	--	--	--	--	--	--
SEP.												
23...	0925	2	27.0	--	1870	3.04	21	20	94	5.7	70	1.0
DEC.												
11...	0940	2	14.0	3499	2070	3.67	15	0	85	--	--	--
JAN., 1971												
07...	1600	2	10.5	--	12200	10.48	90	120	42	8.5	76	1.3
07...	1600	3	10.5	--	--	--	--	--	29	8.5	76	--

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TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	DIS-SOLVED IRON (FE) (UG/L) (01046)	IMME-DIATE COLI-FORM (COL. PER 100 ML) (31501)	DELAYED COLI-FORM (COL-ONIES PER 100 ML) (31503)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L) (70300)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L) (70301)	DIS-SOLVED SOLIDS (TONS PER DAY) (70302)	DIS-SOLVED SOLIDS (TONS PER AC-FT) (70303)	DIS_SOLVED NITRATE (NO3) (MG/L) (71851)	DIS_SOLVED NITRITE (NO2) (MG/L) (71856)
JULY, 1968									
31...	--	--	--	--	--	--	--	--	--
AUG.									
31...	--	--	--	--	--	--	--	.70	.01
SEP.									
30...	--	--	--	--	--	--	--	--	--
OCT.									
31...	--	--	--	--	--	--	--	.60	.01
NOV.									
20...	0	--	--	55	44	420	.07	.50	--
30...	--	--	--	--	--	--	--	1.0	.01
DEC.									
31...	--	--	--	--	--	--	--	.80	.63
JAN., 1969									
15...	0	--	--	60	48	342	.08	.40	--
31...	--	--	--	--	--	--	--	.80	.00
FEB.									
25...	--	--	--	--	--	--	--	.80	.04
MAR.									
13...	0	--	--	48	37	600	.07	.40	--
31...	--	--	--	--	--	--	--	.10	.02
APR.									
27...	--	--	--	--	--	--	--	.90	.02
MAY									
12...	0	--	--	48	45	290	.07	.20	--
31...	--	--	--	--	--	--	--	.80	.03
JUNE									
25...	--	--	--	58	55	269	.08	.00	.00
30...	--	--	--	--	--	--	--	.90	.00
JULY									
23...	150	10000	--	59	47	--	.08	.10	--
23...	--	--	--	--	--	--	--	--	--
31...	--	--	--	--	--	--	--	.30	.02
AUG.									
31...	--	--	--	--	--	--	--	--	.01
SEP.									
30...	--	--	--	--	--	--	--	.30	.02
OCT.									
01...	140	--	14000	56	45	--	.08	.70	--
01...	--	--	--	--	--	--	--	--	--
13...	--	--	--	60	50	415	.08	.90	.01

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L) (00925)	DIS-SOLVED SODIUM (NA) (MG/L) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L) (00935)	DIS-SOLVED CHLO-RIDE (CL) (MG/L) (00940)	DIS-SOLVED SULFATE (SO4) (MG/L) (00945)	DIS-SOLVED FLUO-RIDE (F) (MG/L) (00950)	DIS-SOLVED SILICA (SIO2) (MG/L) (00955)
JULY, 1968									
31...	--	--	--	--	--	--	--	--	--
AUG.									
31...	--	--	--	--	--	--	--	--	--
SEP.									
30...	--	--	--	--	--	--	--	--	--
OCT.									
31...	--	--	--	--	--	--	--	--	--
NOV.									
20...	1.2	3.8	.3	24	1.4	5.5	4.0	.1	8.2
30...	--	--	--	--	--	--	--	--	--
DEC.									
31...	--	--	--	--	--	--	--	--	--
JAN., 1969									
15...	1.4	3.7	.3	21	.7	6.0	2.4	.2	8.8
31...	--	--	--	--	--	--	--	--	--
FEB.									
25...	--	--	--	--	--	--	--	--	--
MAR.									
13...	1.0	3.1	.3	23	.6	4.2	3.2	.1	7.6
31...	--	--	--	--	--	--	--	--	--
APR.									
27...	--	--	--	--	--	--	--	--	--
MAY									
12...	1.3	2.8	.2	16	.8	3.8	2.0	.1	7.9
31...	--	--	--	--	--	--	--	--	--
JUNE									
25...	1.5	2.9	.2	14	.9	3.1	3.6	.1	7.5
30...	--	--	--	--	--	--	--	--	--
JULY									
23...	1.2	3.0	.2	17	1.1	3.5	.0	.1	8.5
23...	--	--	--	--	--	--	--	--	--
31...	--	--	--	--	--	--	--	--	--
AUG.									
31...	--	--	--	--	--	--	--	--	--
SEP.									
30...	--	--	--	--	--	--	--	--	--
OCT.									
01...	1.1	2.9	.2	18	1.3	5.0	.0	.1	9.3
01...	--	--	--	--	--	--	--	--	--
[illegible]...	1.4	3.0	.2	16	.9	4.0	1.0	.2	8.6

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TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	PH (UNITS) (00400)	ALKA-LINITY AS CACO3 (MG/L) (00410)	BICAR-BONATE (HCO3) (MG/L) (00440)	CAR-BONATE (CO3) (MG/L) (00445)	PHOS-PHATE (PO4) (MG/L) (00650)	DIS-SOLVED ORTHO PHOS-PHATE (PO4) (MG/L) (00660)	HARD-NESS (CA,MG) (MG/L) (00900)	NON-CAR-BONATE HARD-NESS (MG/L) (00902)	DIS-SOLVED CAL-CIUM (CA) (MG/L) (00915)
JULY, 1968									
31...	--	--	--	--	.05	.03	--	--	--
AUG.									
31...	--	--	--	--	.10	.03	--	--	--
SEP.									
30...	--	--	--	--	.07	--	--	--	--
OCT.									
31...	--	--	--	--	.11	.06	--	--	--
NOV.									
20...	6.7	20	24	--	--	--	24	5	7.6
30...	--	--	--	--	.08	.03	--	--	--
DEC.									
31...	--	--	--	--	.05	.01	--	--	--
JAN., 1969									
15...	7.0	25	31	--	--	--	31	5	9.8
31...	--	--	--	--	.01	.02	--	--	--
FEB.									
25...	--	--	--	--	.05	.03	--	--	--
MAR.									
13...	6.7	17	21	--	--	--	22	5	7.0
31...	--	--	--	--	.15	.05	--	--	--
APR.									
27...	--	--	--	--	.08	.03	--	--	--
MAY									
12...	6.6	26	32	0	.03	--	31	5	10
31...	--	--	--	--	.05	.03	--	--	--
JUNE									
25...	6.5	36	44	--	--	--	39	3	13
30...	--	--	--	--	.02	.00	--	--	--
JULY									
23...	--	31	--	--	.07	--	30	0	10
23...	7.3	31	38	0	--	--	--	--	--
31...	--	--	--	--	.10	.03	--	--	--
AUG.									
31...	--	--	--	--	.03	.03	--	--	--
SEP.									
30...	--	--	--	--	.12	.04	--	--	--
OCT.									
01...	--	25	--	--	--	--	28	2	9.2
01...	6.8	25	31	0	--	--	--	--	--
13...	6.9	31	38	--	--	--	34	3	11

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TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	TIME	TYPE	TEMPER-ATURE (DEG C) (00010)	DIS-CHARGE (CFS) (00060)	STAGE (FT ABOVE DATUM) (00065)	COLOR (PLAT-INUM-COBALT UNITS) (00080)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS) (00095)	DIS-SOLVED OXYGEN (MG/L) (00300)	PER-CENT SATUR-ATION (00301)	BIO-CHEM-ICAL OXYGEN DEMAND 5 DAY (MG/L) (00310)
JULY. 1968										
31...	0700	2	27.0	--	--	--	115	--	--	--
AUG.										
31...	0700	2	24.0	--	--	--	95	--	--	--
SEP.										
30...	0700	2	--	--	-.90	--	117	--	--	--
OCT.										
31...	0700	2	14.0	--	99.63	--	122	--	--	--
NOV.										
20...	1655	2	12.0	2830	4.18	10	70	--	--	--
30...	0700	2	11.0	--	1.70	--	72	--	--	--
DEC.										
31...	0645	2	11.0	--	5.40	--	57	--	--	--
JAN., 1969										
15...	1520	2	8.0	2110	3.58	10	82	--	--	--
31...	0730	2	15.0	--	355	--	83	--	--	--
FEB.										
25...	0800	2	12.0	--	6.01	--	60	--	--	--
MAR.										
13...	1540	2	11.0	4630	6.97	10	62	--	--	--
31...	0630	2	15.0	--	947	--	52	--	--	--
APR.										
27...	0630	2	18.0	--	5.75	--	77	--	--	--
MAY										
12...	1305	2	22.0	2240	4.05	15	80	--	--	--
31...	0645	2	24.0	--	5.80	--	73	--	--	--
JUNE										
25...	1240	2	33.0	1720	2.74	5	92	5.8	79	--
30...	0645	2	28.0	--	1.02	--	114	--	--	--
JULY										
23...	0715	2	27.0	--	3.79	40	--	--	--	.4
23...	0715	3	27.0	--	3.79	--	93	5.6	69	--
31...	0645	2	25.0	--	7.09	--	61	--	--	--
AUG.										
31...	0730	2	25.0	--	3.58	--	96	--	--	--
SEP.										
30...	0645	2	22.0	--	7.26	--	62	--	--	--
OCT.										
01...	0840	2	20.5	--	6.22	30	--	7.2	78	.7
01...	0840	3	20.5	--	6.22	--	72	7.2	78	--
13...	1150	2	24.0	2560	4.42	5	83	6.8	80	--

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TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	DIS-SOLVED IRON (FE) (UG/L) (01046)	DIS-SOLVED MAN-GANESE (MN) (UG/L) (01056)	DIS-SOLVED STRON-TIUM (SR) (UG/L) (01080)	DIS-SOLVED LITHIUM (LI) (UG/L) (01130)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L) (70300)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L) (70301)	DIS-SOLVED SOLIDS (TONS PER DAY) (70302)	DIS-SOLVED SOLIDS (TONS PER AC-FT) (70303)	DIS_SOLVED NITRATE (NO3) (MG/L) (71851)
OCT., 1960									
12...	0	--	--	--	55	43	--	.07	.50
DEC.									
10...	0	--	--	--	44	42	--	.06	.50
JAN., 1961									
30...	0	--	--	--	53	32	--	.07	.80
MAY									
15...	0	--	--	--	46	39	--	.06	.70
JULY									
10...	0	--	--	--	43	37	--	.06	.70
SEP.									
11...	0	--	--	--	29	25	--	.04	.30
APR., 1965									
12...	180	--	--	--	--	38	583	.05	.70
MAY., 1966									
25...	260	--	--	--	--	42	882	.06	.10
JAN., 1967									
06...	--	--	--	--	--	32	--	.04	1.7
11...	--	--	--	--	--	37	--	.05	.80
MAY									
11...	--	--	0	--	51	43	--	.07	.70
SEP.									
03-10	--	--	--	--	--	--	--	--	--
08...	--	--	--	--	49	39	--	.07	.50
10...	--	--	--	--	68	66	--	.09	1.7
11-16	--	--	--	--	--	--	--	--	--
12...	--	--	--	--	60	54	--	.08	1.6
21-30	--	--	--	--	--	--	--	--	--
OCT.									
23...	40	--	--	--	65	67	--	.09	.80
DEC.									
05...	40	--	--	--	47	40	522	.06	.40
JAN., 1968									
22...	90	--	--	--	35	37	433	.05	.90
FEB.									
26...	150	--	--	500	44	39	473	.06	.50
APR.									
08...	170	--	--	--	48	47	363	.07	.30
JUNE									
04...	20	0	0	--	52	53	271	.07	.70
JULY									
24...	10	--	--	--	66	65	187	.09	.80

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	CARBON DIOXIDE (CO2) (MG/L) (00405)	ALKA-LINITY AS CACO3 (MG/L) (00410)	BICAR-BONATE (HCO3) (MG/L) (00440)	CAR-BONATE (CO3) (MG/L) (00445)	DIS-SOLVED NITRATE (N) (MG/L) (00618)	PHOS-PHATE (PO4) (MG/L) (00650)	DIS-SOLVED ORTHO PHOS-PHATE (PO4) (MG/L) (00660)	HARD-NESS (CA,MG) (MG/L) (00900)	NON-CAR-BONATE HARD-NESS (MG/L) (00902)	DIS-SOLVED CAL-CIUM (CA) (MG/L) (00915)
OCT., 1960										
12...	--	26	32	--	--	--	--	25	0	8.4
DEC.										
10...	--	29	35	--	--	--	--	28	0	8.8
JAN., 1961										
30...	--	16	20	--	--	--	--	16	0	5.2
MAY										
15...	--	22	27	--	--	--	--	22	0	7.6
JULY										
10...	--	23	28	--	--	--	--	23	0	7.6
SEP.										
11...	--	14	17	--	--	--	--	14	0	4.2
APR., 1965										
12...	--	24	29	--	--	--	--	24	0	9.0
MAY , 1966										
25...	--	30	36	--	--	--	.06	31	2	11
JAN., 1967										
08...	3.2	13	16	--	.38	--	--	16	3	5.0
11...	3.8	20	24	--	.18	--	--	20	1	6.6
MAY										
11...	8.6	28	34	0	.16	--	.00	28	0	9.4
SEP.										
03-10	--	36	--	--	--	--	--	--	--	--
08...	5.8	24	29	--	.11	--	--	25	1	8.6
10...	3.8	48	59	--	.38	--	--	46	0	16
11-16	--	24	--	--	--	--	--	--	--	--
12...	2.8	36	44	--	.36	--	--	36	0	12
21-30	--	48	--	--	--	--	--	--	--	--
OCT.										
23...	--	43	52	0	--	--	--	44	1	15
DEC.										
05...	--	23	28	0	--	--	--	24	1	7.9
JAN., 1968										
22...	--	21	26	0	--	--	--	22	1	7.4
FEB.										
26...	--	23	28	0	--	--	--	24	1	8.3
APR.										
08...	--	33	40	--	--	--	--	33	0	11
JUNE										
04...	--	38	46	0	--	.02	--	36	0	12
JULY										
29...	--	48	58	--	--	--	--	48	0	1[illegible]

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TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	DISSOLVED MAGNESIUM (MG) (MG/L) (00925)	DISSOLVED SODIUM (NA) (MG/L) (00930)	SODIUM ADSORPTION RATIO (00931)	PERCENT SODIUM (00932)	DISSOLVED POTASSIUM (K) (MG/L) (00935)	DISSOLVED CHLORIDE (CL) (MG/L) (00940)	DISSOLVED SULFATE (SO4) (MG/L) (00945)	DISSOLVED FLUORIDE (F) (MG/L) (00950)	DISSOLVED SILICA (SIO2) (MG/L) (00955)
OCT., 1960 12...	1.0	3.0	.3	20	.7	4.0	.8	.2	8.5
DEC. 10...	1.5	2.7	.2	17	.6	1.5	.8	.6	8.2
JAN., 1961 30...	.7	2.3	.3	23	.5	4.0	.8	.1	7.6
MAY 15...	.6	2.2	.2	18	.6	6.2	.4	.2	7.3
JULY 10...	1.0	1.0	.1	8	.5	3.5	.8	.0	7.7
SEP. 11...	.9	1.6	.2	19	.7	3.0	.0	.0	6.2
APR., 1965 12...	.4	2.5	.2	18	.7	4.2	.0	.1	6.3
MAY, 1966 25...	.9	2.1	.2	12	.8	2.8	.0	.2	5.4
JAN., 1967 08...	.9	2.3	.2	23	.6	3.5	2.4	.1	7.4
11...	1.0	2.4	.2	20	.6	4.0	2.0	.1	7.7
MAY 11...	1.2	2.7	.2	17	.9	3.8	.0	.2	7.1
SEP. 03-10	--	--	--	--	--	--	--	--	--
08...	1.0	2.4	.2	16	.8	3.8	1.0	.3	6.8
10...	1.6	3.5	.2	14	.7	4.5	1.0	.2	7.8
11-16	--	--	--	--	--	--	--	--	--
12...	1.3	3.0	.2	15	.8	4.0	1.0	.3	7.6
21-30	--	--	--	--	--	--	--	--	--
OCT. 23...	1.6	3.4	.2	14	.9	10	.4	.1	9.1
DEC. 05...	1.1	3.0	.3	20	1.0	4.0	.4	.0	7.8
JAN., 1968 22...	1.0	2.6	.2	20	.6	4.0	.0	.1	7.5
FEB. 26...	1.0	2.7	.2	19	.5	4.2	.8	.2	6.4
APR. 08...	1.3	2.8	.2	15	.7	3.5	.0	.1	7.1
JUNE 04...	1.3	3.0	.2	15	.8	4.5	.0	.1	7.7
JULY 29...	1.8	3.4	.2	13	.9	4.0	2.0	.1	7.3

TABLE 2.5A-3 (Continued)

WATER QUALITY DATA

DATE	TIME	TYPE	TEMPER-ATURE (DEG C) (00010)	DIS-CHARGE (CFS) (00060)	STAGE (FT ABOVE DATUM) (00065)	COLOR (PLAT-INUM-COBALT UNITS) (00080)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS) (00095)	DIS-SOLVED OXYGEN (MG/L) (00300)	PER-CENT SATUR-ATION (00301)	PH (UNITS) (00400)
OCT., 1960										
12...	--	2	--	--	--	5	68	--	--	6.7
DEC.										
10...	--	2	--	--	--	0	71	--	--	7.2
JAN., 1961										
30...	--	2	--	--	--	5	47	--	--	7.0
MAY										
15...	--	2	--	--	--	30	60	--	--	6.9
JULY										
10...	--	2	--	--	--	15	58	--	--	7.0
SEP.										
11...	--	2	--	--	--	10	40	--	--	6.4
APR., 1965										
12...	--	2	--	5680	--	50	59	--	--	6.8
MAY , 1966										
25...	--	2	--	7780	--	100	72	--	--	6.9
JAN., 1967										
08...	--	2	--	--	--	20	41	--	--	6.9
11...	--	2	--	--	--	10	54	--	--	7.0
MAY										
11...	1050	2	23.3	--	--	20	75	--	--	6.8
SEP.										
03-10	--	2	--	--	--	--	--	--	--	--
08...	--	2	--	--	--	45	70	--	--	6.9
10...	--	2	--	--	--	10	112	--	--	7.4
11-16	--	2	--	--	--	--	--	--	--	--
12...	--	2	--	--	--	30	89	--	--	7.4
21-30	--	2	--	--	--	--	--	--	--	--
OCT.										
23...	1600	2	19.0	--	--	10	105	--	--	6.8
DEC.										
05...	0915	2	10.0	4110	--	20	69	--	--	6.3
JAN., 1968										
22...	1730	2	11.0	4580	--	20	62	--	--	6.7
FEB.										
26...	1640	2	8.0	3980	--	40	62	--	--	6.7
APR.										
08...	1605	2	22.0	2800	4.86	10	82	--	--	5.9
JUNE										
04...	0955	2	27.0	1930	2.98	5	87	6.2	76	6.7
JULY										
29...	1610	2	26.0	1050	--	5	111	--	--	6.8

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APPENDIX D

SECTION 1 OF APPENDIX D

2

The following pages are tables of birds found in the vicinity of the proposed power plant, a fish population summary, and a list of fish collected by U. S. Government biologists during a Northwest Florida striped bass survey. The subsection in section 2.7 which first invokes them is shown in parenthesis:

Table 2.7A-1, "Birds of the General Area," and other associated pages (Refer to subsection 2.7.1.11.3, "Results of Studies.")

Table 2.7A-2, "Fish Population Summary" (Refer to subsection 2.7.2.2.1.3.1, "Important Fish Species.")

Table 2.7A-3, "Fish Collected by Federal Biologists in 15-Foot Seine Hauls for the Northwest Florida Striped Bass Project" (Refer to subsection 2.7.2.2.1.3.1, "Important Fish Species.")

TABLE 2.7A-1

BIRDS OF THE GENERAL AREA 8-31-74 3:30 P.M. TO 5:30 P.M.

Birds are listed in check-list order followed by listings of occurrence, relative density, and number of sightings:

Occurrence	Density
R-Resident	R-Rare*
W-Winter Resident	U-Uncommon
S-Summer Resident	C-Common
M-Migrant	A-Abundant
A-Accidental	

Common Loon: W-R
Horned Grebe: W,M-R
Pied-billed Grebe: R-U
Anhinga: A-R
Great Blue Heron: R-U
Eastern Green Heron: S-C
Little Blue Heron: S-U
Cattle Egret: S-U
Common Egret: R-U
Black-crowned Night Heron: S-R
American Bittern: M-U
Wood Stork: S-U
Mallard: W-U
Black Duck: W-U
Wood Duck: R-U
Ring-necked Duck: W-U
Common Goldeneye: W-R
Ruddy Duck: W-R
Hooded Merganser: W-R
Common Merganser: W-R
Red-breasted Merganser: W-R
Turkey Vulture: R-C -2
Black Vulture: R-C
Sharp-shinned Hawk: R-R
Cooper's Hawk: R-R
Red-tailed Hawk: R-C
Red-shouldered Hawk: R-C
Marsh Hawk: W-U
Osprey: M-U
Sparrow Hawk: W-U
Bobwhite: R-C
Turkey: R-U
Virginia Rail: M-R
Sora: M-R
Killdeer: R-C
Black-bellied Plover: M-R
American Woodcock: R-U
Common Snipe: W-C
Lesser Yellowlegs: M-R
Least Sandpiper: W-U
Ring-billed Gull: W-R
Rock Dove: R-U
Mourning Dove: R-A -7
Broad-winged Hawk:

Ground Dove: R-U -4
Barn Owl: R-U
Screech Owl: R-U
Great Horned Owl: R-C
Barred Owl: R-C
Ruby-throated Hummingbird: S-C
Belted Kingfisher: R-C 1
Yellow-shafted Flicker: R-C
Red-bellied Woodpecker: R-A -5
Red-headed Woodpecker: R-U -2
Yellow-bellied Sapsucker: W-U
Hairy Woodpecker: R-U
Downy Woodpecker: R-C -1
Red-cockaded Woodpecker: R-R
Eastern Kingbird: S-C
Eastern Phoebe: W-C
Acadian Flycatcher: S-C
Least Flycatcher: M-U
Eastern Wood Pewee: S-C
Tree Swallow: M-U
Bank Swallow: M-U
Rough-winged Swallow: S-C
Barn Swallow: M-U
Purple Martin: R-C
Blue Jay: R-A -7
Common Crow: R-C -5
Fish Crow: R-U -2
Carolina Chickadee: R-A
Tufted Titmouse: R-A
Red-breasted Nuthach: W-U
Brown-headed Nuthatch: R-C
Brown Creeper: W-U
House Wren: W-R
Winter Wren: W-U
Carolina Wren: R-C -1
Mockingbird: R-A -9
Catbird: R-R,C
Brown Thrasher: R-A
Robin: R-A -1
Wood Thrush: S-C
Eastern Bluebird: R-U
Blue-grey Gnatcatcher: S-U
Golden-crowned Kinglet: W-U
Ruby-Crowned Kinglet: W-A
Water Pipit: W-C
Cedar Waxwing: W-C
Loggerhead Shrike: R-C -15
Starling: R-C
White-eyed Vireo: S-C
Yellow-throated Vireo: S-C
Red-eyed Vireo: S-C
Black-and-white Warbler-M-U
Prothonotary Warbler: S-C
Worm-eating Warbler: S-R
Golden-winged Warbler: M-U
Tennessee Warbler: M-C
Orange Crowned Warbler: M(W)-U
Parula Warbler: S(M)-U
Yellow Warbler: S-U
Myrtle Warbler: W-C
Pileated Woodpecker
Yellow-billed Cuckoo -2
Chimney Swift -33

Yellow-throated Warbler: S-U
Pine Warbler: R-C -1
Prairie Warbler: S-C
Palm Warbler: M-U
Louisiana Waterthrush: S-U
Kentucky Warbler: S-U
Yellowthroat: R-C
Yellow-breasted Chat: S-C
Hooded Warbler: S-C
American Redstart: S-C
Eastern Meadowlark: R-C
Redwinged Blackbird: R-C -4
Orchard Oriole: S-C
Baltimore Oriole: M(W)-U
Rusty Blackbird: W-U
Common Grackle: R-C -32
Brown-headed Cowbird: R-C
Scarlet Tanager: M-U
Summer Tanager: R-C
Cardinal: R-A 5
Rose-breasted Grosbeak: M-U
Glue Grosbeak: S-C
Indigo Buntings: S-C
Dickcissel: S-R
Evening Grosbeak: W-U 1
Purple Finch: W-C
Pine Siskin: W-U
American Goldfinch: R-U
Rufous-sided Towhee: R-A
Savannah Sparrow: W-C
Grasshopper Sparrow: R-U
Vesper Sparrow: W-U
Bachman's Sparrow: R-U
Slate-colored Junco: W-C
Chipping Sparrow: R-C
Field Sparrow: R-C
White-crowned Sparrow: W-R
White-throated Sparrow: W-A
Fox Sparrow: W-C
Swamp Sparrow: W-C
Song Sparrow: W-C

Additional Remarks

20 Species
139 Individuals
48/Hr.

***Use of the term "Rare" serves only as an indication of frequency of observation. It does not describe the existence of the birds as recorded in the Federal or State classifications of rare, endangered, or protected species.**

TABLE 2.7A-1 (Continued)

BEAVER SWAMP AREA BIRDS, HATHAWAY MILL CREEK 9-1-74 11:30 A.M. TO 12:30 P.M.

Birds are listed in check-list order followed by listings of occurrence, relative density, and number of sightings:

Occurrence	Density
R-Resident	R-Rare*
W-Winter Resident	U-Uncommon
S-Summer Resident	C-Common
M-Migrant	A-Abundant
A-Accidental	

Common Loon: W-R
Horned Grebe: W,M-R
Pied-billed Grebe: R-U
Anhinga: A-R
Great Blue Heron: R-U
Eastern Green Heron: S-C
Little Blue Heron: S-U
Cattle Egret: S-U
Common Egret: R-U
Black-crowned Night Heron: S-R
American Bittern: M-U
Wood Stork: S-U
Mallard: W-U
Black Duck: W-U
Wood Duck: R-U
Ring-necked Duck: W-U
Common Goldeneye: W-R
Ruddy Duck: W-R
Hooded Merganser: W-R
Common Merganser: W-R
Red-breasted Merganser: W-R
Turkey Vulture: R-C
Black Vulture: R-C
Sharp-shinned Hawk: R-R
Cooper's Hawk: R-R
Red-tailed Hawk: R-C
Red-shouldered Hawk: R-C -2
Marsh Hawk: W-U
Osprey: M-U
Sparrow Hawk: W-U
Bobwhite: R-C -2
Turkey: R-U
Virginia Rail: M-R
Sora: M-R
Killdeer: R-C
Black-bellied Plover: M-R
American Woodcock: R-U
Common Snipe: W-C
Lesser Yellowlegs: M-R
Least Sandpiper: W-U
Ring-billed Gull: W-R
Rock Dove: R-U
Mourning Dove: R-A
Broad-winged Hawk:

Ground Dove: R-U -1
Barn Owl: R-U
Screech Owl: R-U
Great Horned Owl: R-C
Barred Owl: R-C
Ruby-throated Hummingbird: S-C
Belted Kingfisher: R-C
Yellow-shafted Flicker: R-C
Red-bellied Woodpecker: R-A -3
Red-headed Woodpecker: R-U -2
Yellow-bellied Sapsucker: W-U
Hairy Woodpecker: R-U
Downy Woodpecker: R-C -1
Red-cockaded Woodpecker: R-R
Eastern Kingbird: S-C
Eastern Phoebe: W-C
Acadian Flycatcher: S-C
Least Flycatcher: M-U
Eastern Wood Pewee: S-C
Tree Swallow: M-U
Bank Swallow: M-U
Rough-winged Swallow: S-C
Barn Swallow: M-U
Purple Martin: R-C
Blue Jay: R-A -3
Common Crow: R-C
Fish Crow: R-U
Carolina Chickadee: R-A
Tufted Titmouse: R-A -3
Red-breasted Nuthach: W-U
Brown-headed Nuthatch: R-C -5
Brown Creeper: W-U
House Wren: W-R
Winter Wren: W-U
Carolina Wren: R-C -2
Mockingbird: R-A
Catbird: R-R,C
Brown Thrasher: R-A
Robin: R-A
Wood Thrush: S-C
Eastern Bluebird: R-U
Blue-grey Gnatcatcher: S-U
Golden-crowned Kinglet: W-U
Ruby-Crowned Kinglet: W-A
Water Pipit: W-C
Cedar Waxwing: W-C
Loggerhead Shrike: R-C
Starling: R-C
White-eyed Vireo: S-C
Yellow-throated Vireo: S-C
Red-eyed Vireo: S-C
Black-and-white Warbler-M-U
Prothonotary Warbler: S-C
Worm-eating Warbler: S-R
Golden-winged Warbler: M-U
Tennessee Warbler: M-C
Orange Crowned Warbler: M(W)-U
Parula Warbler: S(M)-U -3
Yellow Warbler: S-U
Myrtle Warbler: W-C
Pileated Woodpecker
Yellow-billed Cuckoo
Chimney Swift

Yellow-throated Warbler: S-U
Pine Warbler: R-C
Prairie Warbler: S-C
Palm Warbler: M-U
Louisiana Waterthrush: S-U
Kentucky Warbler: S-U
Yellowthroat: R-C
Yellow-breasted Chat: S-C
Hooded Warbler: S-C
American Redstart: S-C
Eastern Meadowlark: R-C
Redwinged Blackbird: R-C
Orchard Oriole: S-C
Baltimore Oriole: M(W)-U
Rusty Blackbird: W-U
Common Grackle: R-C
Brown-headed Cowbird: R-C
Scarlet Tanager: M-U
Summer Tanager: R-C
Cardinal: R-A 5
Rose-breasted Grosbeak: M-U
Glue Grosbeak: S-C
Indigo Buntings: S-C
Dickcissel: S-R
Evening Grosbeak: W-U 1
Purple Finch: W-C
Pine Siskin: W-U
American Goldfinch: R-U
Rufous-sided Towhee: R-A
Savannah Sparrow: W-C
Grasshopper Sparrow: R-U
Vesper Sparrow: W-U
Bachman's Sparrow: R-U
Slate-colored Junco: W-C
Chipping Sparrow: R-C
Field Sparrow: R-C
White-crowned Sparrow: W-R
White-throated Sparrow: W-A
Fox Sparrow: W-C
Swamp Sparrow: W-C
Song Sparrow: W-C

Additional Remarks

12 Species
32 Individuals
32/Hr.

***Use of the term "Rare" serves only as an indication of frequency of observation. It does not describe the existence of the birds as recorded in the Federal or State classifications of rare, endangered, or protected species.**

TABLE 2.7A-1 (Continued)

BIRDS OF THE WEST END OF THE TRANSMISSION LINE 9-1-74 2:00 P.M. TO 5:30 P.M.

Birds are listed in check-list order followed by listings of occurrence, relative density, and number of sightings:

Occurrence	Density
R-Resident	R-Rare*
W-Winter Resident	U-Uncommon
S-Summer Resident	C-Common
M-Migrant	A-Abundant
A-Accidental	

Common Loon: W-R
Horned Grebe: W,M-R
Pied-billed Grebe: R-U
Anhinga: A-R
Great Blue Heron: R-U
Eastern Green Heron: S-C -1
Little Blue Heron: S-U
Cattle Egret: S-U
Common Egret: R-U
Black-crowned Night Heron: S-R
American Bittern: M-U
Wood Stork: S-U
Mallard: W-U
Black Duck: W-U
Wood Duck: R-U
Ring-necked Duck: W-U
Common Goldeneye: W-R
Ruddy Duck: W-R
Hooded Merganser: W-R
Common Merganser: W-R
Red-breasted Merganser: W-R
Turkey Vulture: R-C -1
Black Vulture: R-C
Sharp-shinned Hawk: R-R
Cooper's Hawk: R-R
Red-tailed Hawk: R-C
Red-shouldered Hawk: R-C -2
Marsh Hawk: W-U
Osprey: M-U
Sparrow Hawk: W-U
Bobwhite: R-C
Turkey: R-U
Virginia Rail: M-R
Sora: M-R
Killdeer: R-C
Black-bellied Plover: M-R
American Woodcock: R-U
Common Snipe: W-C
Lesser Yellowlegs: M-R
Least Sandpiper: W-U
Ring-billed Gull: W-R
Rock Dove: R-U
Mourning Dove: R-A
Broad-winged Hawk:

Ground Dove: R-U
Barn Owl: R-U
Screech Owl: R-U
Great Horned Owl: R-C
Barred Owl: R-C
Ruby-throated Hummingbird: S-C
Belted Kingfisher: R-C
Yellow-shafted Flicker: R-C
Red-bellied Woodpecker: R-A -4
Red-headed Woodpecker: R-U
Yellow-bellied Sapsucker: W-U
Hairy Woodpecker: R-U
Downy Woodpecker: R-C -3
Red-cockaded Woodpecker: R-R
Eastern Kingbird: S-C
Eastern Phoebe: W-C
Acadian Flycatcher: S-C
Least Flycatcher: M-U
Eastern Wood Pewee: S-C
Tree Swallow: M-U
Bank Swallow: M-U
Rough-winged Swallow: S-C
Barn Swallow: M-U
Purple Martin: R-C
Blue Jay: R-A -5
Common Crow: R-C -2
Fish Crow: R-U -1
Carolina Chickadee: R-A -4
Tufted Titmouse: R-A -3
Red-breasted Nuthach: W-U
Brown-headed Nuthatch: R-C
Brown Creeper: W-U
House Wren: W-R
Winter Wren: W-U
Carolina Wren: R-C -3
Mockingbird: R-A
Catbird: R-R,C
Brown Thrasher: R-A
Robin: R-A
Wood Thrush: S-C
Eastern Bluebird: R-U
Blue-grey Gnatcatcher: S-U -1
Golden-crowned Kinglet: W-U
Ruby-Crowned Kinglet: W-A
Water Pipit: W-C
Cedar Waxwing: W-C
Loggerhead Shrike: R-C
Starling: R-C
White-eyed Vireo: S-C -1
Yellow-throated Vireo: S-C
Red-eyed Vireo: S-C -1
Black-and-white Warbler-M-U
Prothonotary Warbler: S-C
Worm-eating Warbler: S-R
Golden-winged Warbler: M-U
Tennessee Warbler: M-C
Orange Crowned Warbler: M(W)-U
Parula Warbler: S(M)-U
Yellow Warbler: S-U
Myrtle Warbler: W-C
Pileated Woodpecker -1
Yellow-billed Cuckoo -2
Chimney Swift -3

Yellow-throated Warbler: S-U
Pine Warbler: R-C
Prairie Warbler: S-C
Palm Warbler: M-U
Louisiana Waterthrush: S-U
Kentucky Warbler: S-U
Yellowthroat: R-C
Yellow-breasted Chat: S-C
Hooded Warbler: S-C
American Redstart: S-C
Eastern Meadowlark: R-C
Redwinged Blackbird: R-C
Orchard Oriole: S-C
Baltimore Oriole: M(W)-U
Rusty Blackbird: W-U
Common Grackle: R-C
Brown-headed Cowbird: R-C
Scarlet Tanager: M-U
Summer Tanager: R-C -1
Cardinal: R-A -3
Rose-breasted Grosbeak: M-U
Glue Grosbeak: S-C
Indigo Buntings: S-C
Dickcissel: S-R
Evening Grosbeak: W-U
Purple Finch: W-C
Pine Siskin: W-U
American Goldfinch: R-U
Rufous-sided Towhee: R-A -2
Savannah Sparrow: W-C
Grasshopper Sparrow: R-U
Vesper Sparrow: W-U
Bachman's Sparrow: R-U
Slate-colored Junco: W-C
Chipping Sparrow: R-C
Field Sparrow: R-C
White-crowned Sparrow: W-R
White-throated Sparrow: W-A
Fox Sparrow: W-C
Swamp Sparrow: W-C
Song Sparrow: W-C

Additional Remarks

20 Species
44 Individuals
17.6/Hr.

***Use of the term "Rare" serves only as an indication of frequency of observation. It does not describe the existence of the birds as recorded in the Federal or State classifications of rare, endangered, or protected species.**

TABLE 2.7A-1 (Continued)

BIRDS OF THE GENERAL AREA 9-3-74 11:00 A.M. TO 5:15 P.M. (MINUS 2.5 HRS.)

Birds are listed in check-list order followed by listings of occurrence, relative density, and number of sightings:

Occurrence	Density
R-Resident	R-Rare*
W-Winter Resident	U-Uncommon
S-Summer Resident	C-Common
M-Migrant	A-Abundant
A-Accidental	

Common Loon: W-R
Horned Grebe: W,M-R
Pied-billed Grebe: R-U
Anhinga: A-R
Great Blue Heron: R-U
Eastern Green Heron: S-C
Little Blue Heron: S-U
Cattle Egret: S-U -6
Common Egret: R-U
Black-crowned Night Heron: S-R
American Bittern: M-U
Wood Stork: S-U
Mallard: W-U
Black Duck: W-U
Wood Duck: R-U
Ring-necked Duck: W-U
Common Goldeneye: W-R
Ruddy Duck: W-R
Hooded Merganser: W-R
Common Merganser: W-R
Red-breasted Merganser: W-R
Turkey Vulture: R-C
Black Vulture: R-C
Sharp-shinned Hawk: R-R
Cooper's Hawk: R-R
Red-tailed Hawk: R-C
Red-shouldered Hawk: R-C -1
Marsh Hawk: W-U
Osprey: M-U
Sparrow Hawk: W-U
Bobwhite: R-C
Turkey: R-U
Virginia Rail: M-R
Sora: M-R
Killdeer: R-C
Black-bellied Plover: M-R
American Woodcock: R-U
Common Snipe: W-C
Lesser Yellowlegs: M-R
Least Sandpiper: W-U
Ring-billed Gull: W-R
Rock Dove: R-U
Mourning Dove: R-A -6
Broad-winged Hawk:

Ground Dove: R-U
Barn Owl: R-U
Screech Owl: R-U
Great Horned Owl: R-C
Barred Owl: R-C
Ruby-throated Hummingbird: S-C
Belted Kingfisher: R-C
Yellow-shafted Flicker: R-C
Red-bellied Woodpecker: R-A
Red-headed Woodpecker: R-U
Yellow-bellied Sapsucker: W-U
Hairy Woodpecker: R-U
Downy Woodpecker: R-C -1
Red-cockaded Woodpecker: R-R
Eastern Kingbird: S-C
Eastern Phoebe: W-C
Acadian Flycatcher: S-C
Least Flycatcher: M-U
Eastern Wood Pewee: S-C
Tree Swallow: M-U
Bank Swallow: M-U
Rough-winged Swallow: S-C
Barn Swallow: M-U
Purple Martin: R-C
Blue Jay: R-A -4
Common Crow: R-C
Fish Crow: R-U
Carolina Chickadee: R-A
Tufted Titmouse: R-A
Red-breasted Nuthach: W-U
Brown-headed Nuthatch: R-C
Brown Creeper: W-U
House Wren: W-R
Winter Wren: W-U
Carolina Wren: R-C -2
Mockingbird: R-A -12
Catbird: R-R,C
Brown Thrasher: R-A -1
Robin: R-A
Wood Thrush: S-C
Eastern Bluebird: R-U
Blue-grey Gnatcatcher: S-U
Golden-crowned Kinglet: W-U
Ruby-Crowned Kinglet: W-A
Water Pipit: W-C
Cedar Waxwing: W-C
Loggerhead Shrike: R-C -14
Starling: R-C -2
White-eyed Vireo: S-C
Yellow-throated Vireo: S-C
Red-eyed Vireo: S-C
Black-and-white Warbler-M-U
Prothonotary Warbler: S-C
Worm-eating Warbler: S-R
Golden-winged Warbler: M-U
Tennessee Warbler: M-C
Orange Crowned Warbler: M(W)-U
Parula Warbler: S(M)-U
Yellow Warbler: S-U
Myrtle Warbler: W-C
Pileated Woodpecker -2
Yellow-billed Cuckoo -1
Chimney Swift -5

Yellow-throated Warbler: S-U
Pine Warbler: R-C
Prairie Warbler: S-C
Palm Warbler: M-U
Louisiana Waterthrush: S-U
Kentucky Warbler: S-U
Yellowthroat: R-C
Yellow-breasted Chat: S-C
Hooded Warbler: S-C
American Redstart: S-C
Eastern Meadowlark: R-C
Redwinged Blackbird: R-C
Orchard Oriole: S-C
Baltimore Oriole: M(W)-U
Rusty Blackbird: W-U
Common Grackle: R-C
Brown-headed Cowbird: R-C
Scarlet Tanager: M-U
Summer Tanager: R-C
Cardinal: R-A -4
Rose-breasted Grosbeak: M-U
Glue Grosbeak: S-C
Indigo Buntings: S-C
Dickcissel: S-R
Evening Grosbeak: W-U
Purple Finch: W-C
Pine Siskin: W-U
American Goldfinch: R-U
Rufous-sided Towhee: R-A
Savannah Sparrow: W-C
Grasshopper Sparrow: R-U
Vesper Sparrow: W-U
Bachman's Sparrow: R-U
Slate-colored Junco: W-C
Chipping Sparrow: R-C
Field Sparrow: R-C
White-crowned Sparrow: W-R
White-throated Sparrow: W-A
Fox Sparrow: W-C
Swamp Sparrow: W-C
Song Sparrow: W-C

Additional Remarks

14 Species
61 Individuals
16.2/Hr.

*Use of the term "Rare" serves only as an indication of frequency of observation. It does not describe the existence of the birds as recorded in the Federal or State classifications of rare, endangered, or protected species.

TABLE 2.7A-1 (Continued)

BIRDS OF THE BEAVER SWAMP AREA, HATHAWAY MILL CREEK 9-3-74 12:30 P.M. TO 3:00 P.M.

Birds are listed in check-list order followed by listings of occurrence, relative density, and number of sightings:

Occurrence	Density
R-Resident	R-Rare*
W-Winter Resident	U-Uncommon
S-Summer Resident	C-Common
M-Migrant	A-Abundant
A-Accidental	

Common Loon: W-R
Horned Grebe: W,M-R
Pied-billed Grebe: R-U
Anhinga: A-R
Great Blue Heron: R-U
Eastern Green Heron: S-C
Little Blue Heron: S-U
Cattle Egret: S-U
Common Egret: R-U
Black-crowned Night Heron: S-R
American Bittern: M-U
Wood Stork: S-U
Mallard: W-U
Black Duck: W-U
Wood Duck: R-U
Ring-necked Duck: W-U
Common Goldeneye: W-R
Ruddy Duck: W-R
Hooded Merganser: W-R
Common Merganser: W-R
Red-breasted Merganser: W-R
Turkey Vulture: R-C
Black Vulture: R-C
Sharp-shinned Hawk: R-R
Cooper's Hawk: R-R
Red-tailed Hawk: R-C -1
Red-shouldered Hawk: R-C
Marsh Hawk: W-U
Osprey: M-U
Sparrow Hawk: W-U
Bobwhite: R-C
Turkey: R-U
Virginia Rail: M-R
Sora: M-R
Killdeer: R-C
Black-bellied Plover: M-R
American Woodcock: R-U
Common Snipe: W-C
Lesser Yellowlegs: M-R
Least Sandpiper: W-U
Ring-billed Gull: W-R
Rock Dove: R-U
Mourning Dove: R-A
Broad-winged Hawk:

Ground Dove: R-U
Barn Owl: R-U
Screech Owl: R-U
Great Horned Owl: R-C
Barred Owl: R-C
Ruby-throated Hummingbird: S-C
Belted Kingfisher: R-C
Yellow-shafted Flicker: R-C -1
Red-bellied Woodpecker: R-A -2
Red-headed Woodpecker: R-U
Yellow-bellied Sapsucker: W-U
Hairy Woodpecker: R-U
Downy Woodpecker: R-C
Red-cockaded Woodpecker: R-R
Eastern Kingbird: S-C
Eastern Phoebe: W-C
Acadian Flycatcher: S-C -1
Least Flycatcher: M-U
Eastern Wood Pewee: S-C
Tree Swallow: M-U
Bank Swallow: M-U
Rough-winged Swallow: S-C
Barn Swallow: M-U
Purple Martin: R-C
Blue Jay: R-A
Common Crow: R-C
Fish Crow: R-U -2
Carolina Chickadee: R-A
Tufted Titmouse: R-A
Red-breasted Nuthach: W-U
Brown-headed Nuthatch: R-C
Brown Creeper: W-U
House Wren: W-R
Winter Wren: W-U
Carolina Wren: R-C -4
Mockingbird: R-A
Catbird: R-R,C
Brown Thrasher: R-A
Robin: R-A
Wood Thrush: S-C
Eastern Bluebird: R-U
Blue-grey Gnatcatcher: S-U
Golden-crowned Kinglet: W-U
Ruby-Crowned Kinglet: W-A
Water Pipit: W-C
Cedar Waxwing: W-C
Loggerhead Shrike: R-C
Starling: R-C
White-eyed Vireo: S-C
Yellow-throated Vireo: S-C
Red-eyed Vireo: S-C
Black-and-white Warbler-M-U
Prothonotary Warbler: S-C
Worm-eating Warbler: S-R
Golden-winged Warbler: M-U
Tennessee Warbler: M-C
Orange Crowned Warbler: M(W)-U
Parula Warbler: S(M)-U
Yellow Warbler: S-U
Myrtle Warbler: W-C
Pileated Woodpecker -2
Yellow-billed Cuckoo -1
Chimney Swift

Yellow-throated Warbler: S-U
Pine Warbler: R-C
Prairie Warbler: S-C
Palm Warbler: M-U
Louisiana Waterthrush: S-U
Kentucky Warbler: S-U
Yellowthroat: R-C
Yellow-breasted Chat: S-C
Hooded Warbler: S-C
American Redstart: S-C
Eastern Meadowlark: R-C
Redwinged Blackbird: R-C
Orchard Oriole: S-C
Baltimore Oriole: M(W)-U
Rusty Blackbird: W-U
Common Grackle: R-C
Brown-headed Cowbird: R-C
Scarlet Tanager: M-U
Summer Tanager: R-C
Cardinal: R-A -3
Rose-breasted Grosbeak: M-U
Glue Grosbeak: S-C
Indigo Buntings: S-C
Dickcissel: S-R
Evening Grosbeak: W-U
Purple Finch: W-C
Pine Siskin: W-U
American Goldfinch: R-U
Rufous-sided Towhee: R-A -4
Savannah Sparrow: W-C
Grasshopper Sparrow: R-U
Vesper Sparrow: W-U
Bachman's Sparrow: R-U
Slate-colored Junco: W-C
Chipping Sparrow: R-C
Field Sparrow: R-C
White-crowned Sparrow: W-R
White-throated Sparrow: W-A
Fox Sparrow: W-C
Swamp Sparrow: W-C
Song Sparrow: W-C

Additional Remarks

10 Species
21 Individuals
8.4/Hr.

*Use of the term "Rare" serves only as an indication of frequency of observation. It does not describe the existence of the birds as recorded in the Federal or State classifications of rare, endangered, or protected species.

1

TABLE 2.7A-1 (Continued)

BIRDS OF THE BEAVER SWAMP AREA, HATHAWAY MILL CREEK 9-4-74 11:00 A.M. TO 1:15 P.M.

Birds are listed in check-list order followed by listings of occurrence, relative density, and number of sightings:

Occurrence	Density
R-Resident	R-Rare*
W-Winter Resident	U-Uncommon
S-Summer Resident	C-Common
M-Migrant	A-Abundant
A-Accidental	

Common Loon: W-R
Horned Grebe: W,M-R
Pied-billed Grebe: R-U
Anhinga: A-R -1
Great Blue Heron: R-U -1
Eastern Green Heron: S-C
Little Blue Heron: S-U
Cattle Egret: S-U
Common Egret: R-U
Black-crowned Night Heron: S-R
American Bittern: M-U
Wood Stork: S-U
Mallard: W-U
Black Duck: W-U
Wood Duck: R-U
Ring-necked Duck: W-U
Common Goldeneye: W-R
Ruddy Duck: W-R
Hooded Merganser: W-R
Common Merganser: W-R
Red-breasted Merganser: W-R
Turkey Vulture: R-C -1
Black Vulture: R-C
Sharp-shinned Hawk: R-R
Cooper's Hawk: R-R
Red-tailed Hawk: R-C
Red-shouldered Hawk: R-C -1
Marsh Hawk: W-U
Osprey: M-U
Sparrow Hawk: W-U
Bobwhite: R-C
Turkey: R-U
Virginia Rail: M-R
Sora: M-R
Killdeer: R-C
Black-bellied Plover: M-R
American Woodcock: R-U
Common Snipe: W-C
Lesser Yellowlegs: M-R
Least Sandpiper: W-U
Ring-billed Gull: W-R
Rock Dove: R-U
Mourning Dove: R-A
Broad-winged Hawk:

Ground Dove: R-U -1
Barn Owl: R-U
Screech Owl: R-U
Great Horned Owl: R-C
Barred Owl: R-C
Ruby-throated Hummingbird: S-C
Belted Kingfisher: R-C
Yellow-shafted Flicker: R-C -1
Red-bellied Woodpecker: R-A -2
Red-headed Woodpecker: R-U -1
Yellow-bellied Sapsucker: W-U
Hairy Woodpecker: R-U
Downy Woodpecker: R-C
Red-cockaded Woodpecker: R-R
Eastern Kingbird: S-C
Eastern Phoebe: W-C
Acadian Flycatcher: S-C
Least Flycatcher: M-U
Eastern Wood Pewee: S-C
Tree Swallow: M-U
Bank Swallow: M-U
Rough-winged Swallow: S-C
Barn Swallow: M-U
Purple Martin: R-C
Blue Jay: R-A -6
Common Crow: R-C-2
Fish Crow: R-U
Carolina Chickadee: R-A -4
Tufted Titmouse: R-A
Red-breasted Nuthach: W-U
Brown-headed Nuthatch: R-C -5
Brown Creeper: W-U
House Wren: W-R
Winter Wren: W-U
Carolina Wren: R-C
Mockingbird: R-A
Catbird: R-R,C
Brown Thrasher: R-A
Robin: R-A
Wood Thrush: S-C
Eastern Bluebird: R-U
Blue-grey Gnatcatcher: S-U
Golden-crowned Kinglet: W-U
Ruby-Crowned Kinglet: W-A
Water Pipit: W-C
Cedar Waxwing: W-C
Loggerhead Shrike: R-C
Starling: R-C
White-eyed Vireo: S-C -1
Yellow-throated Vireo: S-C
Red-eyed Vireo: S-C
Black-and-white Warbler-M-U
Prothonotary Warbler: S-C
Worm-eating Warbler: S-R
Golden-winged Warbler: M-U
Tennessee Warbler: M-C
Orange Crowned Warbler: M(W)-U
Parula Warbler: S(M)-U
Yellow Warbler: S-U
Myrtle Warbler: W-C
Pileated Woodpecker
Yellow-billed Cuckoo -2
Chimney Swift

Yellow-throated Warbler: S-U
Pine Warbler: R-C 3
Prairie Warbler: S-C
Palm Warbler: M-U
Louisiana Waterthrush: S-U -1
Kentucky Warbler: S-U
Yellowthroat: R-C
Yellow-breasted Chat: S-C
Hooded Warbler: S-C
American Redstart: S-C
Eastern Meadowlark: R-C
Redwinged Blackbird: R-C
Orchard Oriole: S-C
Baltimore Oriole: M(W)-U
Rusty Blackbird: W-U
Common Grackle: R-C
Brown-headed Cowbird: R-C
Scarlet Tanager: M-U
Summer Tanager: R-C
Cardinal: R-A
Rose-breasted Grosbeak: M-U
Glue Grosbeak: S-C
Indigo Buntings: S-C
Dickcissel: S-R
Evening Grosbeak: W-U
Purple Finch: W-C
Pine Siskin: W-U
American Goldfinch: R-U
Rufous-sided Towhee: R-A -2,
Savannah Sparrow: W-C
Grasshopper Sparrow: R-U
Vesper Sparrow: W-U
Bachman's Sparrow: R-U
Slate-colored Junco: W-C
Chipping Sparrow: R-C
Field Sparrow: R-C
White-crowned Sparrow: W+R
White-throated Sparrow: W-A
Fox Sparrow: W-C
Swamp Sparrow: W-C
Song Sparrow: W-C

Additional Remarks

17 Species
35 Individuals
15.6/Hr.

*Use of the term "Rare" serves only as an indication of frequency of observation. It does not describe the existence of the birds as recorded in the Federal or State classifications of rare, endangered, or protected species.

TABLE 2.7A-1 (Continued)

BIRDS OF THE GENERAL AREA 9-4-74 1:15 P.M. TO 4:45 P.M.

Birds are listed in check-list order followed by listings of occurrence, relative density, and number of sightings:

Occurrence	Density
R-Resident	R-Rare*
W-Winter Resident	U-Uncommon
S-Summer Resident	C-Common
M-Migrant	A-Abundant
A-Accidental	

Common Loon: W-R
Horned Grebe: W,M-R
Pied-billed Grebe: R-U
Anhinga: A-R
Great Blue Heron: R-U
Eastern Green Heron: S-C
Little Blue Heron: S-U
Cattle Egret: S-U -81
Common Egret: R-U
Black-crowned Night Heron: S-R
American Bittern: M-U
Wood Stork: S-U
Mallard: W-U
Black Duck: W-U
Wood Duck: R-U
Ring-necked Duck: W-U
Common Goldeneye: W-R
Ruddy Duck: W-R
Hooded Merganser: W-R
Common Merganser: W-R
Red-breasted Merganser: W-R
Turkey Vulture: R-C
Black Vulture: R-C
Sharp-shinned Hawk: R-R
Cooper's Hawk: R-R
Red-tailed Hawk: R-C
Red-shouldered Hawk: R-C -1
Marsh Hawk: W-U
Osprey: M-U
Sparrow Hawk: W-U
Bobwhite: R-C -6
Turkey: R-U
Virginia Rail: M-R
Sora: M-R
Killdeer: R-C
Black-bellied Plover: M-R
American Woodcock: R-U
Common Snipe: W-C
Lesser Yellowlegs: M-R
Least Sandpiper: W-U
Ring-billed Gull: W-R
Rock Dove: R-U
Mourning Dove: R-A -1
Broad-winged Hawk: -1

Ground Dove: R-U -2
Barn Owl: R-U
Screech Owl: R-U
Great Horned Owl: R-C
Barred Owl: R-C -2
Ruby-throated Hummingbird: S-C
Belted Kingfisher: R-C
Yellow-shafted Flicker: R-C
Red-bellied Woodpecker: R-A
Red-headed Woodpecker: R-U
Yellow-bellied Sapsucker: W-U
Hairy Woodpecker: R-U
Downy Woodpecker: R-C
Red-cockaded Woodpecker: R-R
Eastern Kingbird: S-C
Eastern Phoebe: W-C
Acadian Flycatcher: S-C
Least Flycatcher: M-U
Eastern Wood Pewee: S-C
Tree Swallow: M-U
Bank Swallow: M-U
Rough-winged Swallow: S-C
Barn Swallow: M-U
Purple Martin: R-C
Blue Jay: R-A -8
Common Crow: R-C -2
Fish Crow: R-U
Carolina Chickadee: R-A
Tufted Titmouse: R-A
Red-breasted Nuthach: W-U
Brown-headed Nuthatch: R-C
Brown Creeper: W-U
House Wren: W-R
Winter Wren: W-U
Carolina Wren: R-C
Mockingbird: R-A -6
Catbird: R-R,C
Brown Thrasher: R-A
Robin: R-A
Wood Thrush: S-C
Eastern Bluebird: R-U
Blue-grey Gnatcatcher: S-U
Golden-crowned Kinglet: W-U
Ruby-Crowned Kinglet: W-A
Water Pipit: W-C
Cedar Waxwing: W-C
Loggerhead Shrike: R-C -5
Starling: R-C
White-eyed Vireo: S-C -1
Yellow-throated Vireo: S-C
Red-eyed Vireo: S-C
Black-and-white Warbler-M-U
Prothonotary Warbler: S-C
Worm-eating Warbler: S-R
Golden-winged Warbler: M-U
Tennessee Warbler: M-C
Orange Crowned Warbler: M(W)-U
Parula Warbler: S(M)-U
Yellow Warbler: S-U
Myrtle Warbler: W-C
Pileated Woodpecker
Yellow-billed Cuckoo
Chimney Swift

Yellow-throated Warbler: S-U
Pine Warbler: R-C
Prairie Warbler: S-C
Palm Warbler: M-U
Louisiana Waterthrush: S-U
Kentucky Warbler: S-U
Yellowthroat: R-C
Yellow-breasted Chat: S-C
Hooded Warbler: S-C
American Redstart: S-C
Eastern Meadowlark: R-C
Redwinged Blackbird: R-C
Orchard Oriole: S-C
Baltimore Oriole: M(W)-U
Rusty Blackbird: W-U
Common Grackle: R-C
Brown-headed Cowbird: R-C
Scarlet Tanager: M-U
Summer Tanager: R-C
Cardinal: R-A -9
Rose-breasted Grosbeak: M-U
Glue Grosbeak: S-C
Indigo Buntings: S-C
Dickcissel: S-R
Evening Grosbeak: W-U
Purple Finch: W-C 1
Pine Siskin: W-U
American Goldfinch: R-U
Rufous-sided Towhee: R-A
Savannah Sparrow: W-C
Grasshopper Sparrow: R-U
Vesper Sparrow: W-U
Bachman's Sparrow: R-U
Slate-colored Junco: W-C
Chipping Sparrow: R-C
Field Sparrow: R-C
White-crowned Sparrow: W-R
White-throated Sparrow: W-A
Fox Sparrow: W-C
Swamp Sparrow: W-C
Song Sparrow: W-C

Additional Remarks

13 Species
125 Individuals
35.7/Hr.

*Use of the term "Rare" serves only as an indication of frequency of observation. It does not describe the existence of the birds as recorded in the Federal or State classifications of rare, endangered, or protected species.

TABLE 2.7A-1 (Continued)

BIRDS OF THE GENERAL AREA 9-5-74 10:30 A.M. TO 2:00 P.M.; 3:00 P.M. TO 5:00 P.M.

Birds are listed in check-list order followed by listings of occurrence, relative density, and number of sightings:

Occurrence	Density
R-Resident	R-Rare*
W-Winter Resident	U-Uncommon
S-Summer Resident	C-Common
M-Migrant	A-Abundant
A-Accidental	

Common Loon: W-R
Horned Grebe: W,M-R
Pied-billed Grebe: R-U
Anhinga: A-R
Great Blue Heron: R-U -1
Eastern Green Heron: S-C -1
Little Blue Heron: S-U
Cattle Egret: S-U -12
Common Egret: R-U
Black-crowned Night Heron: S-R
American Bittern: M-U
Wood Stork: S-U -1
Mallard: W-U
Black Duck: W-U
Wood Duck: R-U
Ring-necked Duck: W-U
Common Goldeneye: W-R
Ruddy Duck: W-R
Hooded Merganser: W-R
Common Merganser: W-R
Red-breasted Merganser: W-R
Turkey Vulture: R-C
Black Vulture: R-C
Sharp-shinned Hawk: R-R
Cooper's Hawk: R-R
Red-tailed Hawk: R-C -1
Red-shouldered Hawk: R-C -2
Marsh Hawk: W-U
Osprey: M-U
Sparrow Hawk: W-U
Bobwhite: R-C -4
Turkey: R-U
Virginia Rail: M-R
Sora: M-R
Killdeer: R-C
Black-bellied Plover: M-R
American Woodcock: R-U
Common Snipe: W-C
Lesser Yellowlegs: M-R
Least Sandpiper: W-U
Ring-billed Gull: W-R
Rock Dove: R-U
Mourning Dove: R-A -16
Broad-winged Hawk:

Ground Dove: R-U -1
Barn Owl: R-U
Screech Owl: R-U
Great Horned Owl: R-C
Barred Owl: R-C -1
Ruby-throated Hummingbird: S-C
Belted Kingfisher: R-C
Yellow-shafted Flicker: R-C
Red-bellied Woodpecker: R-A -2
Red-headed Woodpecker: R-U
Yellow-bellied Sapsucker: W-U
Hairy Woodpecker: R-U
Downy Woodpecker: R-C -1
Red-cockaded Woodpecker: R-R
Eastern Kingbird: S-C 3
Eastern Phoebe: W-C
Acadian Flycatcher: S-C -1
Least Flycatcher: M-U
Eastern Wood Pewee: S-C
Tree Swallow: M-U
Bank Swallow: M-U
Rough-winged Swallow: S-C
Barn Swallow: M-U
Purple Martin: R-C
Blue Jay: R-A -6
Common Crow: R-C -15
Fish Crow: R-U - 3
Carolina Chickadee: R-A - 4
Tufted Titmouse: R-A -1
Red-breasted Nuthach: W-U
Brown-headed Nuthatch: R-C -2
Brown Creeper: W-U
House Wren: W-R
Winter Wren: W-U
Carolina Wren: R-C -2
Mockingbird: R-A -10
Catbird: R-R,C
Brown Thrasher: R-A
Robin: R-A
Wood Thrush: S-C
Eastern Bluebird: R-U
Blue-grey Gnatcatcher: S-U
Golden-crowned Kinglet: W-U
Ruby-Crowned Kinglet: W-A
Water Pipit: W-C
Cedar Waxwing: W-C
Loggerhead Shrike: R-C -5
Starling: R-C
White-eyed Vireo: S-C -3
Yellow-throated Vireo: S-C
Red-eyed Vireo: S-C
Black-and-white Warbler-M-U
Prothonotary Warbler: S-C
Worm-eating Warbler: S-R
Golden-winged Warbler: M-U
Tennessee Warbler: M-C
Orange Crowned Warbler: M(W)-U
Parula Warbler: S(M)-U
Yellow Warbler: S-U
Myrtle Warbler: W-C
Pileated Woodpecker -1
Yellow-billed Cuckoo - 3
Chimney Swift -3

Yellow-throated Warbler: S-U
Pine Warbler: R-C -2
Prairie Warbler: S-C
Palm Warbler: M-U
Louisiana Waterthrush: S-U
Kentucky Warbler: S-U
Yellowthroat: R-C -1
Yellow-breasted Chat: S-C
Hooded Warbler: S-C -1
American Redstart: S-C
Eastern Meadowlark: R-C
Redwinged Blackbird: R-C
Orchard Oriole: S-C
Baltimore Oriole: M(W)-U
Rusty Blackbird: W-U
Common Grackle: R-C
Brown-headed Cowbird: R-C
Scarlet Tanager: M-U
Summer Tanager: R-C
Cardinal: R-A -12
Rose-breasted Grosbeak: M-U
Glue Grosbeak: S-C
Indigo Buntings: S-C
Dickcissel: S-R
Evening Grosbeak: W-U 1
Purple Finch: W-C
Pine Siskin: W-U
American Goldfinch: R-U
Rufous-sided Towhee: R-A -3
Savannah Sparrow: W-C
Grasshopper Sparrow: R-U
Vesper Sparrow: W-U
Bachman's Sparrow: R-U
Slate-colored Junco: W-C
Chipping Sparrow: R-C
Field Sparrow: R-C
White-crowned Sparrow: W-R
White-throated Sparrow: W-A
Fox Sparrow: W-C
Swamp Sparrow: W-C
Song Sparrow: W-C

Additional Remarks
32 Species
124 Individuals
22.5/Hr.

***Use of the term "Rare" serves only as an indication of frequency of observation. It does not describe the existence of the birds as recorded in the Federal or State classifications of rare, endangered, or protected species.**

TABLE 2.7A-1 (Continued)

BIRDS OF THE GENERAL AREA 9-6-74 11:10 A.M. to 2:50 P.M.

Birds are listed in check-list order followed by listings of occurrence, relative density, and number of sightings:

Occurrence	Density
R-Resident	R-Rare*
W-Winter Resident	U-Uncommon
S-Summer Resident	C-Common
M-Migrant	A-Abundant
A-Accidental	

Common Loon: W-R
Horned Grebe: W,M-R
Pied-billed Grebe: R-U
Anhinga: A-R
Great Blue Heron: R-U -1
Eastern Green Heron: S-C
Little Blue Heron: S-U
Cattle Egret: S-U -6
Common Egret: R-U
Black-crowned Night Heron: S-R
American Bittern: M-U
Wood Stork: S-U . -7
Mallard: W-U
Black Duck: W-U
Wood Duck: R-U
Ring-necked Duck: W-U
Common Goldeneye: W-R
Ruddy Duck: W-R
Hooded Merganser: W-R
Common Merganser: W-R
Red-breasted Merganser: W-R
Turkey Vulture: R-C
Black Vulture: R-C
Sharp-shinned Hawk: R-R
Cooper's Hawk: R-R
Red-tailed Hawk: R-C -1
Red-shouldered Hawk: R-C
Marsh Hawk: W-U
Osprey: M-U
Sparrow Hawk: W-U
Bobwhite: R-C
Turkey: R-U
Virginia Rail: M-R
Sora: M-R
Killdeer: R-C
Black-bellied Plover: M-R
American Woodcock: R-U
Common Snipe: W-C
Lesser Yellowlegs: M-R
Least Sandpiper: W-U
Ring-billed Gull: W-R
Rock Dove: R-U
Mourning Dove: R-A -1
Broad-winged Hawk:

Ground Dove: R-U
Barn Owl: R-U
Screech Owl: R-U
Great Horned Owl: R-C
Barred Owl: R-C
Ruby-throated Hummingbird: S-C
Belted Kingfisher: R-C
Yellow-shafted Flicker: R-C -1
Red-bellied Woodpecker: R-A -4
Red-headed Woodpecker: R-U
Yellow-bellied Sapsucker: W-U
Hairy Woodpecker: R-U
Downy Woodpecker: R-C -1
Red-cockaded Woodpecker: R-R
Eastern Kingbird: S-C
Eastern Phoebe: W-C
Acadian Flycatcher: S-C
Least Flycatcher: M-U
Eastern Wood Pewee: S-C
Tree Swallow: M-U
Bank Swallow: M-U
Rough-winged Swallow: S-C
Barn Swallow: M-U
Purple Martin: R-C
Blue Jay: R-A -2
Common Crow: R-C -2
Fish Crow: R-U
Carolina Chickadee: R-A -1
Tufted Titmouse: R-A -1
Red-breasted Nuthach: W-U
Brown-headed Nuthatch: R-C -2
Brown Creeper: W-U
House Wren: W-R
Winter Wren: W-U
Carolina Wren: R-C -3
Mockingbird: R-A -2
Catbird: R-R,C
Brown Thrasher: R-A -1
Robin: R-A
Wood Thrush: S-C
Eastern Bluebird: R-U
Blue-grey Gnatcatcher: S-U
Golden-crowned Kinglet: W-U
Ruby-Crowned Kinglet: W-A
Water Pipit: W-C
Cedar Waxwing: W-C
Loggerhead Shrike: R-C -3
Starling: R-C
White-eyed Vireo: S-C -3
Yellow-throated Vireo: S-C
Red-eyed Vireo: S-C
Black-and-white Warbler-M-U
Prothonotary Warbler: S-C
Worm-eating Warbler: S-R
Golden-winged Warbler: M-U
Tennessee Warbler: M-C
Orange Crowned Warbler: M(W)-U
Parula Warbler: S(M)-U
Yellow Warbler: S-U
Myrtle Warbler: W-C
Pileated Woodpecker -3
Yellow-billed Cuckoo -1
Chimney Swift

Yellow-throated Warbler: S-U
Pine Warbler: R-C -1
Prairie Warbler: S-C
Palm Warbler: M-U
Louisiana Waterthrush: S-U
Kentucky Warbler: S-U
Yellowthroat: R-C
Yellow-breasted Chat: S-C
Hooded Warbler: S-C
American Redstart: S-C
Eastern Meadowlark: R-C
Redwinged Blackbird: R-C
Orchard Oriole: S-C
Baltimore Oriole: M(W)-U
Rusty Blackbird: W-U
Common Grackle: R-C
Brown-headed Cowbird: R-C
Scarlet Tanager: M-U
Summer Tanager: R-C -1
Cardinal: R-A -1
Rose-breasted Grosbeak: M-U
Glue Grosbeak: S-C
Indigo Buntings: S-C
Dickcissel: S-R
Evening Grosbeak: W-U
Purple Finch: W-C
Pine Siskin: W-U
American Goldfinch: R-U
Rufous-sided Towhee: R-A -2
Savannah Sparrow: W-C
Grasshopper Sparrow: R-U
Vesper Sparrow: W-U
Bachman's Sparrow: R-U
Slate-colored Junco: W-C
Chipping Sparrow: R-C
Field Sparrow: R-C
White-crowned Sparrow: W-R
White-throated Sparrow: W-A
Fox Sparrow: W-C
Swamp Sparrow: W-C
Song Sparrow: W-C

Additional Remarks

24 Species
51 Individuals
13.8/Hr.

*Use of the term "Rare" serves only as an indication of frequency of observation. It does not describe the existence of the birds as recorded in the Federal or State classifications of rare, endangered, or protected species.

1

TABLE 2.7A-2

FISH POPULATION SUMMARY (75)

Location Choctawhatchee River Below Highway 90 Bridge **Date** June 26, 1974

Collected U. S. Fish and Wildlife Service electroshocking boat **Time** 1130-1200 hrs
Water quality: turbidity NA*, D. O. 8 ppm, surface temperature 79°F, pH 6.8, total hardness 30 ppm

NUMBER AND WEIGHT OF EACH SPECIES

	Highfin Carpsucker			Blacktail Redhorse					
	TL[1]	WGT[2]	K(TL)[3]	TL	WGT	K(TL)	TL	WGT	K(TL)
	40.5	760	1.14	34.0	296	0.75			
	37.0	560	1.11	20.0	174	2.18			
	36.0	470	1.01						
	34.0	590	1.50						
	31.0	460	1.54						

NUMBER AND WEIGHT OF EACH SPECIES

1

NUMBER AND WEIGHT OF EACH SPECIES

[1]total length in centimeters
[2]weight in grams
[3]condition index using total length
*not available

TABLE 2.7A-2 (Continued)

Location Choctawhatchee River Above Highway 90 Bridge **Date** June 26, 1974

Collected U. S. Fish and Wildlife Service electroshocking boat **Time** 1245-1315 hrs
Water quality: turbidity NA*, D. O. 8.0 ppm, surface temperature 79°F, pH 6.8, total hardness 30 ppm

NUMBER AND WEIGHT OF EACH SPECIES

	Largemouth Bass			Bluegill			Spotted Sunfish		
	TL[1]	WGT[2]	K(TL)[3]	TL	WGT	K(TL)	TL	WGT	K(TL)
	17.5	55	1.03	16.0	90	2.20	14.5	80	2.62
				26.5	450	2.42	15.0	90	2.67

NUMBER AND WEIGHT OF EACH SPECIES

	Highfin Carpsucker			Blacktail Redhorse			Spotted Sucker		
	TL	WGT	K(TL)	TL	WGT	K(TL)	TL	WGT	K(TL)
	39.5	630	1.02	31.5	259.3	0.83	16.0	40	0.98
	32.0	500	1.53	29.0	238.5	0.98			
	32.0	460	1.40	21.0	172.2	1.86			
	38.5	640	1.12						

NUMBER AND WEIGHT OF EACH SPECIES

	Spotted Gar			Blacktail Shiner					
	TL	WGT	K(TL)	TL	WGT	K(TL)	TL	WGT	K(TL)
	46.0	350	0.36	10.0	12.1	1.21			
				6.5	7.9	2.88			

[1]total length in centimeters
[2]weight in grams
[3]condition index using total length
*not available

1

TABLE 2.7A-2 (Continued)

Location Choctawhatchee River Below Highway 90 Bridge **Date** July 16, 1974

Collected U. S. Fish and Wildlife Service electroshocking boat **Time** 1130-1200 hrs

Water quality: turbidity 10 JTU, D. O. 7 ppm, surface temperature 84°F, pH 7.6, total hardness 40 ppm

NUMBER AND WEIGHT OF EACH SPECIES

	Largemouth Bass			Bluegill			Alabama Shad		
	TL[1]	WGT[2]	K(TL)[3]	TL	WGT	K(TL)	TL	WGT	K(TL)
	48.0	1710	1.55	25.0	355	2.27	9.5	10	1.17
	52.0	2350	1.67	16.0	75	1.83			
	35.5	640	1.43	19.0	125	1.82			

NUMBER AND WEIGHT OF EACH SPECIES

	Blacktail Shiner			Redear Sunfish			Quillback		
	TL	WGT	K(TL)	TL	WGT	K(TL)	TL	WGT	K(TL)
	9.0	7.6	1.04	9.0	15	2.06	42.0	790	1.07
	10.5	8.9	0.77				39.0	610	1.03
	9.0	7.6	1.04				36.5	490	1.01
	7.0	6.0	1.75				21.0	710	0.77
	11.5	9.8	0.64				30.5	375	1.32
							38.0	790	1.44
							32.0	450	1.37
							38.0	650	1.18

1

NUMBER AND WEIGHT OF EACH SPECIES

	Quillback (cont.)								
	TL	WGT	K(TL)	TL	WGT	K(TL)	TL	WGT	K(TL)
	38.0	500	0.91						
	35.5	500	1.12						
	40.5	725	1.09						
	42.0	790	1.07						
	35.5	500	1.12						

[1]total length in centimeters
[2]weight in grams
[3]condition index using total length

TABLE 2.7A-2 (Continued)

Location Choctawhatchee River at Mouth of Wrights Creek **Date** July 16, 1974

Collected U. S. Fish and Wildlife Service electroshocking boat **Time** 1320-1350 hrs
Water quality: turbidity 10 JTU, D. O. 10 ppm, surface temperature 84°F, pH 7.6, total hardness 40 ppm

NUMBER AND WEIGHT OF EACH SPECIES

	Largemouth Bass			Longnose Gar			Spotted Sucker		
	TL[1]	WGT[2]	K(TL)[3]	TL	WGT	K(TL)	TL	WGT	K(TL)
	40.0	870	1.36	102.0	2670	0.25	47.0	1190	1.15
				71.5	800	0.22	45.0	1025	1.12
				41.0	110	0.16			

NUMBER AND WEIGHT OF EACH SPECIES

	Blacktail Redhorse			Bowfin			Blacktail Shiner		
	TL	WGT	K(TL)	TL	WGT	K(TL)	TL	WGT	K(TL)
	28.5	250	1.08	44.5	945	1.07	8.0	5	0.98
				56.5	1895	1.05			

NUMBER AND WEIGHT OF EACH SPECIES

	Rockbass								
	TL	WGT	K(TL)	TL	WGT	K(TL)	TL	WGT	K(TL)
	25.5	415	2.50						

[1]total length in centimeters
[2]weight in grams
[3]condition index using total length

TABLE 2.7A-2 (Continued)

Location Choctawhatchee River Below Highway 90 Bridge **Date** Aug. 12, 1974

Collected U. S. Fish and Wildlife Service electroshocking boat **Time** 1145-1215 hrs
Water quality: D. O. 7, surface temperature 83°F, pH 6.9, total hardness 30 ppm

NUMBER AND WEIGHT OF EACH SPECIES

	Largemouth Bass			Highfin Carpsucker			Longnose Gar		
	TL[1]	WGT[2]	K(TL)[3]	LT	WGT	K(TL)	TL	WGT	K(TL)
	45.0	1400	1.54	30.5	325	1.15	36.5	82.1	0.17
							39.0	87.9	0.15
							41.5	110	0.15

NUMBER AND WEIGHT OF EACH SPECIES

	Bluegill			Spotted Sunfish			Blacktail Shiner		
	TL	WGT	K(TL)	TL	WGT	K(TL)	TL	WGT	K(TL)
	12.0	34.8	2.01	8.0	12.1	2.36	8.0	2.2	0.43
	13.0	37.6	1.71	~~8.5~~	~~12.9~~	~~2.10~~	7.0	1.9	0.55
	13.0	37.6	1.71				3.5	0.9	2.10

1

NUMBER AND WEIGHT OF EACH SPECIES

[1] total length in centimeters
[2] weight in grams
[3] condition index using total length

TABLE 2.7A-2 (Continued)

Location Choctawhatchee River, Wards Landing to Mouth of Wrights Creek **Date** Aug. 12, 1974

Collected U. S. Fish and Wildlife Service electroshocking boat **Time** 1300-1330 hrs
Water quality: D. O. 7, surface temperature 83°F, pH 6.9, total hardness 30 ppm

NUMBER AND WEIGHT OF EACH SPECIES

	Largemouth Bass			Rockbass			Quillback		
	TL[1]	WGT[2]	K(TL)[3]	TL	WGT	K(TL)	TL	WGT	K(TL)
	53.0	2200	1.48	24.5	335	2.28	37.0	510	1.01
	34.0	600	1.53						

NUMBER AND WEIGHT OF EACH SPECIES

	Spotted Gar			Bluegill			Blacktail Shiner		
	TL	WGT	K(TL)	TL	WGT	K(TL)	TL	WGT	K(TL)
	51.0	850	0.64	14.5	45	1.48	10.5	7.1	0.61
				11.0	20	1.50	10.5	7.1	0.61
							8.5	5.8	0.94

1

NUMBER AND WEIGHT OF EACH SPECIES

	Blacktail Redhorse			Hogchoker					
	TL	WGT	K(TL)	TL	WGT	K(TL)	TL	WGT	K(TL)
	7.5	5	1.19	9.0	10	1.37			

[1]total length in centimeters
[2]weight in grams
[3]condition index using total length

TABLE 2.7A-3

FISH COLLECTED BY FEDERAL BIOLOGISTS IN 15-FOOT SEINE HAULS FOR THE NORTHWEST FLORIDA STRIPED BASS PROJECT (75)

August 16, 1973 - Holmes County: from Choctawhatchee River from U. S. Highway No. 90 bridge to upstream 1-1/2 miles during daylight hours.

No.	Species	No.	Species
8	*Alosa alabamae*	18	*Hybopsis* spp (juveniles)
5	*Dorosoma cepedianum*	12	*Notropis venustus*
23	*Carpiode velifer*	1	*Lepomis megalotis*
5	*Moxostoma poecilurum*	3	*Micropterus salmoides*
1	*Ericymba buccata*	2	*Ammocrypta beanii*
1	*Hybopsis ambylops*	1	*Trinectes maculatus*

1

August 29, 1973 - Holmes County: from Choctawhatchee River from U. S. Highway No. 90 bridge to 1 mile downstream during daylight hours.

No.	Species	No.	Species
1	*Lepisosteus osseus*	3	*Ictalurus punctatus*
1	*Esox niger*	1	*Labidesthes sicculus*
64	*Notropis venustus*	1	*Lepomis* spp. (juvenile)
83	*Notropis texanus*	1	*Pomoxis nigromaculatus*
1	*Hybopsis aestivalis*	2	*Micropterus salmoides*
7	*Carpiodes cyprinus*	1	*Percina caproides*
1	*Carpiodes carpio*	1	*Percina nigrofasciata*
2	*Moxostoma poecilurum*		

APPENDIX E

SECTION 1 OF APPENDIX E

This space is reserved for appendix material to section 4.1, "Site Preparation and Plant Construction." This material will be added by a subsequent amendment to this Site Certification Application. 2

APPENDIX F

SECTION 1 OF APPENDIX F 2

The following is a technical discussion of the Theis Nonequilibrium Method and the Cooper Leaky Aquifer Method as they relate to Ground Water. This Section is referenced in the fifth paragraph of subsection 6.4.1.1, "Model to Predict Changes in Ground-Water Levels." 2

6.4A.1 Theis Nonequilibrium Method

Gulf analyzed the results of the pumping test in the shallow aquifer by the following nonequilibrium formula (1):

$$s = \frac{114.6Q}{T} W(u)$$ 2

Where

$$W(u) = \int_u^{\infty} \frac{e^{-u}}{u} du = -0.5772 - \log_e(u) + u - \frac{u^2}{2x2!} + \frac{u^3}{3x3!} - \frac{u^4}{4x4!} + \cdots$$

$$u = 1.87\ r^2S/Tt$$

and

s is the drawdown, in feet, at any point of observation in the vicinity of a well discharging at a constant rate,

Q is the rate of discharge in gallons per minute, 2

T is the coefficient of transmissibility, in gallons per day per foot,

r is the distance, in feet, from the discharging well to the observation well,

S is the coefficient of storage expressed as a decimal fraction, and

t is the time, in days, since pumping began.

6.4A.2 Cooper Leaky Aquifer Method

The coefficients of transmissibility and storage of a leaky artesian aquifer and the leakage P'/m' of the confining bed can be determined from nonsteady-state drawdowns. The method is an extension of the Theis graphic method for solving the nonequilibrium formula. If the coefficients of transmissibility and storage are known or can be determined, the method can be used for the prediction of drawdowns.

The Cooper leaky aquifer formula may be written as:

where

$$T = 114.6Q \frac{L(u, v)}{s}$$

$$S = \frac{T(t/r^2)}{1.87(1/u)}$$

$$\frac{P'}{m'} = 7.485S \frac{v^2/u}{t}$$

and L(u,v) is the leaky aquifer function

T is the transmissibility, in gallons per day per foot,

Q is the rate of discharge, in gallons per minute,

s is the drawdown, in feet, at any point of observation in the vicinity of a well discharging at a constant rate,

S is the coefficient of storage expressed as a decimal fraction,

r is the distance, in feet, from the discharging well to the observation well,

t is the time in days, since pumping began,

P' is the vertical permeability of the confining bed,

m' is the thickness, in feet, of the confining bed, and

$\frac{P'}{m'}$ is the leakage in gallons per day per square feet.

Because geologic and hydrologic conditions are favorable in the Caryville area, the coefficients of transmissibility, storage, and leakage can be used (a) to estimate the rate and amount of lowering in water levels to be expected at various rates and distribution of pumping. (b) to determine optimum well yields, and (c) to determine the proper spacing of wells to effectively develop the required amount of water on a perennial basis.

6.4A.3 Reference for Section1 to Appendix F 2

(1) Theis, C. V. "Relation between the lowering of the piezometric surface and the rate and discharge of a well using ground-water storage." Am. Geophys. Union Trans., Pt. 2, pp. 519-524, 1935.

Caryville Steam Plant

Site Certification Application

VOLUME 3

GULF POWER Company

APRIL, 1975

COPY NO. 37

AMENDMENT 3

PAGE INSERTION GUIDE

Update your copy of the Caryville Steam Plant Site Certification Application by inserting this Amendment into it. Page-by-page instructions for adding, replacing, or deleting pages are given below. Note that only right-hand pages are listed in these instructions. In each case, a right-hand page number is given to identify the whole sheet (front and back) on which it appears. Thus, left-hand pages printed on the back of these sheets are also effected.

To improve readibility of the following tabular information, a double-space break separates every fifty entry.

RIGHT-HAND PAGE NUMBER	INSTRUCTION
Amendment 2 Page Insertion Guide (Pages 1 through 12 of 12)	Delete
Amendment 3 Page Insertion Guide (Pages 1 through 10 of 10)	Add
Volume 1 Amendment 2 Amendment Status Page (Pages A through G/H of G/H)	Delete
Volume 1 Amendment 3 Amendment Status Page (Pages A through J of J)	Add
i (Volume 1 Book Table of Contents)	Replace
iii (Volume 1 Book Table of Contents)	Replace
v (Volume 1 Book Table of Contents)	Replace
2-i (Chapter 2.0 Table of Contents)	Replace
2-iii (Chapter 2.0 Table of Contents)	Replace
2-v (Chapter 2.0 List of Tables)	Replace
2.3-1/2.3-2	Replace
2.7-69	Replace
Figure 2.7-6	Replace
2.9-1	Replace
2.9-3	Replace
Table 2.9-4	Replace
Table 2.9-5	Add
Volume 2 Amendment 2 Amendment Status Page (Pages A through G/H of G/H)	Delete
Volume 2 Amendment 3 Amendment Status Page (Pages A through J of J)	Add
i (Volume 2 Book Table of Contents)	Replace

3

RIGHT-HAND PAGE-NUMBER	INSTRUCTION
iii (Volume 2 Book Table of Contents)	Replace
v (Volume 2 Book Table of Contents)	Replace
3-i (Chapter 3.0 Table of Contents)	Replace
3-iii (Chapter 3.0 Table of Contents)	Replace
3-v (Chapter 3.0 List of Tables)	Replace
3-vii (Chpater 3.0 List of Figures)	Delete
3-viii/3-viii (Chapter 3.0 List of Figures)	Add
3.3-1	Replace
3.4-1	Replace
Table 3.4-2	Replace
Table 3.4-6	Replace
3.5-1	Replace
3.5-3	Replace
3.5-5	Replace
3.5-7	Replace
3.5-9	Replace
3.5-11	Replace
3.5-13	Replace
3.5-15	Delete
Table 3.5-1	Replace
Table 3.5-2	Replace
Table 3.5-3	Replace
Table 3.5-4	Delete
Table 3.5-5	Delete
Table 3.5-6	Delete
Table 3.5-7	Delete
Table 3.5-8	Delete
Table 3.5-9	Delete
Figure 3.5-1	Replace
Figure 3.5-7	Replace
3.6-1	Replace
3.6-3	Add
3.6-5/3.6-6	Add
Table 3.6-1	Add
Figure 3.6-1	Add
Figure 3.6-2	Add
Figure 3.6-3	Add
Figure 3.6-4	Add
4-i (Chapter 4.0 Table of Contents)	Replace
4.1-5	Replace

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RIGHT-HAND PAGE NUMBER	INSTRUCTION
4.1-9	Replace
4.2-1/4.2-2	Replace
5-i (Chapter 5.0 Table of Contents)	Replace
5-iii (Chapter 5.0 List of Tables)	Replace
5-v (Chapter 5.0 List of Figures)	Replace
5.1-1	Replace
5.1-3	Replace
5.1-5	Replace
5.1-7	Replace
Table 5.1-1	Replace
Table 5.1-2	Delete
Figure 5.1-1	Replace
Figure 5.1-2	Replace
Figure 5.1-3	Replace
Figure 5.1-4	Replace
Figure 5.1-5	Replace
Figure 5.1-6	Replace
Figure 5.1-7	Replace
Figure 5.1-8	Add
5.2-1	Replace
5.2-3	Replace
5.2-5/5.2-6	Replace
Figure 5.2-1	Replace
Figure 5.2-2	Replace
Figure 5.2-3	Replace
Figure 5.2-4	Replace
Figure 5.2-5	Replace
Figure 5.2-6	Add
Figure 5.2-7	Add
5.6-1	Replace
5.6-3	Replace
5.6-5/5.6-6	Add
Figure 5.6-4	Add
Figure 5.6-5	Add
Figure 5.6-6	Add
Figure 5.6-7	Add
6-i (Chapter 6.0 Table of Contents)	Replace
6.4-5	Replace
6.4-7	Add
*Volume 3 Amendment 3 Amendment Status Page (Pages A through J of J)	Add
i (Volume 3 Book Table of Contents)	Add

3

*SEE NOTE AT BOTTOM OF PAGE 10

RIGHT-HAND PAGE-NUMBER	INSTRUCTION	
iii (Volume 3 Book Table of Contents)	Add	
v (Volume 3 Book Table of Contents)	Add	
A-i/A-ii (Appendices)	Replace	
S1-i/S1-ii (Section 1 of Appendix A)	Replace	
i/ii	Add	
1	Add	
3	Add	
5	Add	
7	Add	
9	Add	
11	Add	
13	Add	
15	Add	
17	Add	
19	Add	
21	Add	
23	Add	
25	Add	3
27	Add	
29	Add	
31	Add	
33	Add	
35	Add	
37	Add	
39	Add	
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43	Add	
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61	Add	
63	Add	
65	Add	
67	Add	
69	Add	

RIGHT-HAND PAGE NUMBER	INSTRUCTION	
71	Add	
73	Add	
75	Add	
77	Add	
79	Add	
81	Add	
83	Add	
85	Add	
87	Add	
89	Add	
91	Add	
93/94	Add	
S2-i/S2-ii (Section 2 of Appendix D)	Add	
i/ii	Add	
iii	Add	
v	Add	
vii	Add	
ix	Add	
I-1	Add	3
I-3	Add	
I-5	Add	
I-7	Add	
II-1	Add	
II-3		
III-1	Add	
III-3 (Figure III-1)	Add	
blank page (backed by page III-4)	Add	
III-5 (Figure III-2)	Add	
blank page (backed by page III-6)	Add	
III-7	Add	
III-9 (Sheet 1 of 2) (Figure III-3a)	Add	
III-9 (Sheet 2 of 2) (Figure III-3b)	Add	
blank page (backed by page III-10)	Add	
III-11 (Figure III-4A and Figure III-4B)	Add	
blank page (backed by page III-12)	Add	
III-13 (backed by blank page)	Add	
III-14 (Figure III-5)	Add	
III-15 (backed by blank page)	Add	
III-16 (Figure III-6)	Add	
III-17 (Figure III-7)	Add	

RIGHT-HAND PAGE NUMBER	INSTRUCTION
III-18 (Figure III-8)	Add
III-19	Add
III-21 (Figure III-9)	Add
blank page (backed by page III-22)	Add
III-23	Add
III-25	Add
III-27 (backed by blank page)	Add
III-28 (Figure III-10)	Add
III-29 (Figure III-11)	Add
III-30 (Figure III-12)	Add
III-31	Add
III-33 (Figure III-13)	Add
III-34 (Figure 13a)	Add
III-35	Add
III-37	Add
III-39	Add
III-41	Add
III-43	Add
III-45	Add
III-47	Add
III-49	Add
III-51	Add
III-53	Add
III-55 (Figure III-14)	Add
blank page (backed by page III-56)	Add
III-57	Add
III-59	Add
III-61	Add
III-63	Add
III-65	Add
III-67	Add
III-69	Add
III-71	Add
III-73 (Figure III-15)	Add
III-74 (Figure III-16)	Add
III-75 (Figure III-17)	Add
blank page (backed by page III-76)	Add
III-77	Add
III-79	Add
III-81	Add

3

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RIGHT-HAND PAGE NUMBER	INSTRUCTION
III-83	Add
III-85	Add
III-86 (Figure III-18)	Add
III-87	Add
IV-1	Add
IV-3	Add
IV-5 (Figure IV-1)	Add
blank page (backed by page IV-6)	Add
IV-7	Add
IV-9	Add
IV-11 (backed by blank page)	Add
IV-12 (Figure IV-2)	Add
IV-13 (Figure IV-3)	Add
IV-14 (Figure IV-4)	Add
IV-15 (backed by blank page)	Add
IV-16 (Figure IV-5)	Add
IV-17 (backed by blank page)	Add
IV-18 (Figure IV-6)	Add 3
IV-19 (Figure IV-7)	Add
blank page (backed by page IV-20)	Add
IV-21	Add
IV-23	Add
IV-25	Add
IV-27	Add
IV-29 (Figure IV-8)	Add
blank page (backed by page IV-30)	Add
IV-31	Add
IV-33	Add
IV-35	Add
IV-37	Add
IV-39	Add
IV-41	Add
IV-43	Add
IV-45	Add
IV-47	Add
IV-49 (Figure IV-9)	Add
blank page (backed by page IV-50)	Add
IV-51	Add
IV-53	Add
IV-55	Add

RIGHT-HAND PAGE NUMBER	INSTRUCTION
IV-57	Add
IV-59	Add
IV-61	Add
IV-63 (backed by blank page)	Add
IV-64 (Figure IV-10)	Add
IV-65	Add
IV-67	Add
IV-69	Add
IV-71	Add
IV-73	Add
IV-75	Add
IV-77	Add
IV-79	Add
IV-81	Add
IV-83	Add
IV-85	Add
V-1 (backed by blank page)	Add
V-2 (Figure V-1)	Add
V-3 (Figure V-2)	Add
blank page (backed by page V-4)	Add
V-5	Add
V-7	Add
V-9	Add
V-11	Add
V-13	Add
V-15	Add
V-17	Add
V-19	Add
V-21 (backed by blank page)	Add
V-22 (Figure V-3)	Add
V-23	Add
V-25	Add
VI-1	Add
VI-3	Add
VI-5	Add
VI-7	Add
S1-i/S1-ii (Section 1 of Appendix E)	Replace
1 (backed by blank page)	Add
Map 1	Add
3	Add

3

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RIGHT-HAND PAGE-NUMBER	INSTRUCTION	
Map 2	Add	
blank page (backed by page 6)	Add	
7	Add	
9	Add	
11	Add	
13	Add	
15	Add	
17	Add	
19	Add	
Map 3	Add	
Map 4	Add	
23	Add	
25	Add	
27 (Figure 5)	Add	
blank page (backed by page 28)	Add	
29	Add	
31 (backed by blank page)	Add	
Map 6	Add	
33	Add	3
35	Add	
37	Add	
39 (backed by blank page)	Add	
Map 7	Add	
41	Add	
43	Add	
45	Add	
47	Add	
49	Add	
51	Add	
53	Add	
55	Add	
57	Add	
59	Add	
61	Add	
63	Add	
65	Add	
67	Add	
69	Add	
61	Add	
73	Add	

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RIGHT-HAND PAGE NUMBER	INSTRUCTION
75	Add
77	Add
79	Add
81/82	Add
83	Add
85	Add

3

*NOTE: With amendment 3, this publication will now occupy three binders (volumes). Volume 2 ends with page 6.4-7 and page 6.4-8. Remove all of the appendix tabs from volume 2 and place them in volume 3.

AMENDMENT STATUS PAGE

Periodically throughout the life of this document, new pages will be added, some existing pages will be deleted, and some existing pages will be amended and replaced. Such changes are called amendments and are accomplished to reflect updated information and agreements between Gulf Power Company and various regulatory agencies.

Insert latest amended pages and dispose of superseded pages in accordance with the amended page status indicated below.

NOTES: A. A zero in the amendment number column indicates an original page. An arabic number in this column indicates the latest amendment number to a page.

B. On an amended text or table page, that portion of the text or table affected by the latest amendment is indicated by a vertical line and an amendment number in the outer margin of the page, and the latest amendment number and date is shown at the bottom of that page.

C. Amendments to figures (illustrations) are indicated by the latest amendment number and its date above the title block.

D. Occasionally a page of text, a table, or a figure may be replaced which has been amended only, for example, to correct a misspelled word or to improve its visual appearance. Such a page will not have the vertical line, amendment number, etc.

E. To improve readability of the following tabular information, a double-space break separates every fifth entry.

3

Page Number	Amendment Number	
1-i through 1-ii	0	
1.1-1	0	
1.1-2	1	
Fla. Certification	0	
Figure 1.1-1	0	
Title Page (Chapter 2.0)	0	
2-i		
2-ii	2	
2-iii	3	
2-iv	2	
2-v	1	
2-vi	3	
2-vii	2	
2-viii	1	
2-ix	2	
2-x through 2-xi	1	
2-xii	0	
2-xiii	1	
2-xiv	0	3
2.1-1/2.1-2	0	
Figure 2.1-1 through Figure 2.1-2	0	
2.2-1 through 2.2-5/2.2-6	0	
Table 2.2-1 through Table 2.2-2	0	
Figure 2.2-1 through Figure 2.2-5	0	
2.3-1/2.3-2		
Figure 2.3-1	0	
Figure 2.3-2	2	
2.4-1	0	
2.4-2 through 2.4-6	2	
2.4-7 through 2.4-9	0	
2.4-10 through 2.4-11	2	
2.4-12 through 2.4-13/2.4-14	0	
Figure 2.4-1	0	
Figure 2.4-2	2	
Figure 2.4-3	0	
Figure 2.4-4	2	
Figure 2.4-5	0	
Figure 2.4-6 through Figure 2.4-6c	2	
Figure 2.4-7	2	
Figure 2.4-8 through Figure 2.4-9	0	
Figure 2.4-10	1	
Figure 2.4-11	0	
Figure 2.4-12	1	

Page Number	Amendment Number
Figure 2.4-13 through Figure 2.4-15	0
Figure 2.4-16	2
Figure 2.4-17 through 2.4-18	0
Figure 2.4-19	2
2.5-1 through 2.5-3	2
2.5-4	0
2.5-5 through 2.5-12	2
2.5-9/2.5-10	0
Table 2.5-1	2
Table 2.5-2 through Table 2.5-6	0
Table 2.5-6a through Table 2.5-6b	2
Table 2.5-7	0
Figure 2.5-1 through Figure 2.5-3	0
Figure 2.5-4	2
Figure 2.5-5 through Figure 2.5-17	0
Figure 2.5-17a	2
Figure 2.5-18	0
Figure 2.5-18a	2
Figure 2.5-19	0
Figure 2.5-19a	2
Figure 2.5-20 through Figure 2.5-39	0
2.6-1	1
2.6-2	2
2.6-3 through 2.6-5/2.6-6	1
Table 2.6-1 through Table 2.6-10	1
Figure 2.6-1 through Figure 2.6-6	1
2.7-1 through 2.7-44	0
2.7-45 through 2.7-46	2
2.7-47 through 2.7-61	1
2.7-62 through 2.7-63	2
2.7-64 through 2.7-68	1
2.7-69	3
2.7-70 through 2.7-71	0
2.7-72 through 2.7-78	1
Table 2.7-1 through Table 2.7-10	0
Table 2.7-11 through Table 2.7-25	1
Figure 2.7-1 through Figure 2.7-5	0

3

Page Number	Amendment Number	
Figure 2.7-6	3	
Figure 2.7-7 through Figure 2.7-62	1	
Figure 2.7-63 (Sheet 1 of 3)	2	
Figure 2.7-63 (Sheet 2 and 3 of 3)	1	
Figure 2.7-6 through Figure 2.7-65	1	
2.8-1/2.8-2	1	
2.9-1 through 2.9-4	3	
2.9-5/2.9-6	0	
Table 2.9-1 through Table 2.9-3	0	
Table 2.9-4	3	
Table 2.9-5	0	
Figure 2.9-1 through Figure 2.9-6	0	
Title Page (Volume 2)	0	
A through G/H (Volume 2 Amendment Status Page)	2	
i through vi	3	
Title Page (Chapter 3.0)	0	
3-i	2	
3-ii through 3-iv	3	3
3-v	2	
3-vi	3	
3-vii/3-viii	2	
3.1-1	0	
3.1-2	2	
Figure 3.1-1 through Figure 3.1-2	2	
Figure 3.1-3	0	
3.2-1 through 3.2-4	2	
3.2-5/3.2-6	0	
3.3-1 through 3.3-2	3	
Table 3.3-1 through 3.3-3	2	
Table 3.3-4	0	
Table 3.3-5	2	
Figure 3.3-1	2	
3.4-1 through 3.4-2	3	
3.4-3 through 3.4-5/3.4-6	2	
Table 3.4-1	0	
Table 3.4-2	3	
Table 3.4-3 through Table 3.4-5	2	
Table 3.4-6	3	
Figure 3.4-1	2	
Figure 3.4-2	0	
Figure 3.4-3 through Figure 3.4-4	2	

Page Number	Amendment Number	
3.5-1 through 3.5-2	3	
3.5-3	0	
3.5-4 through 3.5-13	3	
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Table 3.5-1 through 3.5-3	3	
Figure 3.5-1	3	
Figure 3.5-2 through Figure 3.5-6	0	
Figure 3.5-7	3	
3.6-1 through 3.6-5/3.6-6	3	
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2.0 THE SITE

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2.0 THE SITE

LIST OF TABLES (Continued)

2.3 Regional Historic, Scenic, Cultural, and Natural Landmarks

2.3.1 Landmarks

According to Mr. E. W. Carswell, Editor, Washington County News (Florida), and other local citizens, no significant historic, cultural, or natural landmarks exist in the area. However, portions of Hathaway Mill, a gristmill first opened in the late 1800's and in operation until about 1959, are to be found to the northwest of the proposed plant site. No sites in the five-mile radius area are listed in the National Register of Historic Places; the National Registry of Natural Landmarks; or on the historical identification maps maintained by the State of Florida Bureau of Historic Sites and Properties, Division of Archives, History, and Records Management. No unusual or unique scenic site or vista is located within the five-mile radius.

2.3.2 Archaeological Significance

Figure 2.3-1 shows various archaeological sites within the five-mile radius area identified by the State of Florida Bureau of Historic Sites and Properties, Division of Archives, History, and Records Management. The number adjacent to each site corresponds to the State of Florida's listing. The sites shown represent only an initial identification of archaeological sites in the area by the State of Florida. A survey is currently being conducted by the Division of Archives, History, and Records Management to ensure a complete listing. Gulf will develop and carry out specific preservation or excavation plans as warranted on the basis of the survey.

2.3.3 Archaeological Sites Along Transmission Line Rights-Of-Way

Figure 2.3-2 shows the location of archaeological sites adjacent to the proposed transmission line rights-of-way. These are sites identified by the State of Florida Bureau of Historic Sites and Properties, Division of Archives, History, and Records Management. The sites shown represent only an initial State of Florida identification of archaeological or historic sites. A more detailed archaeological and historical survey of the transmission line rights-of-way is currently being conducted by the Division of Archives, History, and Records Management.

2.3.4 Archaeological and Historical Survey

For a detailed discussion of an archaeological and historical survey of the proposed power plant site, refer to Section 1 of Appendix A. 3

2.7.2.2.3.4 Summary of Results of Studies - Data collected by Gulf indicated that water quality conditions are relatively high in the study area, as was reflected particularly in the species number and composition of the periphyton populations (attached algae). The populations of attached algae, which form the base of the aquatic food chain, were dominated by diatoms (86 percent by number and 98 percent by volume) in the study area.

2.7.2.2.4 Summary of Recent Fisheries, Benthic, and Periphyton Ecology - Recent biological studies made of the Choctawhatchee River in the proposed Caryville plant site indicate that water quality conditions are relatively high, while the biological productivity of the river is relatively low. Biologically, the study area is characterized by (proceeding from the base of the food chain to fish): a dominance of diatom algae; a dominance of midge and mayflies; and a relatively even distribution of recreational, commercial, rough, and forage type fish. No striped bass or eggs have been collected. The asiatic clam, Corbicula, is the dominant mollusk in the area and poses a threat to the native mollusk fauna, as well as to potential industrial and municipal water users.

2.7.3 Additional Detailed Ecological Data

Refer to Section 2 of Appendix D for additional detailed ecological data supplementary to that contained in 2.7.1 and 2.7.2 above. 3

2.7.4 References

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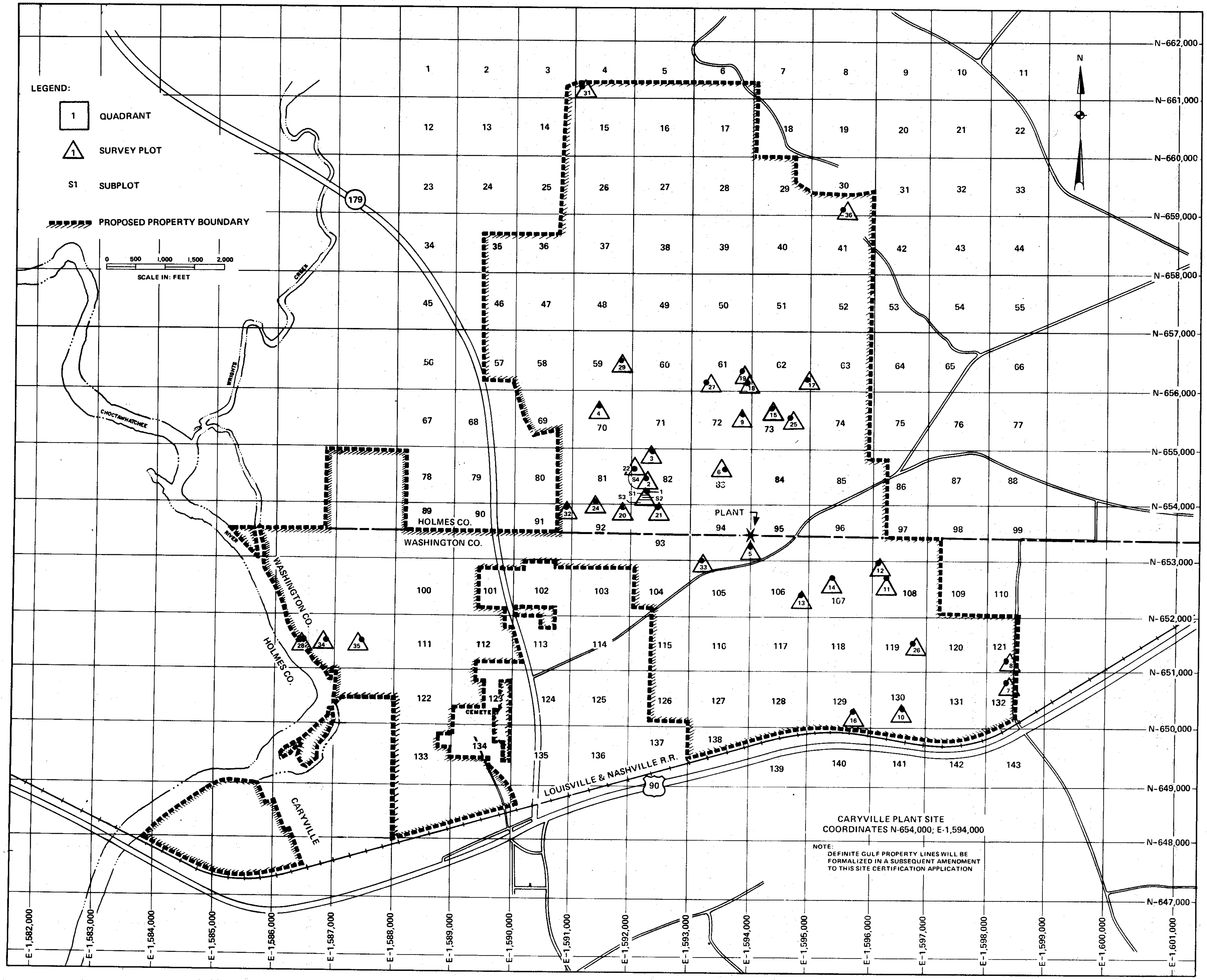

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GULF POWER CO.
CARYVILLE STEAM PLANT

PROPOSED PROPERTY BOUNDARIES AND PROJECTED IMPACT AREA WITH LOCATION OF TERRESTRIAL SURVEY PLOTS

FIGURE 2.7-6

2.9 Other Environmental Features

2.9.1 Sound Level Studies

2.9.1.1 Introduction - This section discusses Gulf's past and presently ongoing ambient sound level studies at the proposed plant site. The purpose of these studies is to determine and document the sound levels which presently exist at several grid coordinates about the site under various temporal, meteorological, and seasonal conditions. Additionally, based on sound level studies conducted at other plant sites, Gulf predicts the expected sound levels during the construction and operation stages of its proposed Caryville plant. (Refer to subsection 5.6.5, "Sound Levels During Plant Operation," for more discussion.)

2.9.1.2 Ambient Sound Levels - During the summer of 1974, Gulf began sound level measurements using the equipment schematically illustrated in figure 2.9-1. These measurements were made at a number of locations around the proposed site to determine ambient sound levels prior to construction and are still being conducted in order to establish seasonal variations in the sound levels.

2.9.1.2.1 Sound Level Monitoring Equipment Formats - The information obtained from the sound level monitoring equipment is presented in a number of different formats as discussed below.

A. An all-weather outdoor microphone system provides the input to the environmental noise classifier. The classifier develops a complete amplitude distribution of sound levels in eleven bands, Such a distribution allows the plotting of histograms for various intervals of time such as per hour, per shift, or per day. A good estimation of both the equivalent sound level, designated L_{eq}, 3
and the sound level exceeded N percent of the time, designated L_N, can also be determined.

B. Short samples of the sound level as a function of time are plotted on the level recorder to illustrate significant aspects of the noise.

C. Magnetic tape recordings are processed using narrow band analyzers to obtain the actual sound spectrum as a function of frequency. Such processing determines if a predominant frequency exists which could cause community noise problems.

D. Octave band data and A-weighted sound level data are tabulated at each site.

2.9.1.2.2 Grid Coordinates - The following descriptions are summaries of results obtained at locations "A," "B," and "C" shown on figure 2.9-2.

A. Florida Grid N-658,500; E-1,596,000 - This location is near the Northeast corner property line. Figure 2.9-3 shows representative plots of sound levels versus time for both daytime and nighttime 3 as observed during the summer of 1974. From this figure, the following sound level can be observed:

	Summer Sound Levels	
	dBA	dB Linear
Daytime	26 to 42	37 to 50
Nighttime	46 to 52	47 to 65

Weather conditions during these tests were (a) clear to partly cloudy, (b) winds ranging from calm to five miles per hour, and (c) daytime Fahrenheit temperatures in the low 90's and nighttime temperatures dropping to the high 70's.

Nighttime sound levels were higher due to an increase in noise associated with crickets, frogs, and other summer night life sounds. A plot of the nighttime sound as a function of frequency, as shown in figure 2.9-4, indicates that the spectrum is concentrated in the 2,000 to 4,000 hertz (Hz) range. Such a spectrum for summer nighttime outdoor sound levels is typical.

Although the subject measurement grid coordinate is approximately 1.5 miles from U.S. Highway No. 90, truck traffic noises were clearly audible and produced intermittent peaks in the sound level. These peaks are quite noticeable in the dB linear plots on figure 2.9-3 for both daytime and nighttime hours. With the low background noise during the day, peaks also occur in the dBA response. However, with the much higher ambient noise level at night, the A-weighted response on figure 2.9-3 remains relatively constant and is essentially controlled by night life sounds. Some truck traffic did increase the sound level by four to five dBA.

Results quite similar to those illustrated in figures 2.9-3 and -4 were obtained when the sound level studies were repeated 3 during the summer of 1975.

Illustrated in figure 2.9-5 are representative plots of sound levels versus time for both daytime and nighttime during winter months. From this figure, the following sound level ranges can be observed:

	Winter Sound Levels	
	dBA	dB Linear
Daytime	26 to 42	43 to 51
Nighttime	15 to 28	30 to 45

Weather conditions during these tests were (a) clear, (b) winds calm to five miles per hour, and (c) daytime Fahrenheit temperatures in the 40's and nighttime temperatures ranging from 25 to 37 degrees.

A comparison of summer and winter sound levels plotted on figures 2.9-3 and -5, respectively, indicates that daytime sound levels are similar for both periods, but nighttime sound levels during the winter are much lower. Virtually no animal or insect sounds were noted during the winter nights but birds were commonly present during winter days. Truck traffic noises from U.S. Highway No. 90 were clearly audible and produced intermittent peaks in the sound level during the winter tests.

B. Florida Grid N-656,000; E-1,591,400 - This location is on the Northwest side of the property and beneath the existing east-west transmission line. The sound levels measured at this point were similar in all respected to those obtained at position A above (Florida grid N-658,500; E-1,596,000).

C. Florida Grid N-649,500; E-1,594,500 - This location is a proposed property line adjacent to the Louisville and Nashville railroad, approximately 250 feet from U.S. Highway No. 90. At this location, the sound level varies over quite a wide range. Figure 2.9-6 is representative of the daytime sound levels observed. With no traffic, the sound level dropped below 40 dBA. With light traffic composed of automobiles only, the sound levels were in the 45 to 55 dBA range. Heavy truck traffic increased the sound level to 70 to 75 dBA.

Gulf used an environmental noise classifier to determine hourly amplitude distributions of the sound level during several different time periods. These distribution data are listed on tables 2.9-1 through -5. From table 2.9-1 note the significant shift in the predominant sound level distribution from 47 to 50 dBA range to the 52 to 55 dBA range. This shift occurred shortly after sunset on September 23, 1974, and continued throughout the remainder of the test period. The shift is attributed to a marked increase in cricket and other night life sounds. The temperature was 72°F at sunset and dropped to only the mid-60's during the night. As shown in table 2.9-3, no such shift occurred during the night of October 2/3, 1974, when the temperature dropped to approximately 40°F. The crickets, etc., were much quieter for this October test. 3

A comparison of the sound level amplitude distributions for the morning hours shown on table 2.9-2 and the afternoon hours shown on table 2.9-1 indicates that the distributions are quite similar. Note also that during daytime hours the sound level was below 45 dBA for approximately 20 minutes each hour, whereas the sound level did not drop below 45 dBA during the nighttime hours for the September test. However, for the October test, the evening sound levels were below 45 dBA for approximately 30 minutes each hour.

A 24-hour sound level distribution study was conducted on June 16-17, 1975, to determine the effect of opening Interstate Highway No. 10 eastward of Bonifay, Florida. The results are shown in table 2.9-4. Although the number of trucks was not determined for each hour, it appears that the number of trucks passing the proposed plant site along U.S. Highway No. 90 has been reduced 3
significantly. This reduction in the number of trucks has caused a corresponding decrease in the duration of sound levels in the 50 to 60 dBA range as may be noted by comparing the data in tables 2.9-1 and -2 with those in table 2.9-4. The upward shift in the sound level distribution at sunset also occurred during this survey.

Table 2.9-5 lists three typical 12-hour dBA amplitude distributions of sound levels taken during nighttime hours using the environmental noise classifier. The distributions were obtained during fall and winter nights when the temperature was 40°F or lower. A comparison of these three distributions reveals that they are similar. Thus, the winter nighttime sound level distributions appear to be repeatable.

2.9.1.2.3 Summary of the Environmental Sound Level Measurements - The sound levels in the ranges greater than 55 dBA were due primarily to trucks. These trucks were counted and the resulting count is shown on tables 2.9-1, -2, and -3. For the 23-hour period covered in the tests, 907 trucks were counted. Based on 6,240 vehicles (1), as the 1973 average daily traffic on U.S. Highway No. 90, this number of trucks represents 15 percent of the total. However, during the nighttime hours, particularly from midnight to 5:00 a.m., trucks were the predominant vehicles. As noted above, the number of trucks has declined with the 3
extension of Interstate Highway No. 10.

At locations "A" and "B," shown in figure 2.9-2, the sound levels are, in general, considerably lower than those at location "C." This is particularly true during the winter nighttime. As a result, it can be concluded that the sound level distribution at location "C" is dominated by truck traffic.

During the summer months insect and other night life sounds increase the ambient sound levels to values considerably higher than those measured during the winter.

TABLE 2.9-4

SOUND LEVEL STUDY (HOURLY INCREMENTS FROM 3 P.M. THROUGH 3 P.M.)
AT CARYVILLE PLANT SITE TYPICAL dBA AMPLITURE DISTRIBUTION OF SOUND LEVEL
AT FLORIDA GRID N-649,500; E-1,594,500

Level \ Time	3-4 p.m.	4-5 p.m.	5-6 p.m.	6-7 p.m.	7-8 p.m.	8-9 p.m.	9-10 p.m.	10 p.m.-7 a.m.
45 to 47	9.5	9.0	8.5	8.7	7.7	0.1	0.0	110.9
47 to 50	13.9	14.2	14.8	12.7	10.0	0.3	0.2	160.0
50 to 52	5.5	5.0	5.1	4.0	4.8	0.5	0.3	51.0
52 to 55	1.5	1.9	1.8	2.1	2.8	30.2	37.0	84.8
55 to 57	2.3	2.8	2.0	2.5	2.7	27.3	20.5	9.2
57 to 60	1.7	2.0	1.8	1.8	1.3	0.7	1.1	8.5
60 to 62	0.4	0.4	0.5	0.4	0.4	0.2	0.2	2.8
62 to 65	0.3	0.5	0.8	0.3	0.5	0.4	0.3	3.4
65 to 67	0.0	0.3	0.2	0.3	0.2	0.2	0.2	1.0
67 to 70	0.1	0.1	0.1	0.2	0.3	0.1	0.1	0.9
70 to 72	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.2
72 to 75	0.0	0.0	2.5	0.1	0.0	0.0	0.1	2.9
Number of Trucks	16							

Level \ Time	7-8 a.m.	8-9 a.m.	9-10 a.m.	10-11 a.m.	11-12 N	12-1 p.m.	1-2 p.m.	2-3 p.m.
45 to 47	11.0	8.8	7.6	8.4	7.0	7.4	7.4	7.7
47 to 50	16.8	12.4	9.5	8.1	8.1	7.7	9.6	10.9
50 to 52	3.7	3.3	2.7	3.8	3.3	4.6	3.2	3.9
52 to 55	4.5	2.1	1.1	0.3	0.4	0.0	0.4	1.5
55 to 57	1.5	1.9	1.7	1.4	1.4	0.2	0.3	1.3
57 to 60	1.3	1.3	1.1	1.4	1.1	0.7	0.5	0.9
60 to 62	0.3	0.4	0.3	0.2	0.5	0.5	0.1	0.2
62 to 65	0.5	0.3	0.4	0.4	0.5	0.1	0.1	0.2
65 to 67	0.1	0.1	0.2	0.3	0.3	0.2	0.2	0.1
67 to 70	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.0
70 to 72	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0
72 to 75	0.0	0.0	0.3	0.0	0.0	0.4	0.0	0.0
Number of Trucks	22	23	20	24	26	11	11	25

Date of Survey: June 16-17, 1975

3

TABLE 2.9-5

SOUND LEVEL STUDY AT CARYVILLE PLANT SITE
TYPICAL 12-HOUR dBA AMPLITUDE DISTRIBUTION OF
SOUND LEVEL AT FLORIDA GRID N-649,500; E-1,594,500 DURING NIGHTTIME HOURS

dBA	October 2-3, 1974		December 9-10, 1974		February 10-11, 1975	
Range	Minutes	Percent	Minutes	Percent	Minutes	Percent
< 45	≈296	41.1	≈245	34.1	≈265	36.8
45 to 47	55.0	7.6	43.8	6.1	59.3	8.2
47 to 50	116.5	16.2	90.7	12.6	113.6	15.8
50 to 52	19.0	2.6	23.1	3.2	25.2	3.5
52 to 55	113.7	15.8	125.3	17.4	129.3	18.0
55 to 57	28.5	4.0	43.2	6.0	34.6	4.8
57 to 60	36.5	5.1	53.5	7.4	36.2	5.0
60 to 62	13.6	1.9	23.3	3.2	13.7	1.9
62 to 65	21.7	3.0	32.4	4.5	21.5	3.0
65 to 67	6.4	0.9	13.7	1.9	8.5	1.1
67 to 70	5.3	0.7	15.1	2.1	6.4	0.9
70 to 72	1.3	0.2	4.6	0.6	1.5	0.2
62 to 75	6.8	0.9	6.5	0.9	5.7	0.8

<= less than

≈= approximately

AMENDMENT STATUS PAGE

Periodically throughout the life of this document, new pages will be added, some existing pages will be deleted, and some existing pages will be amended and replaced. Such changes are called amendments and are accomplished to reflect updated information and agreements between Gulf Power Company and various regulatory agencies.

Insert latest amended pages and dispose of superseded pages in accordance with the amended page status indicated below.

NOTES: A. A zero in the amendment number column indicates an original page. An arabic number in this column indicates the latest amendment number to a page.

B. On an amended text or table page, that portion of the text or table affected by the latest amendment is indicated by a vertical line and an amendment number in the outer margin of the page, and the latest amendment number and date is shown at the bottom of that page.

C. Amendments to figures (illustrations) are indicated by the latest amendment number and its date above the title block.

D. Occasionally a page of text, a table, or a figure may be replaced which has been amended only, for example, to correct a misspelled word or to improve its visual appearance. Such a page will not have the vertical line, amendment number, etc.

E. To improve readability of the following tabular information, a double-space break separates every fifth entry.

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3.3 Plant Water Use

3.3.1 Water Sources

Water will be supplied to the plant from the Choctawhatchee River and from the Floridan aquifer via deep wells.

3.3.1.1 Well Water - Gulf will install two 750-gallon-per-minute (GPM) capacity wells for Unit No. 1 (one for service and one spare) and one additional well for Unit No. 2. A total of four wells will be developed for the 3,000 megawatt (MW) plant site, thus yielding a total installed capacity of 3,000 GPM. The wells will supply water for the make-up demineralizer influent, potable and plant service use, fire protection, and construction.

One demineralizer plant will be shared between each pair of plant generating Units to process water to a demineralized water storage tank. Demineralized water will be used for boiler make-up, demineralizer backwash and regeneration, and for small miscellaneous uses such as sampling and laboratory needs.

The plant's potable chlorinated well-water supply will be contained in and drawn from potable water storage tanks located on the building roofs. 3
This water will be used for drinking, showers, the plant kitchen, lavatories, and miscellaneous plant service. The potable water storage tank serving the concrete batch plant during the construction period will be retained 3
as a permanent potable water storage tank.

Two 300,000 gallon storage tanks will be provided for fire protection for the 3,000 MW site. Capacity to fill a 300,000 gallon tank in eight hours will be provided.

3.3.1.2 River Water - For Unit No. 1, two 7,500 GPM pumps will be installed on the Choctawhatchee River. One pump will be in service and one will act as a spare. A total of six pumps will be installed for the 3,000-MW plant site (three 7,500 GPM and three 15,000 GPM with one of each size acting as a spare), thus providing a total active pumping capacity of 45,000 GPM. The pumps will supply make-up water for the heat dissipation system.

3.3.2 Consumption and Analysis

Although the potential is provided for withdrawing 3,000 GPM from the deep aquifer, Gulf does not anticipate such withdrawal during normal routine 3
operation. Included in this 3,000 GPM capacity is one 750 GPM well that acts as a spare in the event a natural or mechanical malfunction should render a well inoperable. This spare also ensures availability of water in the event of an abnormally high surge demand. Since water drawn from the wells is not directly returned to the aquifer, all well water use may be termed as consumptive. The quantitative well water consumption

is listed in tables 3.3-1 through -4 for maximum, average, minimum, and shutdown conditions. As shown, the actual consumptive use is much smaller than the pumping potential. The design well water analysis is shown in table 3.3-5.

A well load factor of about 33 percent is desirable to prevent overpumping the individual wells. The spare will serves as a reliability factor. In future years, however, as the well system develops, experience may prove a spare well to be unnecessary. Maximum well water demand for the 3,000 MW plant site will be about 2,600 GPM. In normal routine operation, Gulf expects the 3,000 MW plant site pumping demand to be about 1,000 GPM. This will be about 40 percent of maximum demand or about 33 percent of installed capacity. As subsequent generating units are added to develop the 3,000 MW site, the need for additional wells will be evaluated to 3 determine if they are necessary based on plant consumption, system installed capacity, and system load factor.

Presently, the exact well capacity of those to be drilled and the number of wells required is not known. Further testing may show that the capacity of each well will be more or less than 750 GPM.

For the 3,000 MW site, a maximum pumping capacity of 67,500 GPM will be installed to supply a maximum site demand of 45,000 GPM withdrawal from the Choctawhatchee River. At full load operation (3,000 MW), a withdrawal of 40,000 GPM will normally be expected, thus providing a 12.5 percent pump margin. Except of losses due to cooling tower evaporation and drift, essentially all water withdrawn from the river and wells will be returned directly to the river. Quantitative river water consumption is shown in tables 3.3-1 through -4 for maximum, average, minimum, and shutdown conditions. Water flow to and from each system designed for two 500 MW Units is shown in figure 3.3-1. Refer to table 3.4-1 for river water analyses.

3.4 Heat Dissipation System

3.4.1 Each of Two 500-Megawatt Units

3.4.1.1 Main Circulating Water System - A closed-loop system will provide cooling water for the main condenser and auxiliary heat exchanger. Make-up water will be supplied to the circulating water system from the Choctawhatchee River. (See table 3.4-1.) The main condenser of each 500 megawatt (MW) unit is a single pass multipressure design consisting of two series operating shells. Condensers will have admiralty tubes in the main bank and 90-10 copper-nickel tubes in the air cooler section with a total surface area of 250,000 square feet. Each condenser is sized for a heat load of 2.376×10^9 British Thermal Units (B.T.U.'s) per hour and a circulating water flow of 168,250 gallons per minute (GPM). The heat exchangers for each 500 MW unit will be arranged in parallel with the main condenser and operated independently of the main turbine. The heat exchangers for each unit are sized for a heat load of 6.4×10^7 B.T.U. per hour and a cooling water flow of 8,500 GPM. 3

3.4.1.2 Natural Draft Cooling Towers - Evaporative Type - One natural draft cooling tower designed to be shared by two 500 MW units (Units 1 & 2) will be constructed with the initial 500 MW unit. This tower will operate at one-half its total capacity until unit 2 is in operation.

At maximum unit capacity, the main circulating water system for each 500 MW unit will dissipate to the atmosphere its total heat load of 2.44 $\times 10^9$ B.T.U.'s per hour by means of one natural draft cooling tower. 3 The arrangement and location of the cooling tower is shown in figures 3.1-1 and -2. A flow diagram for the tower make-up water system is shown in figure 3.4-1. The tower will have an internal concrete support structure with cement asbestos fill material. Pertinent tower performance specifications and operating conditions are shown in table 3.4-2 and illustrated in figure 3.4-2.

The level of total dissolved solids (TDS) in the circulating water system will be controlled by continuously extracting a portion of the concentrated circulating water and replacing it with fresh water. The extraction process is called blowdown and the replacement process is called make-up. The amount of make-up is equal to the sum of cooling tower evaporation, drift, and blowdown. The turbine plant design provides for a variable rate of blowdown up to 1,429 GPM per 500 MW unit and is automatically controlled to maintain four to seven cycles of concentration with a circulating water conductivity fixed at 400 to 450 micromhos. This rate corresponds to 268 to 301 milligrams per liter dissolved solids. Constituents contained in the cooling tower blowdown are shown in table 3.4-3. The concentration at which the tower is operated is dependent on the quality of make-up water. Variation extremes of TDS and constituent levels in the make-up water are shown in table 3.4-1.

When the make-up water contains high levels of dissolved solids, the tower is operated at approximately 4.7 cycles of concentration, and when the make-up water contains a medium or low level of TDS, the tower will be operated at approximately 6.2 to 6.6 cycles.

The make-up flow is variable up to 5,774 GPM per 500 MW unit depending on (a) cooling tower evaporation rate which varies with turbine load and ambient humidity, (b) drift, and (c) blowdown. At maximum unit capacity, a maximum evaporation of 4,330 GPM and a maximum drift of 15 GPM is expected for each 500 MW unit regardless of the concentration. Table 3.4-4 shows the make-up and blowdown requirements for maintaining the various cycles of concentration. Material in Section 2 of Appendix C describes the make-up water temperature, including monthly changes in stratification.

Before use as tower make-up, the surface water will require filtration to remove iron and suspended solids. The filters should obviate the need for a mechanical cleaning system for the main condensers. Backwash water from the filters will be routed to a backwash treatment system for removal of suspended solids. To assure maximum water usage, the processed backwash water will be forwarded to the backwash storage compartment for reuse as filter backwash water and the separated solids will be routed to the bottom ash disposal area. Removal of any silt and mud that may accumulate in the tower basin will be accomplished during scheduled outages by draining to the bottom ash disposal area. 3

To control the growth of algae and slime in the circulating water system, liquid chlorine will be introduced to the water on the cold side of the condenser and at the make-up water pumps. The design is to limit chlorine use to a minimum and to maintain strict controls on feeds and levels in the water system. A further discussion of chlorine and other chemical additives is contained in section 3.5, "Chemical and Biocide Waste."

3.4.1.3 Intake Structure - One intake structure will be constructed to supply water for the total 3,000 MW site. For the initial 500 MW unit, two 7,500 GPM pumps will be installed on the river: one in service and one a spare. An additional 7,500 GPM pump will be installed for the second 500 MW unit and an ultimate active pumping capacity of 45,000 GPM will be installed for the total 3,000 MW site requirements. The intake structure will be located on the east bank of the Choctawhatchee River at coordinates N-650,915; E-1,586,705. (See figure 3.1-2.) This location was chosen after giving due consideration to (a) river cross section profiles and subsequent low river flow conditions, (b) suitable foundation conditions, (c) piping and maintenance costs, and (d) environmental factors. The intake structure is designed to minimize entrapment and impingement of aquatic organisms and to maintain intake velocities below one-half

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TABLE 3.4-2

COOLING TOWER PERFORMANCE

Parameters	Unit 1 500 MW	Units 1 & 2 1,000 MW	
A. design wet bulb (°F at 60 percent relative humidity)	80	80	
B. approach (°F)	10	10	
C. range (°F)	28.2	28.2	3
D. water to tower (°F)	118.2	118.2	
E. water from tower (°F)	90	90	
F. water flow (GPM) (maximum)	176,750	353,500	
G. water volume (feet cubed)	395,000	790,000	3
H. drift (GPM) (maximum)	15	30	
I. evaporation (GPM) (maximum)	4,330	8,660	
J. air flow (pounds per hour) (estimated)	63.5×10^6	127×10^6	
K. exit air temperature (°F) (estimated)	107.2	107.2	3
L. exit air velocity (feet per second) (estimated)	14.1	14.1	

MW = Megawatts
GPM = Gallons Per Minute
°F = Degrees Fahrenheit 3

TABLE 3.4-6

3,000 MW SUMMARY

		Unit 1 500 MW	Units 1 & 2 1,000 MW	Site Total 3,000 MW	
1.	Cooling tower evaporation (maximum) (GPM)	4,330	8,660	25,980	
2.	Cooling tower drift (0.008 percent maximum) (GPM)	15	30	90	
3.	Cooling tower blowdown @ 4 cycles (GPM)	1,429	2,858	8,574	3
4.	Cooling tower make-up @ 4 cycles (GPM)	5,774	11,548	34,644	
5.	River water consumption (GPM)	4,345	8,690	26,070	
6.	Ash sluice make-up (GPM)	776	1,552	4,656	
7.	River water withdrawal (GPM)	6,550	13,100	39,300	3
8.	River pump margin (GPM)	950	1,900	5,700	
9.	River pump capacity (GPM)	7,500	15,000	45,000	
10.	Heat dissipated to atmosphere ($X 10^9$ BTU per hour)	2.44	4.88	14.64	3
11.	Circulating water (recycle)	176,750	353,500	1,060,500	
12.	Number of river pumps (including spare)	2	3	6	

GPM = Gallons Per Minute
MW = Megawatt
BTU = British Thermal Unit

3.5 Chemical and Biocide Waste

The following chemicals and biocides will be used during the operation of the Caryville steam plant: (Figures 3.5-1 through -6 show the chemicals used for the plant's major equipment.)

A. Plant Operating Chemicals and Biocides

1. hydrochloric acid (See figure 3.5-1.) 3
2. sodium hydroxide (See figure 3.5-1 and -3.)
3. hydrazine (See figure 3.5-6.)
4. morpholine (See figure 3.5-6.)
5. laboratory reagents and chemicals
6. oil and grease
7. hydrogen and carbon dioxide gases (See figure 3.5-4.)
8. chlorine and supplementary biocides (See figure 3.5-5.)
9. lime (See figure 3.5-2.)
10. alum, ferric chloride, and ferric sulfate (coagulant aids) (See figure 3.5-2.)
11. chelating agents (See figure 3.5-6.) 3

B. Plant Cleaning Chemical (See figure 3.5-3.)

1. hydrochloric acid
2. trisodium phosphates 3
3. caustic soda
4. ammonium bifluoride
5. detergents
6. sodium sulfite
7. potassium and/or sodium bromate
8. hydrofluoric acid
9. ammonium bicarbonate
10. ammonium hydroxide
11. emulsifiers

3.5.1 Bulk Chemical Storage 3

3.5.1.1 Acid and Caustic for Water Treatment Building, and Acid for Chemical Cleaning Waste Treatment System (Per 1,000 Megawatt (MW))

3.5.1.1.1 Acid and Caustic for Water Treatment Building - A concentrated chemical storage facility will be provided at the water treatment 3 building to accept delivery of and store bulk caustic and acid. Bulk storage provided will consist of two 20,000-gallon tanks for caustic (20 percent NaOH) and one 8,000-gallon tank for 25 percent hydrochloric acid. All bulk chemical storage tanks shall have retaining walls capable of containing 100 percent of the tank capacity to prevent unrestricted chemical spills. A caustic pump and an acid pump with associated piping, valves, and controls will be installed to tranfer chemicals from tank truck deliveries. Water will be provided for dilution of caustic from 50 percent NaOH as delivered to 20 percent NaOH storage.

3.5.1.1.2 Chemicals for the Chemical Cleaning Waste Treatment System - Waste treatment equipment with a small acid storage day-tank will be provided for the recarbonation of the chemical cleaning waste treatment system effluent stream. Facilities will be provided for storage of small amounts of bagged lime and, if required, small amounts of bagged soda ash. 3

3.5.1.2 Hydrazine and Morpholine For Feedwater Chemical Feed System - Hydrazine, caustic soda, and morpholine will be stored in drums on the turbine building base slab in the chemical mix and storage rooms for use in feedwater chemistry control. Sodium sulfite and trisodium phosphates required for feedwater control will be stored in bags. 3

3.5.1.2.1 Hydrazine - Hydrazine may be added to the feedwater as an oxygen scavenger. Three parts of 35 percent hydrazine (N_2H_4) reacts with one part oxygen. Hydrazine residual at the economizer inlet is expected to be about 15 to 20 micrograms per liter. Complete reaction of hydrazine with oxygen produces nitrogen and water. Hydrazine will be used to protect equipment during periods of non-operation.

3.5.1.2.2 Morpholine - Morpholine will be added to the feedwater to reduce iron pickup by neutralizing carbon dioxide and raising the pH. Morpholine is a nitrogen-containing neutralizing volatile compound which does not add to the boiler dissolved solids. About two milligrams per liter (MG/L) of morpholine neutralizes one MG/L of carbon dioxide. The residual at the economizer inlet is expected to be about two to three MG/L with feedwater pH in the range of 8.8 to 9.0 for feedwater heaters tubed with copper alloy tubes.

3.5.1.3 Laboratory Chemicals - The plant laboratory will maintain a reasonable stock of reagent chemicals, in small quantities, for use in performing raw water analysis, boiler water analysis, and other necessary laboratory testing work.

3.5.1.4 Oil and Grease

A. Oil will be stored for main turbine and auxiliary drive turbine lubrication and hydraulic systems in approximately 2,000-gallon capacity lube oil tanks (two tanks per two units).

B. The boiler ignitor No. 2 fuel oil will be stored in approximately 150,000-gallon capacity tanks (one tank per unit).

C. All storage tanks will be provided with adequate fire protection systems and retaining walls to contain any leakage and prevent the migration of oil into other systems, such as yard drainage.

D. The switchyard transformers will be filled with approximately 32,000 gallons of oil total per 500 MW. The transformers located in the turbine building will contain approximately 1,100 gallons of Pyranol, or equivalent, non-flammable liquid.

E. All transformers will have retaining curbs to contain spills. The Pyranol, or equivalent, non-flammable liquid will be drummed for shipment back to its manufacturer for disposal.

F. Oil and grease for normal plant lubrication requirements will be stored in an oil storage room of fireproof construction.

G. Electro-hydraulic control system fluid will be stored in drums.

3.5.1.5 Hydrogen, Carbon Dioxide, and Nitrogen - Hydrogen gas is used as a coolant in the generator and is stored in a separate facility away from the turbine building. The system will be designed for handling this gas with appropriate safety precautions. Carbon dioxide will be used in the generator purge system and fire protection system. Nitrogen may be stored on site for "nitrogen blanketing" of equipment to prevent corrosion during a plant shutdown.

3.5.1.6 Chlorine - Chlorine will be used as the biocide for plant cooling water systems. It will be stored on site in one-ton capacity containers located in appropriate storage facilities designed in accordance with the recommendations of the Chlorine Institute, Inc. Solvay type chlorine leak detectors will be provided at points of storage to alarm in the main control room in event of a chlorine leak. Self-contained breathing apparatus will be provided in storage at readily available locations to enable plant personnel to approach and control chlorine containers for maintenance in event of a chlorine leak.

3.5.2 Chemicals Used in Cooling Tower Operation

3.5.2.1 Chlorine - The tower system chlorination frequency may vary as much as twice per day in the warm summer months to once per week in the winter months. Chlorine will be used on an intermittent basis at the river pump intake to maintain piping free of slime and algae. Chlorine will be introduced to the cooling tower condenser system at the condenser circulating water pump suction. A chlorine residual controller with feedback, installed on the condenser discharge, will be used to limit the free residual at the condenser discharge to less than 1.0 MG/L to optimize feed for economy.

A chlorine storage and feed facility will be installed for chlorine injection in the circulating water system for each pair of units. A chlorinator and storage for eight one-ton containers will be installed for Units 1 and 2. A chlorinator and storage for 16 one-ton containers will be installed for future 2,000 MW expansion. A chlorinator and four one-ton containers will be installed for chlorination at the river-pump intake, for the ultimate 3,000 MW, to prevent fouling in the make-up water lines.

3.5.2.2 Supplementary Biocides - There exists the possibility that chlorine alone will not be entirely sufficient as a tower water biocide. In the event that a special biocide is required, the use and disposal of such material will be consistent with applicable State and Federal regulations.

3.5.2.3 Tower Water Silt Control - In order to remove suspended solids and other particulate matter from the river water, dual media, compartmented filters will be used. The filters will be automatic backwashing type, initiating backwash upon high differential pressure across the 3
filter bed. Interlocking controls will prevent simultaneous backwashing of two or more compartments. Any mud or silt that may accumulate in the tower basins will be removed to the bottom ash disposal area.

3.5.3 Plant Wastes

The generating plant waste volumes are given on a 500- or 1,000-MW generating capacity design basis. Since the proposed plant site is designed to provide a total of 3,000-MW generating capacity, the total plant site waste volumes will be six times greater than the 500-MW volumes. Table 3.5-1 gives the anticipated maximum discharge rates for the plant waste for the proposed generating plant up to 3,000-MW total capacity. Waste from the normal operating processes of the plant include the following:

A. Plant Operating Wastes

1. boiler blowdown
2. condensate polisher exhausted resins
3. make-up demineralizer regenerant waste
4. filter backwash
5. laboratory drains
6. power building floor drains (less oil and grease)
7. coal pile runoff
8. plant site rain water runoff
9. sanitary waste treatment effluent
10. oil and grease
11. spent make-up demineralizer resins
12. lime softener sludges 3
13. cooling tower blowdown and drift

B. Plant Cleaning Wastes

1. preoperational cleanup waste (acid, alkali, and fresh water)
2. periodic boiler cleaning waste
3. air preheater, boiler fireside, and precipitator wash
4. cooling tower desilting sump drains
5. periodic cooling tower basin cleanup waste (mud and other particulate material)

6. miscellaneous (wash water for vehicles, equipment, dirt, dust, etc.)

3.5.3.1 Plant Operating Wastes

3.5.3.1.1 Boiler Blowdown (Per 500 MW) - Boiler blowdown will normally be intermittent and will average approximately 10 gallons per minute (GPM) over a month's time. Boiler water pH is expected to average 10 and to contain 10 MG/L of phosphate in the form of trisodium phosphate. Some sodium sulfate and sodium silicate are expected to be present.

3.5.3.1.2 Condensate Polisher Exhausted Resin - By using a Powdex-type condensate polisher, exhausted resins are not chemically regenerated, but are replaced by new resins. This deletion of the need for chemical regeneration greatly reduces the amount of strong wastes generated by the plant. The exhausted Powdex resins will be transferred to the chemical cleaning waste treatment system and any remaining exchange capacity in 3
the resins will contribute to the treatment of the waste water. The resins will be removed from the softener with the lime sludge.

3.5.3.1.3 Make-Up Demineralizer Regenerate Waste (Per 1,000 MW) - The make-up demineralizer (well water influent) will normally require regeneration once per day. Each demineralizer train regeneration will have a total waste volume of approximately 20,000 gallons, making a total of 40,000 gallons waste volume for the regeneration of both trains of the demineralizer. This waste will be discharged to a regeneration waste basin for neutralization and forwarded to the waste water basin. Based on regeneration with HCL and NaOH, the waste will contain the following constituents:

	Milligrams per Liter as $CaCO_3$
Ca	4,174
Mg	1,108
Na	636
K	43
HCO_3	203
Cl	5,712
SO_4	46
pH	7
SiO_2(asSiO_2)	426

3

3.5.3.1.4 Filter Backwash Waste (Per 1,000 MW) - The generating plant river make-up water, the plant make-up demineralizer, and the chemical cleaning waste treatment system will require filtration equipment to remove organic and suspended material.

The river make-up filters will have a capacity of 15,000 GPM and will normally be backwashed once per day. The backwash volume for these filters will be approximately 325,000 gallons. The backwash will be processed by a backwash treatment system.

The make-up demineralizer will have two, 260 GPM capacity, anthracite filters that will require backwashing once per day. The backwash volume will be approximately 6,500 gallons per filter. The gravity flow mixed 3
media filters in the chemical cleaning waste treatment system will have a 150 GPM capacity and will normally be backwashed once a day. The backwash volume for these filters will be approximately 3,250 gallons. Filter backwash will be cycled from a backwash collecting sump to the chemical cleaning waste basin.

3.5.3.1.5 <u>Plant Laboratory Drains and Sampling Wastes</u> - Waste from the plant laboratory and sampling will be relatively insignificant in volume to the other plant waste. The drains will be piped to the plant 3
waste water basin.

3.5.3.1.6 <u>Power Building Floor Drains</u> - Any drainage system such as plant floor drains subject to contamination by oil spills or leaking oil from equipment will be routed through oil/water separator equipment to remove oil before such water streams are combined for any additional treatment.

3.5.3.1.7 <u>Coal Pile Runoff</u> - Rainwater runoff associated with up to a 10-year/24-hour rainfall event, and orginating from the coal storage pile and coal conveyor drainage area, will be routed to detention Pond "A." The pond will temporaily contain the runoff and allow for settling of suspended solids. After settling, the water from the pond will be pumped to either: (a) the bottom ash disposal area as make-up to the bottom ash sluice system, (b) the fly ash disposal area as make-up to the fly ash sluice system, or (c) the plant make-up water filters to 3
supplement plant make-up water. The water will be routed to the bottom ash and fly ash disposal areas on an "as required" basis. Continuous low-volume coal pile seepage collected between rainfall events will be pumped to the bottom ash disposal area.

All rainfall runoff associated with more than a 10-year/24-hour rainfall event will overflow from Detention Pond "A" to Detention Pond "B." All overflow will be recorded by a weir head event recorder and monitored for suspended solids and pH.

3.5.3.1.8 <u>Site Rain Water Runoff and Silt</u> - To prevent unrestricted wash of silt into the navigable waters, rainwater runoff will be collected and routed to detention pond "B" via drainage ditches located throughout the site. (See figure 3.5-7.) Detention pond "B" temporarily contains rainwater runoff to provide a settling basin for silt and suspended material. After settling, the water will be control released and allowed to flow on its natural drainage course. All released water will be monitored to assure compliance with applicable State and Federal regulations.

Detention pond "B" will be constructed during the initial stage of plant development to contain rainwater runoff during construction as well as after plant completion.

3.5.3.1.9 Sewage Plant - The sewage from the plant will be processed by an aerobic digestion unit. Effluent from the sewage treatment system 3
will be processed through the chemical waste treatment system. A further discussion is contained in section 3.6, "Sanitary and Other Wastes' Systems."

3.5.3.1.10 Plant Oil and Grease Wastes - Oil and grease wastes are expected to be at a minimum at the plant site. Retaining walls will be built around all large volume tanks to prevent the unrestricted flow of oil. The liquid from the building sumps will be passed through oil separators before going to the plant waste treatment system. Oil collected at oil separators will be drummed and ultimately disposed of by burning in the boiler. 3

3.5.3.1.11 Spent Make-Up Demineralizer Resins - The spent ion-exchanger resins will be put in containers and disposed of as land fill on site.

3.5.3.1.12 Lime Softener Sludges - Refer to subsection 3.5.3.3 below.

3.5.3.1.13 Cooling Tower Blowdown - The plant cooling tower will maintain a blowdown to control dissolved and suspended material that would naturally concentrate in the tower system. The tower system will be sized for a blowdown of approximately 1,429 GPM at four cycles of concentration for a 500 MW capacity. At four cycles of concentration, the tower blowdown will be approximately 8,574 GPM for 3,000 MW plant 3
capacity. The blowdown will be discharged to the Choctawhatchee River.

3.5.3.1.14 Cooling Tower Drift - To reduce the amount of drift escaping from the cooling towers, state-of-the-art drift eliminators will be used. These high efficiency drift eliminators reduce the amount of drift to a maximum of 0.008 percent of the circulating water flow, equaling approximately 90 GPM per 3,000 MW.

The total dissolved solids (TDS) and constituents in the drift are the 3
same as contained in the cooling tower blowdown. The quality of blowdown -- which in turn means the quality of drift--is dependent upon the make-up water quality and the cycles of concentration at which the cooling tower is operated. The pounds of solids contained in the drift at design conditions are shown in table 3.5-2. Refer to section 5.2, "Effect of Chemical and Biocide Discharges," for effects of cooling tower drift.

3.5.3.2 Plant Cleaning Wastes

3.5.3.2.1 Preoperational Cleanup Waste (Per 500 MW) - The generating plant requires system flushing and chemical cleanup before initial operation of the turbine generator.

3.5.3.2.1.1 Boiler - Preoperational cleaning of the boiler requires an alkaline boil out, using sodium phosphates and caustic soda or equivalent combination, and two water rinses. An acid cleaning of five percent hydrochloric acid and then a wetting agent, or equivalent combination, may preceed the two water rinses. After the acid cleaning step, if used, and water rinses, a second alkaline boil out may be required. The combined economizer and circulation system volume of the boiler requiring cleaning is 90,000 gallons. The total volume of preoperational waste is estimated at 460,000 to 550,000 gallons. This waste will be collected in a chemical cleaning waste basin and routed to the chemical cleaning 3
waste treatment system.

3.5.3.2.1.2 Condensate and Feedwater System (Per 500 MW) - The condenser and feedwater system will require a high-velocity flushing, hot-alkaline wash, and possibly an acid cleaning before initial unit startup. The estimated volume of the condensate/feedwater piping and equipment is 136,000 gallons per 500 MW. The chemical requirements for this cleaning, in pounds, are estimated to be as follows:

A. trisodium phosphate	6,000	
B. disodium phosphate	3,000	3
C. soda ash	11,000	
D. detergent	1,000	
E. hydroxyacetic - formic acid	34,000	
F. citric acid	1,200	

Total volume of waste from the initial system cleaning is anticipated to be 660,000 to 796,000 gallons. The plant pre-operational waste will be sent to the chemical clearing waste basin for treatment by the 150 GPM 3
softener and ultimate discharge.

Oil and grease removed in the hot alkaline wash will be removed from the waste stream by the use of an oil skimmer.

3.5.3.2.2 Periodic Cleaning Waste

3.5.3.2.2.1 Boiler Acid Cleaning Waste (Per 500 MW) - The boiler is estimated to require chemical cleaning once every two to four years for the removal of copper iron oxides and silica bearing materials. The volume of the boiler requiring cleaning is approximately 90,000 gallons.

For removal of copper, the boiler will be cleaned with ammonium bicarbonate, ammonia, and a bromate compound. An acid cleaning using five percent hydrochloric acid with ammonium bifluoride and inhibitor will follow.

To ensure the neutralization of acid used in cleaning, the boiler will be rinsed twice with water and boiled out with an alkaline solution such as caustic soda and sodium phosphate. The total volume of the operational boiler cleaning operation is estimated to be 360,000 to 540,000 gallons per boiler.

This waste will be collected in the chemical cleaning waste basin for
treatment by the 150 GPM chemical cleaning waste treatment system and 3
ultimate discharge.

<u>3.5.3.2.2.2 Air Preheater, Boiler Fireside, and Precipitators Wash (Per 500 MW)</u> - The surfaces of the air preheater, boiler fireside furnace
walls, and precipitator hoppers will be washed down during unit outages.
Wash water from these operations will be collected in a waste sump for
treatment through the chemical cleaning waste treatment system. Wash- 3
water volume for the air preheater wash is estimated to be 60,000 to
120,000 gallons, the boiler wash 120,000 to 240,000 gallons, and the
precipitator hopper 60,000 gallons.

<u>3.5.3.2.2.3 Cooling Tower Desilting Sump Drains</u> - The cooling
tower cold water basin will have desilting sumps to flush silt and small
debris from the tower basin on a periodic basis, depending on the rate
of silt buildup. This sump drain will be piped to the bottom ash disposal 3
area for disposal.

<u>3.5.3.2.2.4 Cooling Tower Basin Cleanup Waste</u> - In addition to the
desilting sump drain, during scheduled outages, the cold water basin of
the towers may require periodic cleanup of sand, mud, and debris. This
material will be trucked to a suitable place on the site, the bottom ash 3
disposal area, or the lime sludge disposal area.

<u>3.5.3.2.2.5 Miscellaneous Plant Cleaning Waste</u> - Plant cleaning
operations such as equipment wash down, cleaning of floors, etc., will
have to be performed at the plant. The drain system will take this type
of waste to the waste water basin, bottom ash disposal area, or detention 3
pond depending on the quality of the waste stream.

<u>3.5.3.3 Plant Waste Treatment Systems</u>

<u>3.5.3.3.1 Regenerate Waste Neutralization System</u> - A neutralizing
system will be used to systematically collect and neutralize chemical
wastes generated by equipment cleaning and the make-up deminerlizer
regenerate waste. 3

The regenerate waste (180,000 gallons per day 3,000 MW maximum) will be collected in a common regeneration waste basin and will be pumped to the waste water basin via one of the following three routes:

Route No. 1 - From the regeneration waste basin, through the batch neutralizers, to the waste water basin;

Route No. 2 - From the regeneration waste basin, through the chemical cleaning waste treatment system, to the waste water basin; or

Route No. 3 - From the regeneration waste basin directly to the waste water basin.

Route No. 1 will be the normal procedure followed when processing the regenerate waste. The composite waste is expected to be acidic and will require neutralization before being routed to the waste water basin. Provisions will be installed for routing a lime slurry from the chemical cleaning waste treatment system to the neutralizer, resulting in the addition of alkalinity and a neutral pH value. The waste will than be routed to the waste water basin.

In the event the neutralizer is out of service, the lime slurry will be routed directly to the regeneration waste basin. The valves and piping from the basin would be adjusted to a recycle mode to allow the basin's forwarding pumps to circulate the waste and ensure mixing. A pH indicator will be located in the recycle piping. When the waste reaches a neutral pH value, the recycle mode will be discontinued and the solution 3
forwarded to the waste water basin.

Route No. 2 will be used on an abnormal emergency basis. In the event more regenerate waste is produced than the capacity of the regeneration waste basin, the excess flow will be routed to the chemical cleaning waste treatment system. The treated waste will then be forwarded to the waste water basin.

Route No. 3 will be used when the collected regenerate waste is at a neutral pH. The neutralizer and the chemical cleaning waste treatment system will be bypassed and the waste routed directly to the waste water basin.

3.5.3.3.2 Chemical Cleaning Waste - All waste produced from pre-operational boiler tube cleaning, periodic boiler tube cleaning, boiler fireside washes, and air preheater washes will be collected in a chemical waste basin. Before entering the chemical cleaning waste basin, all waste will be processed through an oil/water separator for the removal and drumming of any oil contaminants. After the waste is collected, a grab sample will be taken to determine the pH. If the solution is extremely acidic, a lime slurry mixture will be added to the basin and the waste circulated until the pH is adjusted to a minimum of 5.5. When a suitable pH is reached, the waste will be processed by a 150 GPM lime softener for the removal of metals, hardness, and suspended solids.

The softener effluent will require recarbonation for pH adjustment and filtration for the removal of the carry-over of suspended solids. The filter effluent will be monitored for flow, pH, suspended solids, iron copper, and oil and grease. If any of these parameters are in violation of applicable regulations, the waste will be recycled to the chemical cleaning basin for retreatment. If the parameters are within the established limits, the waste will be routed to the waste water basin for ultimate discharge.

When a lime slurry is needed for pH adjustment in the neutralizer system, treatment of the chemical cleaning waste will be discontinued. Plant service water will then be processed through the lime softener and filtered without the recarbonation process. The filter effluent, at a pH of approximately 11, will be pumped to the regenerant waste neutralizer as a supply of alkalinity. The process would provide the needed alkalinity at less expense than using sodium hydroxide to neutralize excess acidity in the make-up demineralizer wastes.

When processing cleaning waste, lime softener sludge will be continuously rejected from the softener at approximately eight to ten percent solids by weight. The sludge will be processed through a concentrator to be dewatered to approximately 35 percent solids by weight. Approximately three pounds per minute of operation of sludge at 35 percent solids will be produced. However, the waste requiring treatment will be produced on 3
an infrequent basis. The liquid from the dewatered sludge will be collected with the treatment system's filter baskwash and recycled to the chemical cleaning waste basin.

The softener sludge will exist mainly as calcium carbonate; however, due to the nature of the waste treated, heavy metal contaminates are expected to be present. To prevent any leaching of the metals from the sludge due to landfill disposal operations, the sludge will be placed in sealed, leak-proof containers.

3.5.3.3.3 Lime Softener Sludge - Lime softener sludge existing mainly as calcium carbonate ($CaCO_3$) will be continuously rejected from the softener at approximately eight to ten percent solids by weight. The sludge will be processed through a concentrator to be dewatered to about 35 percent solids by weight. The liquid from the dewatered sludge will be routed to the chemical cleaning waste basin.

3.5.3.3.4 Filtration - In order to remove any suspended solids that carry over from the softener, the line softener effluent from the treatment system will be filtered. Spare capacity to allow for a compartment being backwashed is included.

Filter backwash is collected in a backwash collecting sump and is returned to the chemical cleaning waste basin. Effluent from the filters is routed to the waste water basin.

3.5.3.3.5 Plant Operating Waste Treatment - The basic philosophy of the operating waste treatment plan is to provide sufficient flexibility in the plant design for the future installation of additional waste treatment equipment, if required, while closely adhering to the rules and regulations adopted by the Environmental Protection Agency (EPA) and Florida Department of Environmental Regulation (FDER). This philosophy of permitting design flexibility was adopted due to the peculiarities associated with the treatment of waste produced by fossil-fired electric generating units.

Each fossil-fired plant produces waste streams that are unique in quality and constituent levels. There is no method to accurately predict which constituent or parameter in a waste stream, if any, will exist in polluting quantities. Therefore, there is no standard or optimum method of treatment which can be applied universally to process these wastes and comply with discharge standards.

Only after a unit is operating will a waste stream be produced. Thus, the design of a waste treatment method must be selected after operation to assure reliable, efficient, and economical waste control. Present design plans include the initial installation of waste treatment equipment to process waste streams that, based on historical operating data, contain known constituents.

3.5.3.3.5.1 Ash Sluice Bleed-Off - Under CFR (Code of Federal Regulations) Title 40, Parts 425.15 (d) and (e), bottom ash transport 3
water and fly ash transport water are addressed as separate waste streams with separate restrictions on the quality and quantity of transport water discharged. To best comply with these limitations, bottom ash and fly ash transport water remain segregated throughout the ash sluicing process. However, due to the many variables involved which influence the resulting characteristics of the waste streams, waste treatment equipment has not been installed. Selection of this equipment has been deferred until an accurate waste stream analysis has been obtained so the necessity and type of treatment required can be evaluated. Provisions have been included in the plant design to allow for future installation of treatment equipment.

3.5.3.3.5.2 Backwash Treatment System - Due to the large amount of filtering capacity (45,000 GPM) required for future plant make-up, approximately 700 GPM per 3,000 MW of filter backwash will be produced. To reduce water wastage in the plant system, a 1,000 GPM tube settler clarifier treatment system will be installed for removing suspended solids from the backwash. The treatment system will reject the suspended solids in a concentrated stream at approximately 30 GPM. The concentrated stream will be routed to the bottom ash disposal area to allow settling of the solids and serve as partial make-up to the bottom ash sluicing system. The treatment system's processed effluent (approximately 670 GPM) will be routed to the pretreatment filter to serve as make-up to the circulating water system. This system will use maximum water usage and minimum water wastage.

3.5.3.3.6 Low-Volume Waste - The following low-volume wastes produced by the plant will be routed to the waste water basin:

A. Boiler Blowdown
B. Make-up Demeralizer Filter Backwash
C. Oil-Free Turbine and Boiler Building Floor Drains
D. Oil-Free Sample Drains
E. Treated Chemical Cleaning Waste
F. Oil-Free Tractor Garage Floor Drains
G. Lab Drains

The collected composite waste will be monitored for pH, flow, suspended solids, and oil and grease before being routed to the cooling tower blowdown line for discharge. If any of the monitored parameters are in violation of EPA or FDER rules, appropriate equipment will be selected and installed for treatment and compliance.

While boiler blowdown is not classified by EPA as a low-volume waste, it 3
is treated as such in this waste management scheme due to its volume and
quality. The proposed plan would provide a monthly grab sample of
boiler blowdown to monitor for iron and copper to prove that these
materials are within effluent limits for discharge.

3.5.3.3.7 Alternate Waste Treatment - As discussed in subsection 3.5.3.3.5 above, installation of waste treatment equipment, except for treatment associated with waste streams of a known quality, has been deferred until additional design information has been collected. This deletion will assure the installation of necessary, efficient, and environmentally and economically acceptable treatment equipment.

3.5.3.4 Plant Discharge - The plant will have teo monitored points of discharge: (a) tower blowdown with composite waste and (b) detention pond "B." (See figure 3.5-7.)

Tower blowdown with waste water from the waste water basin and ash sluice bleed-offs will be discharged to the Choctawhatchee River via one pipeline. Refer to table 3.5-3 for quality and quantity of waste discharge. All discharged water will be monitored for potential pollutants. (See figure 3.5-7.)

Detention pond "B" and associated drainage ditches will accommodate yard 3
rain water runoff and associated oil free drainage to prevent unrestricted
washing of silt into the public waterways. Water collected by this pond
will be monitored upon controlled release and allowed to flow through
the natural course.

There will be an emergency overflow spillway from the bottom ash and fly 3
ash disposal areas to detention Pond "B." This overflow will be monitored
and will normally have zero flow. The spillway is intended for use only
in event of an extremely large and/or prolonged rainfall event as protection

for ash basin dikes. This very infrequent discharge will be routed through the plant detention pond. (See the plant monitoring diagram shown in figure 3.5-7.)

TABLE 3.5-1

PLANT OPERATING AND CLEANING WASTE

Type of Plant Waste	Maximum Discharge Rate			
	Unit 1 500 MW	Units 1 and 2 1,000 MW	Total Site 3,000 MW	
Boiler Blowdown (gallons per minute)	10	20	60	
Make-Up Demineralizer Regenerant Waste (gallons per minute)	28	56	168	
Filter Backwash Waste (gallons per minute)	8	16	48	
Lime Softener Sludge (pounds per hour) (Dry basis)	60	60	60	3
Boiler Preoperational Cleaning Waste (gallons per minute)	300	300	300	
Condensate and Feedwater System Preoperational Cleaning Waste (gallons per minute)	300	300	300	
Boiler Acid Cleaning Waste (gallons per minute)	300	300	300	
Air Preheater, Boiler "Fireside," and Precipitator Cleaning Waste (gallons per minute)	300	300	300	
Sanitary Waste Treatment Effluent (gallons per minute)	3	5	7	3

TABLE 3.5-2

CONSTITUENTS IN COOLING TOWER DRIFT AT DESIGN CONDITIONS

POUNDS PER HOUR

	Unit 1 500 MW	Units 1 & 2 1,000 MW	Total Site 3,000 MW	
Calcium (Ca)	18.7	37.4	112.2	3
Magnesium (Mg)	3.1	6.2	18.6	
Sodium (Na)	8.5	17.0	51.0	
Potassium (K)	2.6	5.2	15.6	
Bicarbonate (HCO_3)	60.9	121.8	365.4	
Sulfate (SO_4)	10.2	20.4	61.2	
Chloride (Cl)	13.9	27.8	83.4	
Nitrate (NO_3)	1.3	2.6	7.8	
Silica (SiO_2)	20.8	62.4	187.2	
Iron (Fe)	0.1	0.2	0.6	

MW = Megawatts

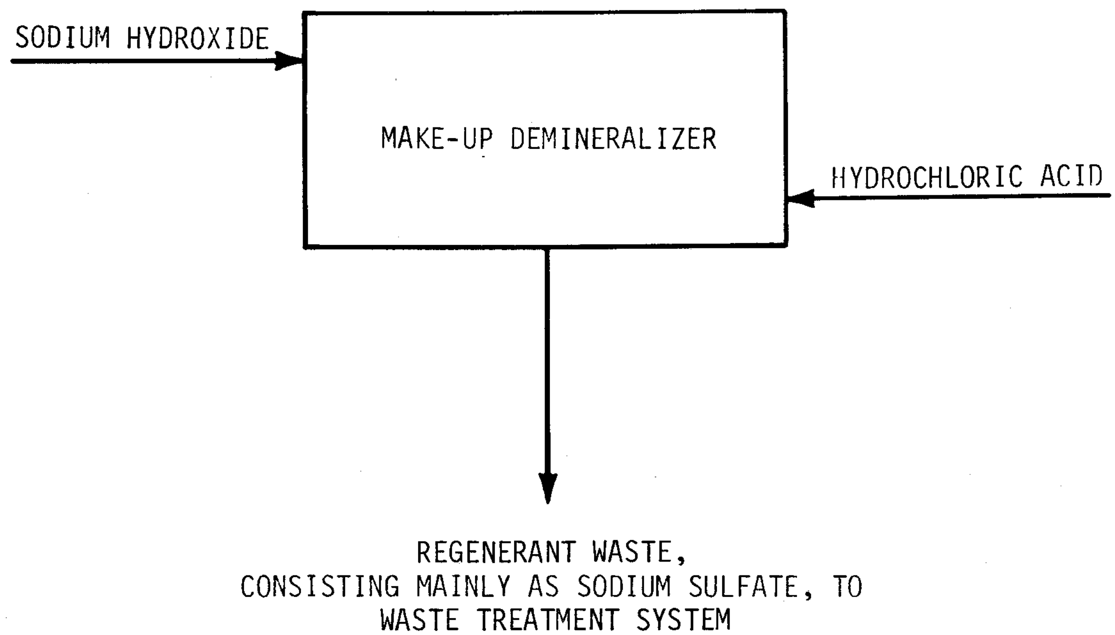
TABLE 3.5-3

PREDICTED QUALITY OF PLANT DISCHARGE*

	MG/L AS $CaCO_3$
Calcium (Ca)	288
Magnesium (Mg)	35
Sodium (Na)	61
Potassium (K)	35
Bicarbonate (HCO_3)	44
Nitrate (NO_3)	2
Chloride (Cl)	40
Sulfate (SO_4)	329
Iron (PPM as Fe)	0.5
Silica (PPM as SiO_2)	2.0
pH	7.0

3

MG/L = Milligrams Per Liter
$CaCO_3$= Calcium Carbonate
PPM = Parts Per Million
*Calculated at normal discharge quantity of 12,441 gallons per minute per 3,000 megawatts.



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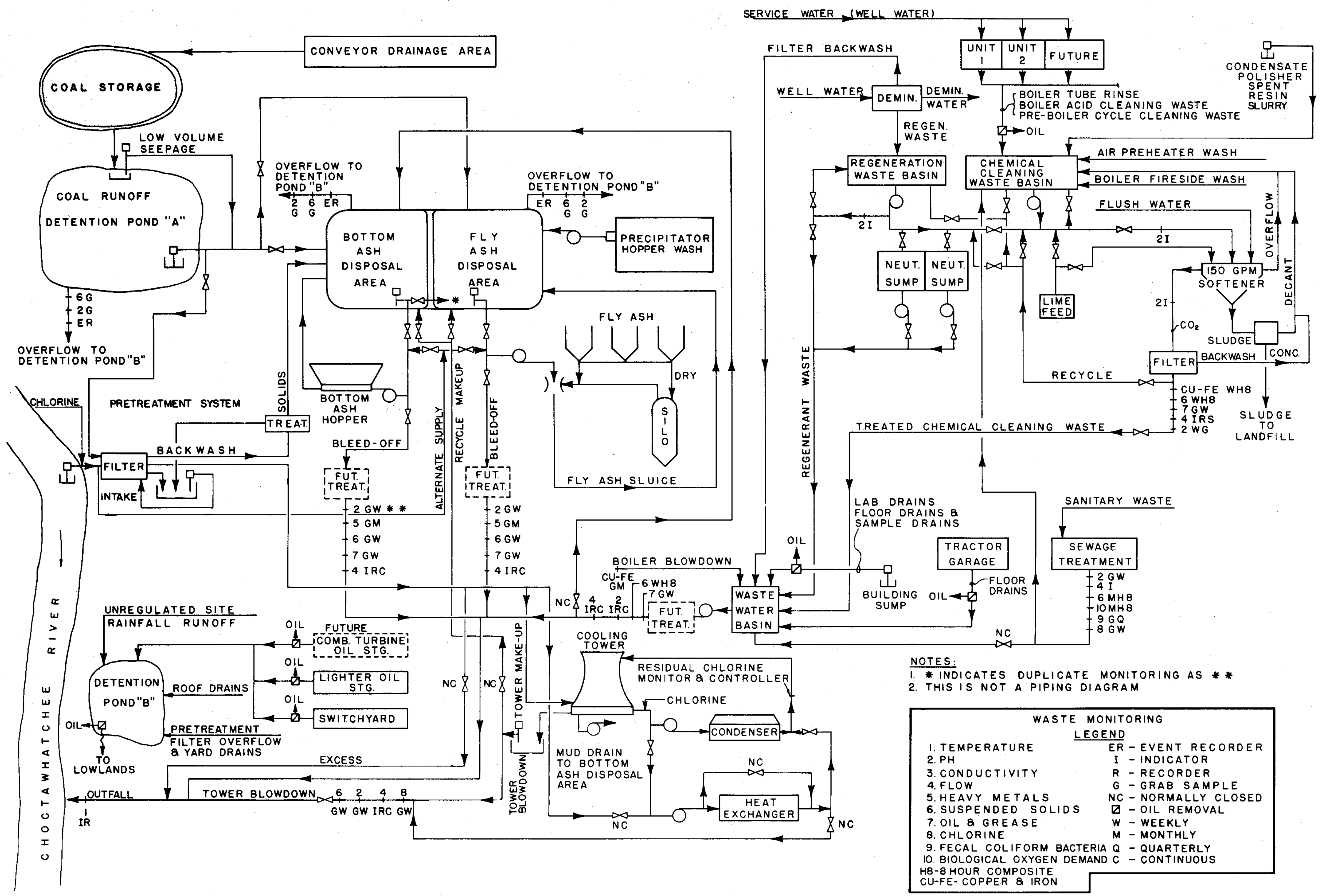
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	CHEMICAL USAGE MAKE-UP DEMINERALIZER FIGURE 3.5-1



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GULF POWER CO.
CARYVILLE STEAM PLANT

WATER AND WASTE FLOW

FIGURE 3.5-7

3.6 Sanitary and Other Wastes' Systems

This section addresses the plant's sanitary waste water system and ash handling system. Other waste produced in the plant operation such as laboratory, operational, and chemical cleaning wastes are described in section 3.5, "Chemical and Biocide Waste."

3.6.1 Sanitary Waste Water System

Gulf will provide a sanitary waste water system consisting of a prefabricated, digestion-type sewage treatment plant capable of treating approximately 10,000 gallons per day of domestic sewage. The plant will include a comminutor and clarifier in addition to an aeration chamber. Chlorinated, effluent waters from the sanitary waste treatment system will be passed to the chemical cleaning waste basin and processed by the chemical cleaning waste treatment system before being discharged off site as treated waste water. This additional treatment will further reduce any remaining organics, suspended solids, and bacteria. 3

3.6.1.1 Sanitary Waste Source - During normal operation of the plant, the personal hygiene activities of personnel will produce sanitary wastes. Sources are plant kitchen, drinking fountains, toilets, showers, and lavatories.

3.6.1.1.1 Collection and Processing - Sanitary waste will be collected and processed by methods unique to the period of plant development. For example, during construction of the plant, the use of portable toilets will be employed. Urinals will also be provided on site where the waste will be collected in tanks. During plant operation, a permanent sanitary waste system will be used which has been designed to provide the on-site sewage treatment necessary for normal plant operations and shut-down periods.

3.6.1.1.2 Inspection and Testing - Gulf personnel will periodically inspect and test the sanitary waste water system's effluent to ensure that the plant (a) is operating as specified, and (b) will meet the standards established by the State and County Boards of Health.

3.6.1.2 Alternatives - Alternatives to the chosen system would be (a) disposal of sewage through a local municipal system, which is not available, or (b) a septic tank/field system. The prefabricated digestion-type treatment system, subsection 3.6.1 above, eliminates any possibility of ground water contamination by sewage waste water.

3.6.1.3 Solid Waste - There will normally be no solids or sludges for disposal produced by the proposed sewage treatment system. In the event of system maintenance where sludge removal might be necessary, such sludges will be removed by a contractor licensed to handle such material.

3.6.2 Ash Handling System

Bottom ash (ash which falls to the bottom of the boiler) will be collected in an ash hopper located beneath the boiler and removed by a continuous ash sluicing process. Sluice water will pass through the hopper, removing the ash, to the north end of the bottom ash disposal area. The sluice water will than flow to the south end of the disposal area to be recycled for ash sluicing. Approximately 7,000,000 tons of bottom ash will be produced during the lift of the 3,000 megawatt (MW) plant.

Fly ash (ash carried upward by hot gases) will be collected by high-efficiency electrostatic precipitators. The fly ash will then be removed from the precipitator hopper by sluicing to the fly ash disposal area. Approximately 40,000,000 tons of fly ash will be produced during the life of the 3,000 MW plant.

Bottom ash sluice water and fly ash sluice water are completely segregated throughout the ash sluice cycle. River water serves as make-up to each ash sluicing system. The sluice water is pumped separately to the bottom ash and fly ash booster pumps where the head is increased for sluicing ashes to the far end of their respective disposal areas. Sluice water then flows to the separate pumps for recycle. In the event of recycle pump failure, or water deficiency, ash sluice water will be supplied by river water direct from the river water pumping system to the booster pumps. 3

Five percent of the circulating bottom ash sluice water (120 gallons per minute (GPM per 500 MW) and approximately 12 percent of the fly ash sluice water (800 GPM per 500 MW) is bled off from their respective recycling streams. Both bleed-off streams are monitored separately for pH, suspended solids, oil and grease, and flow before being routed to the cooling tower blowdown pipe for discharge.

The ash handling concept is based on wet sluicing bottom ash and fly ash to separate basins. This plans involves installation of an ultimate bottom ash storage basin with an initial fly ash storage basin. The ultimate bottom ahs storage basin has approximately 1,500 acre-feet capacity. (An acre-foot is defined as one acre of surface area one foot deep.) The initial fly ash storage basin has sufficient capacity to operate three years after Unit 1 startup, i.e., three years of fly ash production from Unit 1 and two years of fly ash production from Unit 2. When expanded, the fly ash storage basin will ultimately have approximately 8,500 acre-feet capacity. Bottom ash and fly ash will be used in construction of the ultimate storage basin dikes.

These basins, as initially planned, will allow Gulf to determine the ash disposal process chemistry, the amount of water seepage from each basin, the necessity of controlling the seepage, the suitability of ash for construction of the ultimate fly ash storage basin dike, and whether or

not waste treatment equipment will be required. The method of seepage, monitoring, and collecting is discussed in subsection 6.4.2, "Ash Pond Seepage Monitoring and Collecting Well System."

3.6.3 Alternate Methods of Ash Handling

Alternate methods of handling ash include (a) development of a commerical market for sells, and (b) transportation of ashes by dry methods for landfill disposal. However, at the present time, wet sluicing and ponding of the ash is the only feasible method of disposal.

3.6.4 Flue Gas Desulfurization Equipment

As mentioned in subsection 3.2.1.5, "Contracts," Gulf is actively negotiating for low sulfur coal as the fuel for the Caryville palnt. However, sufficient room is being left in the plant layout to install flue gas desulfurization (FGD) equipment in the event low sulfur coal is not available or FGD equipment is deemed necessary to meet air quality regulations. There has been no definite action taken to procure additional land in the present layout for disposal sites for any wastes associated with the operation of FGD equipment.

Gulf is presently participating in a research program to test and evaluate regenerative and nonregenerative as well as wet and dry FGD processes. Three prototype FGD plants from three process suppliers have been installed in a coal fired steam plant within Gulf's system. Due to the competitive arrangement, Gulf believes that the suppliers will ensure optimization of their respective installations as the program progresses. Reliability, sulfur dioxide (SO_2) removal capability, operating cost, and environmental impact potential are among the major areas of interest for all processes. Meaningful engineering information for optimizing design and operating conditions will be gathered and the applicability of each process will be established. 3

Waste sludges produced from the two, wet, nonregenerable FGD processes at the testing facilities are stored separately in lined ponds to permit monitoring for runoff water for leachate composition and to permit review of sludge fixation necessity and techniques. In the event a FGD process is required at Caryville, the results from the research program will be used for optimized selection and operation of the FGD equipment.

The quality and quantity of waste produced will depend on the type of FGD equipment used. FGD systems classified as nonregeneratable such as direct lime or limestone will require large areas for the disposal of sludges. Although regenerable systems do no produce waste sludge, they do produce products having a potential commerical market. However, the technology of regenerable system is not as advances as that for nonregenerable systems.

For a nonregenerable system, two of the major variables involved in determining the quantity of waste produced are sulfur content of the fuel being burned and the amount of SO_2 that must be removed from the flue gas. Other variables include heat value, load factor, and unit capacity.

Table 3.6-1 gives the variables and assumptions for calculating sludge solumes associated with a 500 megawatt (MW) unit. Figures 3.6-1 and -2 show the relationship between the sulfur content of coal and the by-product sludge produced for a 500 MW unit. Assuming that these relationships are linear between unit sizes, the estimated land area required to dispose of the sludge from a nonregenerable system over the life of the Caryville plant would be as follows:

	Minimum Acreage*	Maximum Acreage**
500 MW.	56.5***	627***
1,000 MW.	113***	1,254***
3,000 MW.	339***	3,762***

* Minimum Acreage = Dilute acid process using two percent sulfur coal
** Maximum Acreage = Direct limestone process using six percent sulfur coal 3
*** Assumes a pond depth of 25 feet and a 30-year plant life

The above estimates would be land requirements in addition to those for bottom and fly ash disposal. In the event FGD is necessary, purchase of additional land would be required. Figure 3.6-3 shows the relationship between the sulfur content of the coal and surface area expected to be required at Caryville for sludge disposal.

The regenerative type FGD process under evaluation by Gulf is a dry adsorption process where flue gas is passed through a char bed and the SO_2, nitrogen oxide (NO_x), oxygen, particulates, and water vapor are adsorbed. The nature of the dry adsorption process places an unusual emphasis on mechanical reliability since equipment used in the process in unfamiliar to the utility industry.

Use of the dry adsorption process would not require the purchase of additional land. Since the SO_2 that is adsorbed onto the char is ultimately converted into elemental sulfur, no by-product sludge is produced that would require disposal by ponding. The elemental has a potential use in sulfuric acid production or for commerical purposes. The amount of sulfur produced at varing sulfur content of the coal is shown in figure 3.6-4.

Depending on the FGD process, water use requirements vary from three to six gallons per minute (GPM) per megawatt. The consumptive use of water also varies depending on the FGD equipment. For the Caryville

plant, the amount of water to be withdrawn to support the FGD equipment, should it be required, would vary as follows:

	Minimum Water Withdrawal (GPM)	Maximum Water Withdrawal (GPM)
500 MW.	1,500	3,000
1,000 MW.	3,000	6,000
3,000 MW.	9,000	18,000

3

The above estimates could be water withdrawal requirements in addition to those for normal plant operation. (Refer to section 3.3, "Plant Water Use," for a discussion of normal plant operation water needs.) In the event FGD is necessary, installation of additional intake structures, water pumps, pretreatment equipment and possibly waste treatment facilities may be required. This water requirement could be supplied, however, by plant waste water such as tower blowdown.

TABLE 3.6-1

REACTANT CONSUMPTION AND BY-PRODUCT PRODUCTION ASSUMPTIONS FOR A 500 MW POWER PLANT

ASSUMPTIONS: GENERAL

Maximum Allowed Emission	1.2 lb SO_2 MBTU
Sulfur Content of Coal	As Shown
Coal Heating Value	10,000 BTU/lb
Load Factor (Daily)	0.50
Coal Consumption	482,600 lb.hr
Unit Capacity	500 MW
SO_2 System Availability(1)	95%
Number of Units	1 (2)
Plant Availability	84.1% (307 day/yr)
Coal Ash	12%
Fraction Bottom Ash	15%
E. P. Efficiency	99%
FGD Process Flyash Removal Efficiency	50%

ASSUMPTIONS: PROCESS

3

	Direct Lime	Dual Alkali	Direct Limestone	Chiyoda	Kellog
SO_3/SO_4 in By-Product	10:1	10:1	10:1	0(3)	0(3)
Reactant Type	CaO	CaO	$CaCO_3$	$CaCO_3$	$CaCO_3$
Reactant Purity as CaO(%)	95	95	--	--	--
Reactant Purity as $CaCO_3$(%)	--	--	90	90	90
Ca Utilization (%)	95	95	75	100	80
By-Product Solids Content (%)	40	60	40	80	80
% of SO_2 removed and leaving in the waste cake, but associated with sodium (Na^+)	--	3.5	--	--	--

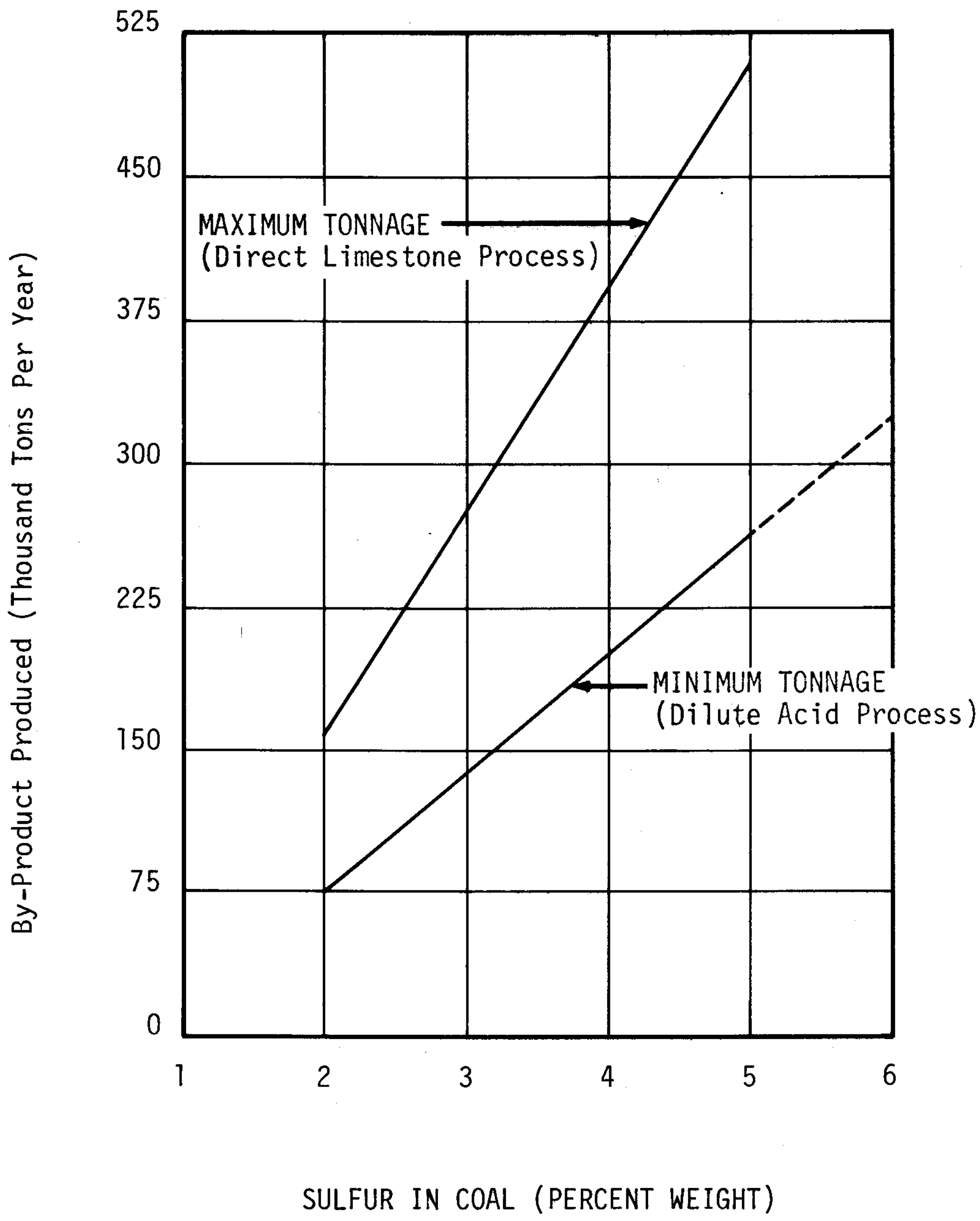
TO COMPUTE VOLUMES:

Gypsum Density (i.e., Chiyoda & Kellog Product)	110 lb/ft^3
Sludge Density (i.e., Direct Lime & Limestone)	83 lb/ft^3
Sludge Density (i.e., Dual Alkali Product)	90 lb/ft^3

(1) Availability - FGD process operating time divided by boiler operating time x 100

(2) These calculations are per unit

(3) No SO_3 in by-product



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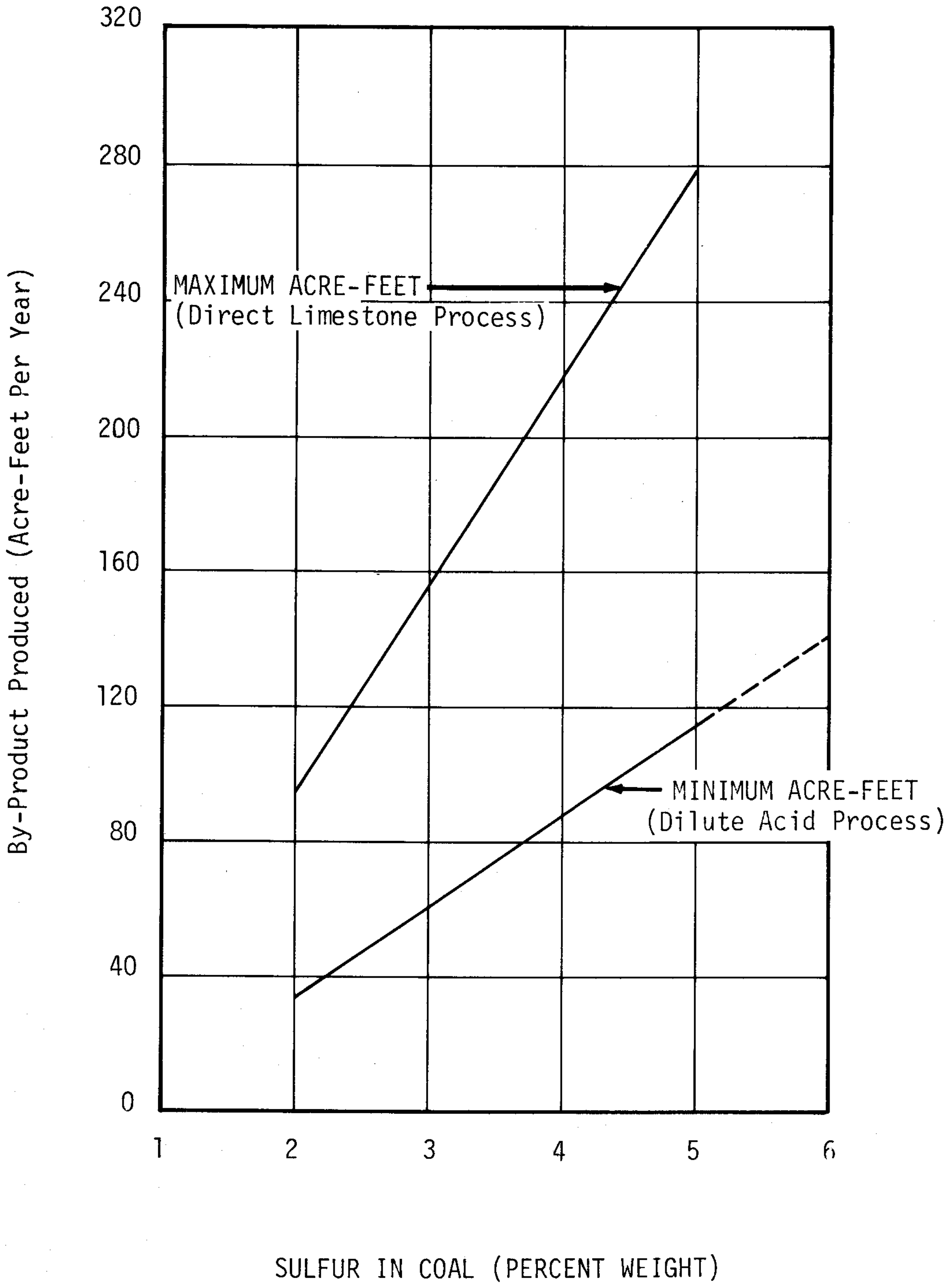
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	FGD WASTE PRODUCTION PER 500 MW IN TONS PER YEAR FIGURE 3.6-1



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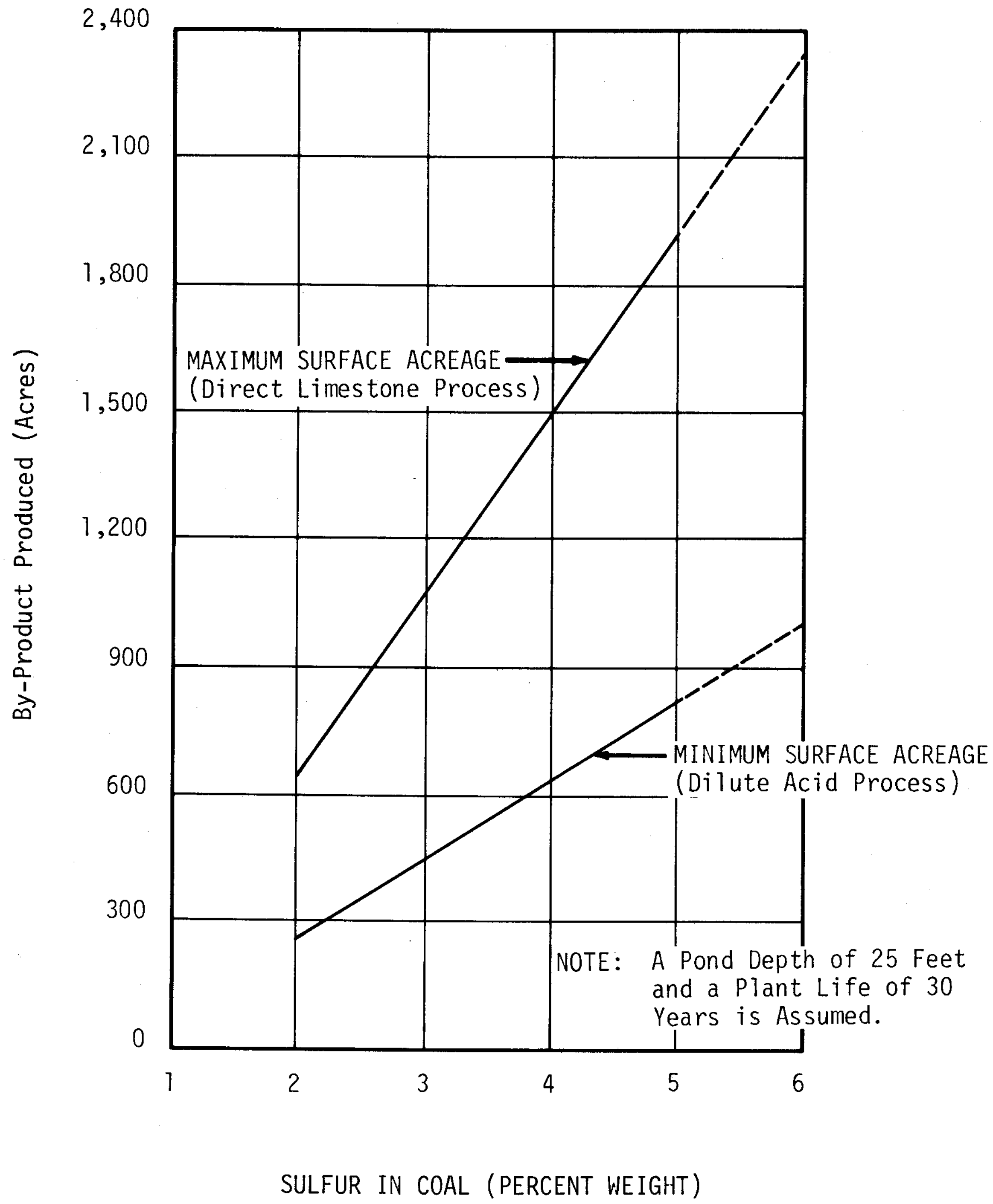
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	FGD WASTE PRODUCTION PER 500 MW IN ACRE-FEET PER YEAR
		FIGURE 3.6-2



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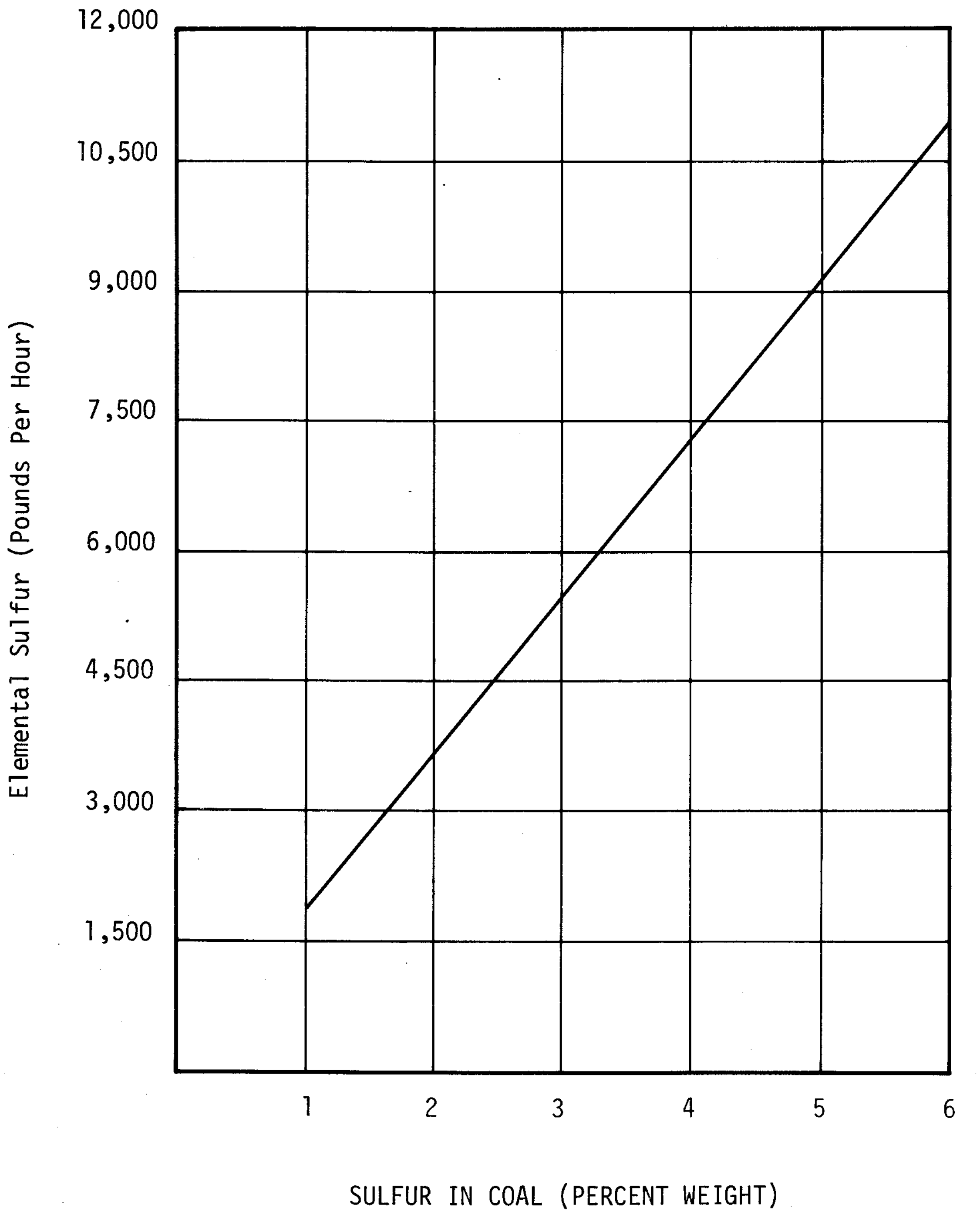
GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	TOTAL SURFACE ACREAGE REQUIRED FOR FGD WASTE DISPOSAL - 3,000 MW SITE TOTAL FIGURE 3.6-3



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GULF POWER CO.
CARYVILLE STEAM PLANT

SULFUR PRODUCTION FROM FLUE GAS DESULFURIZATION - DRY ADSORPTION PROCESS 500 MW

FIGURE 3.6-4

4.0 ENVIRONMENTAL EFFECTS OF SITE PREPARATION, AND PLANT AND ASSOCIATED TRANSMISSION FACILITIES CONSTRUCTION

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about the site containing disposable sanitary drinking cups, lunch wrappings, and the like which will be cleaned up to prevent vermin from being attracted to them.

During periodic cleanups of the work areas, Gulf will segregate and stockpile scrap metal for potential salvage reuse during the course of construction and ultimate disposal by sale as scrap at the conclusion of the project. Combustible materials resulting from work-area cleanups and the periodic pickups and emptying of litter barrels and trash cans will be hauled to a designated solid-waste disposal area. Inconsequential quantities of garbage will be generated, primarily stemming from construction workers' lunch leavings, and will be readily collectable and disposed of with the other combustible materials. Although burning is preferable, an alternate would be to establish a land-fill operation at a carefully selected site location whose topography would preclude adverse affects on ground water.

4.1.4.2 Sanitary Waste - Gulf will handle sanitary waste disposal by portable chemical toilets which contractors will be required to provide for their workers on a one to twenty ratio. (Refer to section 3.6, "Sanitary and Other Wastes' Systems.") Open-pit latrines or privies will not be allowed under any circumstances.

4.1.4.3 Petroleum and Chemical Wastes - Gulf will collect in drums and periodically dispose of used motor oil in conjunction with the disposal of other combustible materials in accordance with all applicable local and State ordinances and regulations. Other chemical wastes will be collected either in drums or, should large volumes be involved, in lined ponds for neutralization and removal by tank trucks. Subsequent disposal will be in accordance with current regulatory standards and recommendations.

4.1.5 Ambient Noise Levels

Ambient noise levels generated by the work are those background noises normally associated with heavy construction. Included are internal combustion engines, the whine of power-driven handsaws and tools, hammering and nailing, the use of impact wrenches for bolting up structural steel, and pile-driving operations. These two latter operations will not persist but for a relatively brief portion of the overall project duration, and while some overlapping of all the noises noted will occur, it is not a continuous overlap. Furthermore, the construction schedule is based on a single-shift, 40-hour work week. Accordingly, the noises discussed below could persist only for eight hours a day, five days a week, and would not exist continuously during and eight-hour work day. This factor in combination with the remoteness of the work site relative to populated areas makes it most unlikely that noise will constitute an adverse impact on the human environment.

4.1.5.1 Proximity of Humans to Noise - Table 4.1-1 and figure 4.1-1 indicate the proximity of human populations and identify the impacts on the environment arising from noise.

4.1.5.2 Construction Noise - Gulf makes the following seven observations, A through G, based on sound level studies made at other plant sites during their construction stages (1, 2, 3).

A. Individual machines used in construction work may produce sound levels which are quite high; e.g., compressors may produce 100 dBA (decibels on "A" scale) at five feet and cranes may produce 90 dBA at five feet.

B. Figure 4.1-2 illustrates typical data acquired at distances of approximately 200 feet and 400 feet from the central construction area of a plant (1). At 200 feet, the sound levels were concentrated in the range of 72 to 80 dBA with L_{10} = 78 dBA, L_{50} = 73 dBA, and L_{90} = 68 dBA. At 400 feet, the sound levels were concentrated in the range of 67 to 75 dBA with L_{10} = 76 dBA, L_{50} = 71 dBA, and L_{90} = 64 dBA.

C. At approximately 3,600 feet from the same construction site (1), the sound level had dropped to the 45 to 55 dBA range with L_{10} = 54 dBA, L_{50} = 47 dBA, and L_{90} = 45 dBA. These levels are only slightly above the expected summer ambient sound levels at the proposed Caryville plant site.

D. A Bechtel Corporation study (3) reported the following results for two monitoring stations around a plant construction site.

	Sound Levels, dBA	
	Ambient	During Construction
Station 1	L_{10} = 42 L_{50} = 36 L_{90} = 33	L_{10} = 64 L_{50} = 58 L_{90} = 51
Station 2	L_{10} = 41 L_{50} = 33 L_{90} = 31	L_{10} = 65 L_{50} = 57 L_{90} = 50

According to the Bechtel study, construction occured within 100 to 200 yards of Station 1 and "very close" to Station 2. The construction phases reported were the site preparation and excavation only.

E. Some construction activities, such as site preparation and excavation, and construction of the water intake system, may have a significant effect on the community since such construction efforts cover a large

Those workers who decide to relocate in the area during plant construction could live in available housing near the plant site or in the nearby cities of Bonifay, Chipley, Marianna, or DeFuniak Springs. Local entrepreneurs could set up mobile home camps either near the plant site itself or in the nearby cities mentioned above. Figure 4.1-9, previously referred to, identifies potential construction mobile homes sites within the five-mile radius area.

Relocated construction workers could purchase a wider variety of goods and services than the commuting workers. Table 4.1-9 identifies the types of business which could be benefited by the relocated construction workers.

Few local purchases of major equipment are anticipated. However, construction material purchases will be substantial, and the nearby metropolitan areas where these purchases could be made will be greatly benefited.

Employment and income could also be benefited by plant construction workers. Table 4.1-10 indicates the estimated employment and income of the business establishments most likely to benefit from purchases from commuting construction workers. Relocated construction worker purchases could be larger and have more variety. The employment and income accruing from the business establishments identified in table 4.1-9 could then be increased.

State, local, and federal taxes could also be benefited by plant construction activities. Table 4.1-11 indicates the types of taxes which could be affected. The potential exists for increased ad valorem taxes due to new commercial development or intensification of existing uses. Sales and use taxes could increase from construction worker purchases; income taxes could increase from increased wages in commercial business; gasoline taxes could increase from construction worker purchases of gasoline; and finally, mobile home licenses could increase if new mobile home camps for relocated construction workers are developed.

4.1.9 Socio-Economic Study for the Proposed Caryville Steam Plant

For a detailed discussion of the socio-economic impact of the proposed power plant, refer to Section 1 of Appendix E. 3

4.1.10 References

(1) Hickman, C. E. Sound Level Monitoring Study, Joseph M. Farley Nuclear Plant, Alabama Power Company, Internal Southern Services, Inc., Document, 1973.

(2) Hickman, C. E. Sound Level Monitoring Study, Edwin I. Hatch Nuclear Plant, Georgia Power Company, Internal Southern Services, Inc., Document 1974.

(3) Colman, R., et. al. Long-Term Noise Monitoring At A Nuclear Generating Station Construction Site, Inter-Noise 74 Conference, Bechtel Corporation Study, September 30 to October 2, 1974

(4) 1973 Average Daily Traffic for Holmes and Washington Counties, Florida Department of Transportation, Division of Planning and Programming, Bureau of Planning, 1974.

4.2 Special Features

4.2.1 Boiler Blowdown Noise

A special feature in the nature of an environmental effect is noise resulting from "blowing down" major steam-piping system. (Steam-piping system "blowing down" is not to be confused with the "blowdown" operation associated with cooling towers. Refer to the first paragraph following subsection 5.6.5 D, "Sound Levels During Plant Operation.") This operation is performed by systematically blowing steam through major steam-piping systems to thoroughly cleanse their interiors immediately prior to final tie-in of the boiler to the turbine. This blowdown is necessary to remove any debris or scale or tools left in the boiler or piping that would damage the turbine. "Blowdown", a prestart-up operation occurring late in the construction cycle, is usually accomplished within a span of several days. The noise produced, the sound and level of which can best be likened to that of a jet aircraft engine, is not continuous over the entire blowdown time span. Rather, a series of blows with durations measured in seconds and possibly minutes are involved with 45- to 90-minute intervals in-between for resupplying boiler feedwater and the build-up of the boiler pressure for the next "blow". This operation is normally conducted during daylight hours only.

4.2.2 Other Effects

Other than fertilizer, which will be used for reseeding and grassing activities, there will be no deleterious chemicals, growth retardants, biocides, etc., used either during or after the site clearing and grading phases of construction.

5.0 ENVIRONMENTAL EFFECTS ON PLANT OPERATION

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5.0 ENVIRONMENTAL EFFECTS OF PLANT OPERATIONS

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5.0 ENVIRONMENTAL EFFECTS OF PLANT OPERATION

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5.1 Effects Of The Operation Of The Heat Dissipation System

The proposed intake structure and the proposed discharge structure described in section 3.4, "Heat Dissipation System," are designed to withdraw and return water to the river at approximately the same depth. Therefore, no adverse effects are anticipated from withdrawal and return at different depths.

5.1.1 Temperature Effects of Tower Blowdown

Gulf will take blowdown from the cool side of the cooling tower, mix it with bleed-off from both the ash sluice systems and the effluent from the waste water basin, and then discharge it directly to the river. 3

In order to accurately predict the effluent temperature under various hydrometeorological conditions, Gulf performed a detailed thermal analysis. Included in the analysis were the following parameters: (a) heat gained in the ash sluice process, (b) net heat transfer from the ash disposal 3 area surfaces, and (c) heat gained from tower blowdown.

The results of the analysis are presented in table 5.1-1.

5.1.2 Discussion of the Analytical Model

Several analytical models are available for predicting plume configurations (1, 2, 3, 4, 5). After studying the river bottom topography, river hydrology, and the discharge structure location, Gulf decided that the three-dimensional submerged discharge model (5) would give the most representative results.

The proposed discharge point is located on a concave bank where the river makes a sharp turn of approximately 90 degrees. Rather strong eddies and turbulence exist in the river due to the existence of a secondary flow (6) in the transverse direction across the river. These strong eddies tend to accelerate the mixing process for the effluent, but the effect of the eddies is neglected by the three-dimensional submerged discharge model. Therefore, the actual plume size will be smaller than predicted by this model, especially in the region where the jet velocity is close to the river velocity. Under low river flow conditions, the upper edge of the plume may reach the water surface some distance downstream of the discharge point, thereby restricting mixing somewhat. However, due to the existence of the secondary flow which tends to keep the plume submerged, this model is considered adequate.

5.1.3 Description of Cases Studied

Gulf's operation of the plant will result in varying discharge rates and temperatures. For the purpose of defining the mixing zone, it is 3 only desirable to describe the largest probable thermal plume which can

occur during a hydrometeorological phenomenon governed by the three parameters of river flow rate, river water temperature, and ambient wet bulb temperature.

To determine the maximum probable plume size, it is necessary to postulate the simultaneous occurrence of (a) minimum river flow rate, thereby assuming the minimum amount of water available for mixing and dilution, and (b) minimum river water temperature. Furthermore, it is necessary to combine these two parameters with various discharge rates and temperatures to determine which combination will produce the largest thermal plume. 3

No computation of the minimum effluent discharge rate for the 500 MW case is possible because the three-dimensional submerged discharge model (5) does not give valid results when discharge velocities are nearly equal to the river velocity. The plume for the 500 MW minimum effluent case will be smaller than the 1,000 MW plume, because the quantity of water discharged is less and the river current velocity is higher than the discharge velocity. The river current tends to "pull" the discharged water from the outlet, resulting in much faster mixing with the river.

The effluent temperature is dependent upon the ambient wet bulb temperature since its source is the blowdown from an evaporative cooling device (wet cooling tower). The time frame of interest is the estimated life of the plant, or approximately 40 years. Since river flow is the only one of the three parameters for which 40 years of record exist, it is impossible to determine if the postulated worst case has occurred. From a statistical evaluation of the records available for ambient wet bulb temperatures (16 years of record) and river temperature (5 years of record), it is possible to estimate the probability of simultaneous occurrence of high wet bulb temperature low river temperature, and low river flow. The probability of simultaneous occurrence of three independent parameters is the product of the probability of each event occurring independently. Expressed mathematically:

$$P = P_{lrf} \times P_{hwb} \times P_{lrt}$$

where

P_{lrf} = probability of occurrence of low river flow

P_{hwb} = probability of occurrence of high wet bulb temperature

P_{lrt} = probability of occurrence of low river temperature

for the general case

$$P = \frac{\text{Number of occurrences}}{\text{Total Number of readings}}$$

specifically

$$P_{lrf} = \frac{1}{90 \times 44}$$

$$P_{hwb} = \frac{43}{35549}$$

$$P_{lrt} = \frac{2}{450}$$

$$P = \frac{1}{90 \times 44} \times \frac{43}{35549} \times \frac{2}{450} = 1.36 \times 10^{-9}$$

It is therefore extremely unlikely that the phenomenon will occur during the life of the plant and, therefore, it is technically and economically undersirable to design the system for such stringent criteria.

A more logical approach is to arbitrarily use the minimum river temperature of record, the maximum wel bulb temperature of record, and the commonly accepted 7-day/10-year river flow of record to define the most severe cases. These record temperatures will produce the effluent temperatures presented in table 5.1-1.

The probability of the occurrence of the maximum temperature difference between the plant effluent and the river is independent of the river flow rate, and is dependent on the wet bulb and river temperatures and the plant effluent flow rate.

It is necessary to evaluate summer, autumn, and winter cases in conjunction with minimum, average, and maximum effluent flow rates in order to determine which case will actually result in the largest thermal plume. The commonly accepted value of 7-day/10-year low flow was arbitrarily selected for use in the prediction of adverse winter and summer conditions. From table 2.5-7, the 7-day/10-year low flow was taken as 870 cubic feet per second (CFS). For the adverse autumn case, the lowest monthly average flow of record (604 CFS) was selected for predictive purposes. At these flow rates, the discharge pipe centerline is estimated to be submerged 3
approximately three feet, while the full river depth is estimated to be approximately 10 feet.

Minimum, average, and maximum effluent flow rates per 500 MW generating capacity are estimated to be 1.84, 4.62, and 7.41 CFS respectively. Furthermore, minimum, average, and maximum flow rates were distributed on a 25 percent, 50 percent, and 25 percent occurrence basis, respectively.

Analyses of the plume under minimum effluent discharge rates and low river flows revealed that the portion of the plume with temperatures higher than 5^{o}F above ambient will not stay submerged for a very long distance from the point of discharge. This is due to the small momentum of a low velocity jet. The discharge pipe center line is therefore set at an angle

of 15° below the horizontal to compensate for the buoyancy of the jet and to assure that the plume stays submerged throughout the reach of the 5°F 3
isotherm.

5.1.4 Results of Analytical Modeling

The results of the plume analyses of Cases 1, 2, and 3 of table 5.1-1 were used to plot the decay curves of figure 5.1-1 in order to determine the hydrometeorological conditions (Case 1, 2, or 3) which will result in the largest thermal plume. From figure 5.1-1, it is apparent that Case 1 is the most severe.

The results of the plume analyses of Cases 1, 4, and 5 were used to plot the decay curves of figure 5.1-2 to determine whether the minimum or 3
maximum effluent creates the largest plume. It is seen from this figure that Case 1 (minimum effluent flow) will produce the largest affected area in the river and therefore the largest plume. The Case 1 plumes are shown in figures 5.1-3 and -4 for 3,000 MW and 1,000 MW, respectively. Plumes of more normal conditions are presented for comparative purposes only, in figures 5.1-5 through -7.

Figure 5.1-8 is a river cross section just downstream of the point of discharge under Case 1 conditions. The area affected by the thermal plume is 116 feet square, or about nine percent of the total cross sectional area of 1,329 feet square.

5.1.5 Whole River Temperature Rises

The "whole river temperature" increase caused by the plant effluent is small. (The "whole river temperature" is that calculated average temperature of the river along its length from the proposed plate site to Choctawhatchee Bay.) Calculated whole river temperature increases are presented in table 5.1-1.

5.1.6 Applicable Thermal Standards

Applicable state thermal standards are outlined in Chapter 17-3, as amended, of the Florida Administrative Code (7), and applicable Federal thermal standards are outlined in CFR (Code of Federal Regulations) Title 40, Part 423.15-1. Both standards permit discharge of heat from the cold side of the condenser.

The State of Florida may grant a zone mixing beyond the point of discharge to afford a reasonable opportunity for dilution and mixing 3
of heated water with the river. Zones of mixing for cooling tower blowdown discharges shall be established on the basis of the physical and biological characteristics of the river.

5.1.7 Environmental Effects of Cooling Towers

The wet natural draft cooling towers for the proposed Caryville plant will release water vapor to the atmosphere at a height greater than 550 feet above the ground elevation and a rate which will vary with plant load and site meteorological conditions. Maximum evaporation from the towers will be about 25,980 gallons per minute (GPM) per 3,000 MW on a hot summer day. The maximum drift rate will be about 90 GPM per 3,000 MW with an expected drift rate of about 45 GPM.

Potential environmental effects due to tower operation include possible increased frequency of fog formation and fog density, reduced visibility, icing on nearby objects, the deposition of materials contained in the drift, and the consumption of water. Each of these effects were considered during the selection of the cooling towers.

5.1.7.1 Local Fogging and Icing - The use of wet natural draft cooling towers with a height in excess of 550 feet will result in tower emissions reaching ground level far less frequently than emissions from shorter towers. Under most meteorological conditions, tower discharge will condense and form a visible water vapor plume until it is evaporated due to mixing with unsaturated air. The length of the visible plume depends on the temperature and the relative humidity of the surrounding 2
air. Much of the time, the visible plume will not extend beyond the site boundary, although, on cool humid mornings, longer plumes may occur. On such occasions, it may be difficult to distinguish such plumes from the overcast.

Gulf is working with other utility companies to develop a cooling tower plume dispersion model and has calibrated it against wet natural draft cooling tower plume observations. The physics of this particular model have been described (8). For relatively flat terrain similar to that at the plant site, the model's plume does not reach ground level at wind speeds up to and in excess of 40 miles per hour (MPH). Observations of cooling tower plumes by the American Electric Power Service Corporation (9) are that no visible plume reached ground level even with winds as strong as 44 MPH. The results of modeling studies and the finding of field observations lead to the conclusion that although natural draft towers have the potential to effect ground level fog, they seldom do. Studies of the environmental effects of cooling towers which support this statement are found in at least four current documents (9, 10, 11, 12).

The elevated cooling tower plume is not expected to contribute significant moisture to the atmosphere at ground level. Due to this low moisture contribution and the moderate climate with a low frequency of freezing conditions, Gulf does not expect increased icing on roads or other ground level surfaces.

5.1.7.2 Drift - The wet natural draft cooling towers selected for the Caryville plant will have state-of-the-art drift eliminators. The expected drift rate for these towers is 0.004 percent of the circulating water flow or approximately 7.5 GPM per 500 MW. The maximum guaranteed drift rate is 0.008 percent of the circulating water flow or approximately 15 GPM per 500 MW. The expected drift rate for the 3,000 MW site development will be approximately 45 GPM with a maximum rate of approximately 90 GPM.

Drift from the natural draft cooling towers will contain dissolved solids at the same concentration as tower blowdown. (See table 3.4-3.) These solids will be deposited over the land surface. At an expected rate of 45 GPM for 3,000 MW, drift will result in the deposition of approximately 31 tons of material per year. Assuming this material were deposited evenly over the 1,500 acre site, deposition would amount to approximately 0.02 tons per acre per year or 40 pounds per acre per year. This value may be compared with reported quantities of material leached from trees by rain. Depending on the type of forest, one inch of rain may leach from between 0.1 to 9.5 pounds per acre of constituents such as calcium, magnesium, potassium, phosphorus, and sodium from tree foliage (13).

The potential impact of icing conditions due to cooling tower drift is considered minimal. The climate in the vicinity of the proposed site is very moderate with a low frequency of freezing conditions.

5.1.7.3 Water Consumption - Evaporation and drift of water due to the operation of the wet natural draft cooling towers will constitute a consumptive use. The estimated consumptive rate for the initial 500 MW unit is 4,345 GPM. The consumptive rate will double to approximately 8,690 GPM for 1,000 MW and reach 26,070 GPM for the ultimate site development of 3,000 MW. Evaporation and drift constitute a consumptive use of surface water but the water is returned to the environment through the hydrologic cycle. (The hydrologic cycle is described in section 2.5, "Hydrology.")

The amount of water involved as consumptive use due to the operation of the natural draft cooling towers for the 3,000 MW site is approximately one percent of the average flow of the Choctawhatchee River at the site. The consumptive use is less than one percent of the average fresh water supply to the Choctawhatchee Bay. Therefore, the consumptive use of water at the proposed plant by natural draft cooling towers is expected to have minimal impact on the Choctawhatchee River and on Choctawhatchee Bay.

5.1.8 Effects on the Biota

For effects of the heat dissipation system on biota, refer to Section 2 of Appendix D. 3

5.1.9 References

(1) Motz, L. H. and B. A. Benedict. "Surface Jet Model for Heated Discharges." J. of Hydraulic Division, ASCE, Vol. 98, No. HY1, pp. 181-199, Jan., 1972.

(2) Carter, H. H. "A Preliminary Report on the Characteristics of a Heated Jet Discharged Horizontally into the Transverse Current, Part I - Constant Depth." Technical Report 61, Chesapeake Bay Institute, The Johns Hopkins University, November, 1969.

(3) Stolzenbach, K. D. and D. R. F. Harleman. "Water Pollution Control Series." An Analytical and Experimental Investigation of Surface Discharges of Heated Water, 16130 DJV 02/71, Feb., 1971.

(4) Shirazi, M. A. and L. R. Davis. Workbook of Thermal Plume Prediction, Volume 2, Surface Discharge, EPA-R2-72-005b, National Environmental Research Center, U. S. EPA, Corvallis, Oregon, 97330, May, 1974.

(5) Hirst, E. "Buoyant Jets with Three-dimensional Trajectories." J. of the Hydraulics Division, ASCE, Vol. 98, No. HY11, pp. 1999-2014, November, 1972.

(6) Engelund, F. "Flow and Bed Topography in Channel Bends." J. of the Hydraulics Division, ASCE. Vol. 100, No. HY11, pp. 1631-1648, November, 1974.

(7) "Pollution of Waters." Rules of the Florida Department of Pollution Control, Chapter 17-3, May 7, 1974.

(8) Calabrese, R. V., J. H. Halitsky, and K. Woodard. "Prediction of Temperature and Moisture Distribution in Cooling Tower Plumes." Proc. American Meteorological Society and World Meteorological Organization Symposium on Atmospheric Diffusion and Air Pollution, Santa Barbara, Calif., 1974.

(9) Cooling Towers and the Environment, study published by American Electric Power Service Corp., 2 Broadway, N.Y., N.Y., October, 1974. 2

(10) Peterson, J. T. "Impact of Thermal Discharges on Air Quality." Effects and Methods of Control of Thermal Discharges, Report to the Congress by EPA in accordance with Section 104(t) of FWPCA, Amendments of 1972, Serial No. 93-14, November, 1973.

(11) Huff, F. A., et.al. "Preliminary Report, Effect of Cooling Tower Effluents on Atmospheric Conditions in Northeast Illinois." Illinois State Water Survey Circular 100, Urbana, Illinois, 1971.

(12) Hosler, C. L. "Wet Cooling Tower Plume Behavior." Cooling Towers, CEP Technical Manual Publication by AICHE, N.Y., N.Y., 1971.

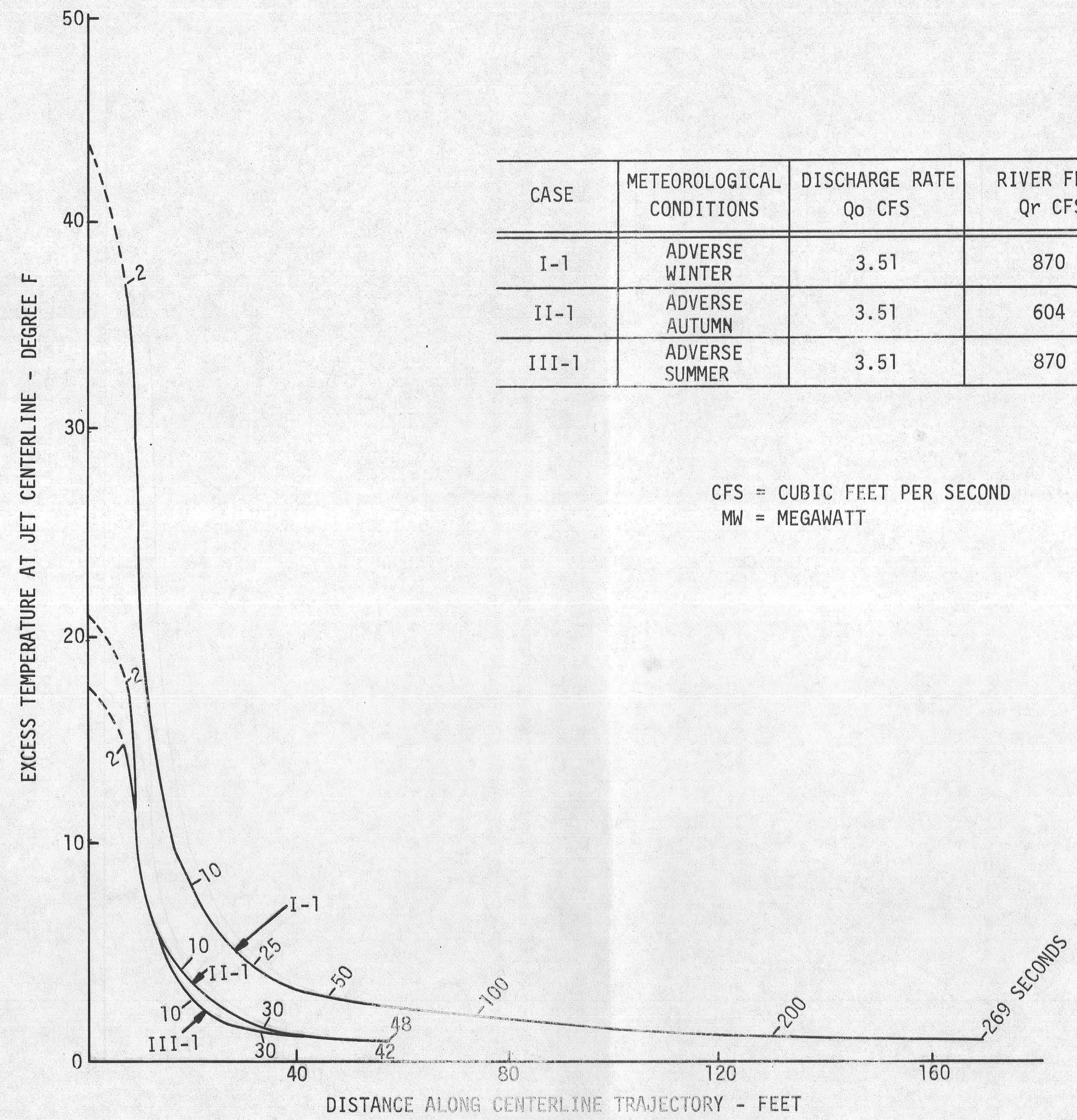
(13) Final Impact Statement Related to the Construction of Joseph M. Farley Nuclear Plant, Units 1 and 2, U.S. Atomic Energy Commission, p. V-7, June, 1972. 2

TABLE 5.1-1

PLANT EFFLUENT TEMPERATURES AND WHOLE RIVER TEMPERATURE RISE

Hydrometeorological Conditions						Effluent Temperatures (°F)			Whole River Temperature Rise (°F)		
Case	Description	Probability of Occurrence	Wet Bulb Temperature (°F)	River Temperature (°F)	River Discharge Rate (cfs)	Generating Capacity (MW)			Generating Capacity (MW)		
						500	1,000	3,000	500	1,000	3,000
1	Minimum plant effluent under adverse winter conditions	5×10^{-8}	72	39	870	83.3	83.3	83.3	0.09	0.19	0.60
2	Minimum plant effluent under adverse summer conditions	1.525×10^{-8}	84	71	870	89.0	89.0	89.0	0.04	0.08	0.24
3	Minimum plant effluent under adverse autumn conditions	2.425×10^{-8}	82	68	604	89.4	89.4	89.4	0.07	0.13	0.43
4	Average plant effluent under adverse winter conditions	10^{-7}	72	39	870	70.5	69.7	70.8	0.17	0.33	1.08
5	Maximum plant effluent under adverse winter conditions	5×10^{-8}	72	39	870	67.1	66.7	67.3	0.24	0.48	1.55
6	Average plant effluent under average winter conditions	6.25×10^{-2}	48	52.1	6,413	68.1	68.6	67.3	0.01	0.02	0.07
7	Average plant effluent under average summer conditions	6.25×10^{-2}	74	79.6	3,805	88.9	89.3	88.0	0.01	0.02	0.06

3



CASE	METEOROLOGICAL CONDITIONS	DISCHARGE RATE Qo CFS	RIVER FLOW Qr CFS	DISCHARGE TEMP. To DEG.F	RIVER TEMP. Ta DEG.F
I-1	ADVERSE WINTER	3.51	870	83.3	39.0
II-1	ADVERSE AUTUMN	3.51	604	89.4	68.0
III-1	ADVERSE SUMMER	3.51	870	89.0	71.0

CFS = CUBIC FEET PER SECOND
MW = MEGAWATT

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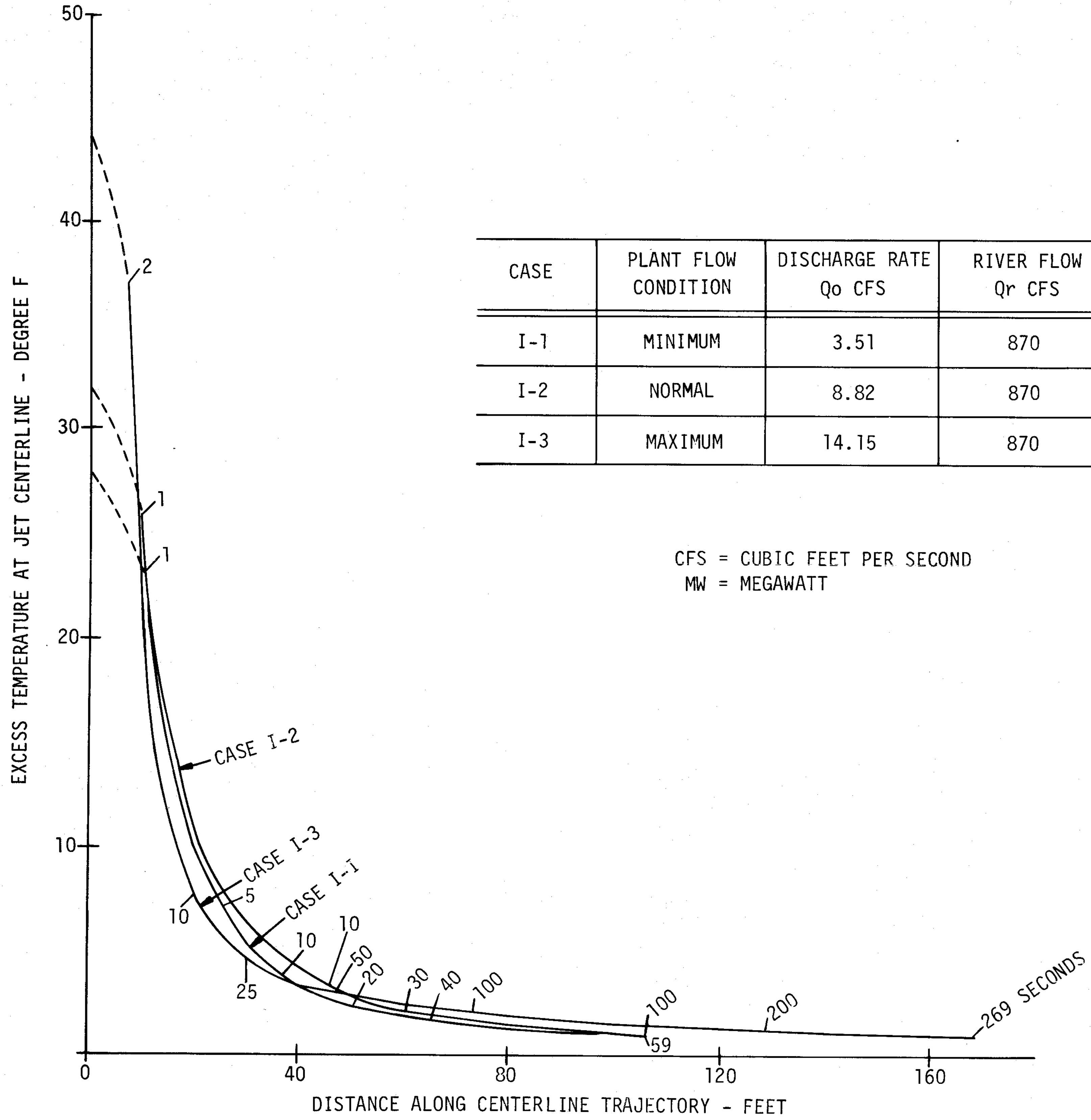
CARYVILLE STEAM PLANT

TEMPERATURE DECAY ALONG CENTERLINE TRAJECTORY, 3,000 MW AND MINIMUM PLANT FLOW CONDITIONS

FIGURE 5.1-1



CASE	PLANT FLOW CONDITION	DISCHARGE RATE Qo CFS	RIVER FLOW Qr CFS	DISCHARGE TEMP. To DEG. F	RIVER TEMP. Ta DEG. F
I-1	MINIMUM	3.51	870	83.3	39.0
I-2	NORMAL	8.82	870	70.8	39.0
I-3	MAXIMUM	14.15	870	67.3	39.0

CFS = CUBIC FEET PER SECOND
MW = MEGAWATT

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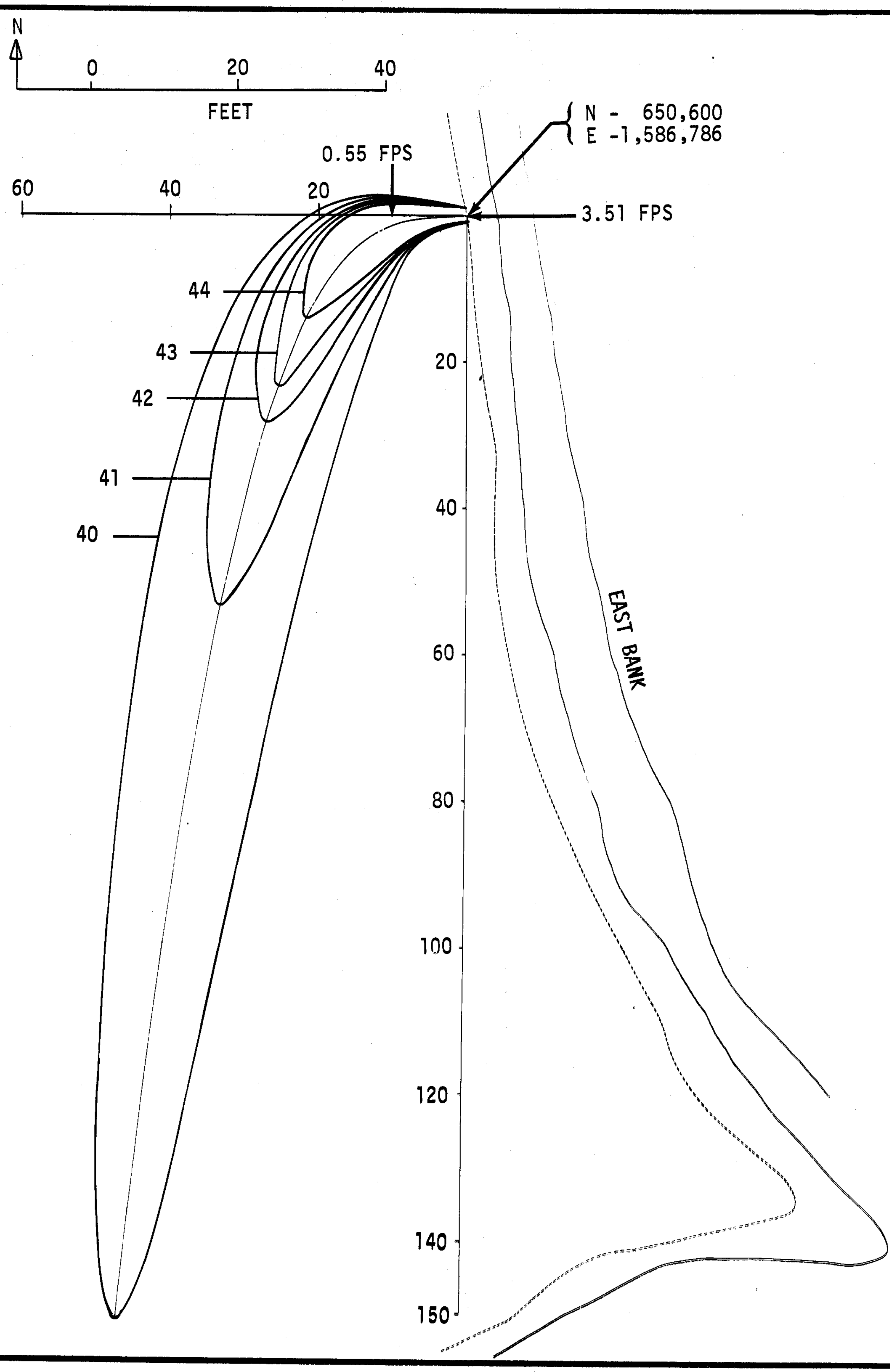
TEMPERATURE DECAY ALONG CENTERLINE TRAJECTORY 3,000 MW AND ADVERSE WINTER CONDITIONS

FIGURE 5.1-2

39.0°F
AMBIENT RIVER TEMPERATURE

FPS - FEET PER SECOND
MW - MEGAWATT



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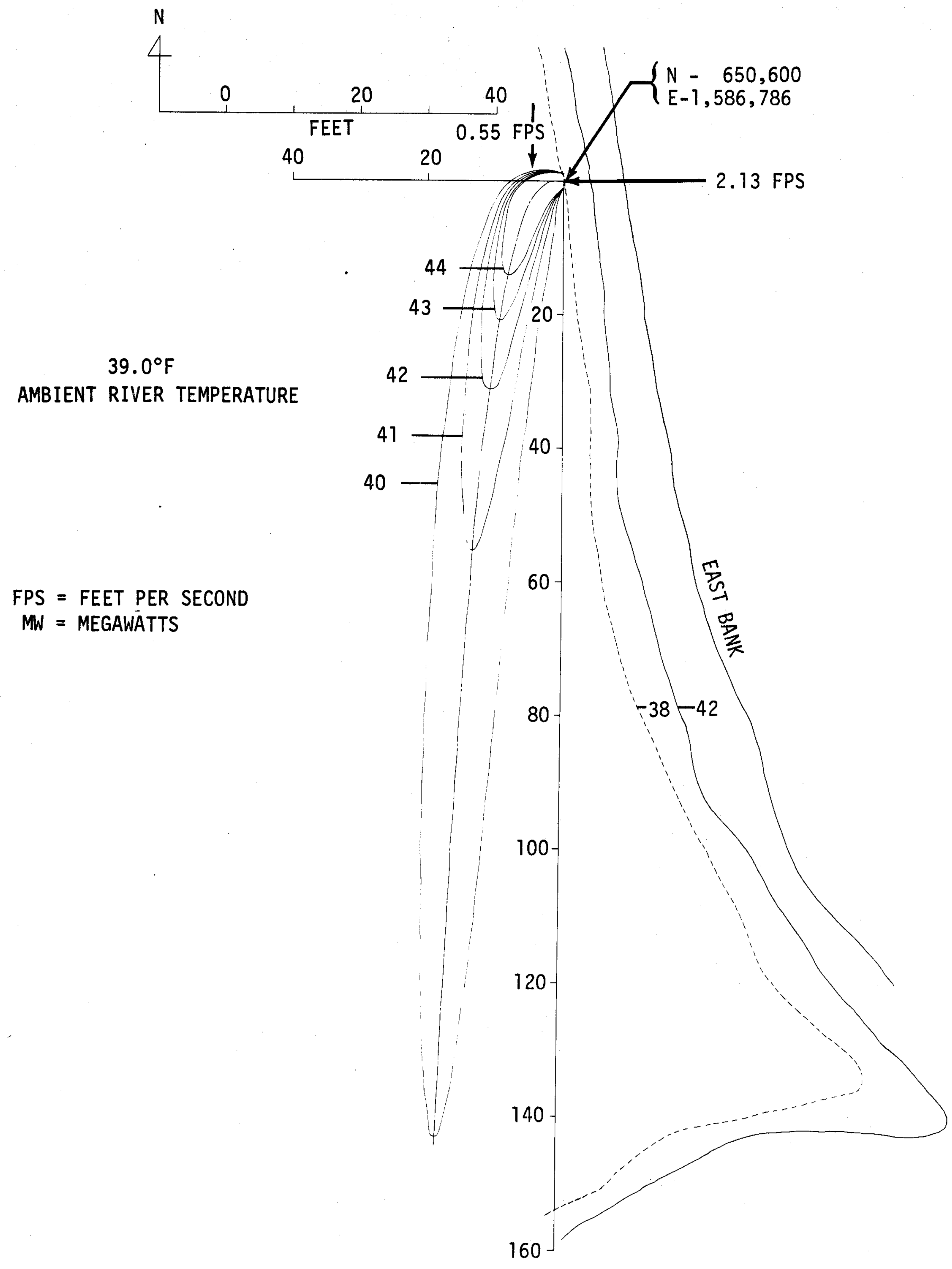
TEMPERATURE ISOTHERMS AT ULTIMATE
3,000 MW CAPACITY ADVERSE WINTER
AND MINIMUM PLANT EFFLUENT RATE

FIGURE 5.1-3



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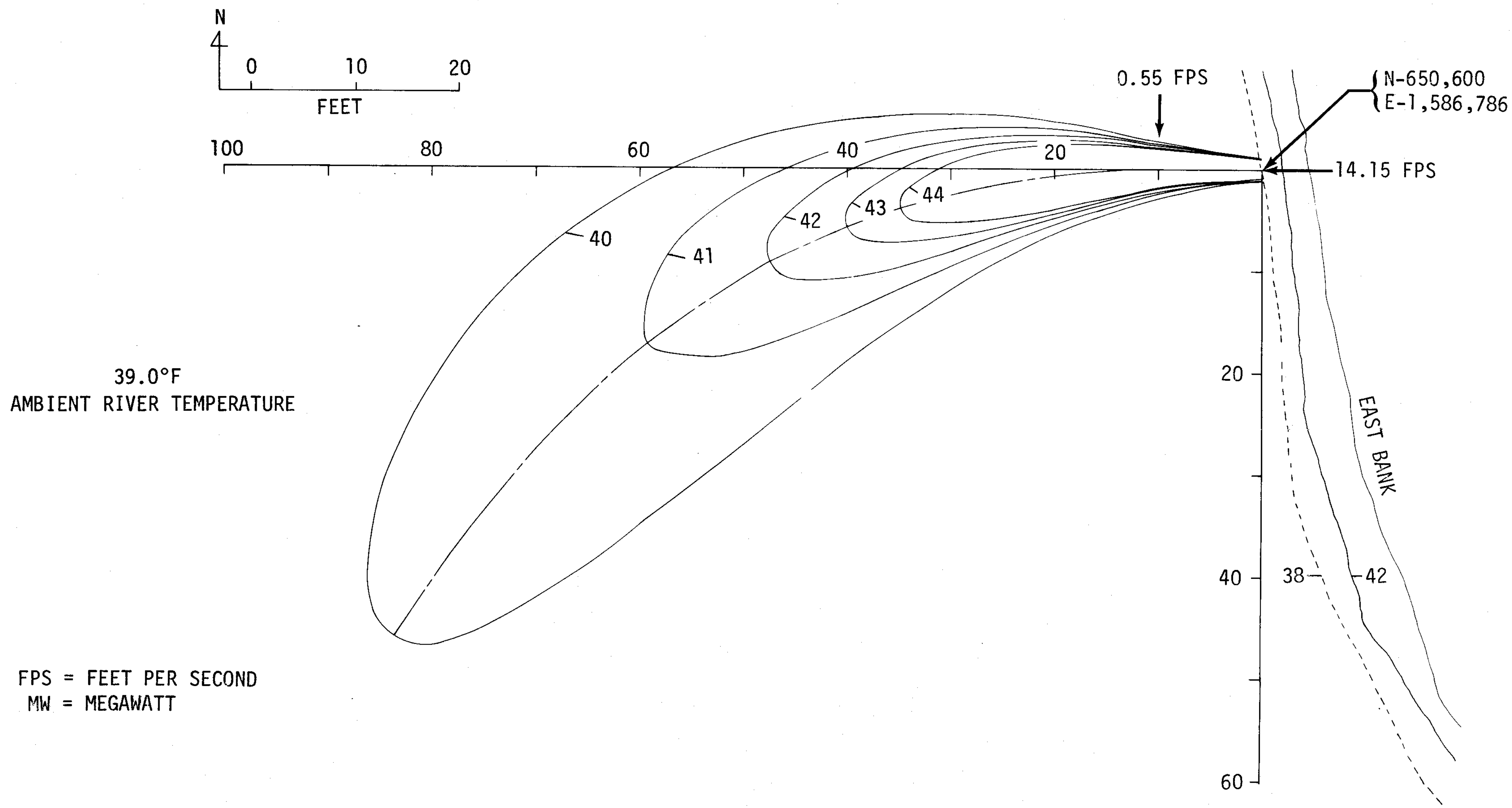
TEMPERATURE ISOTHERMS AT 1,000 MW CAPACITY ADVERSE WINTER AND MINIMUM PLANT EFFLUENT RATE

FIGURE: 5.1-4



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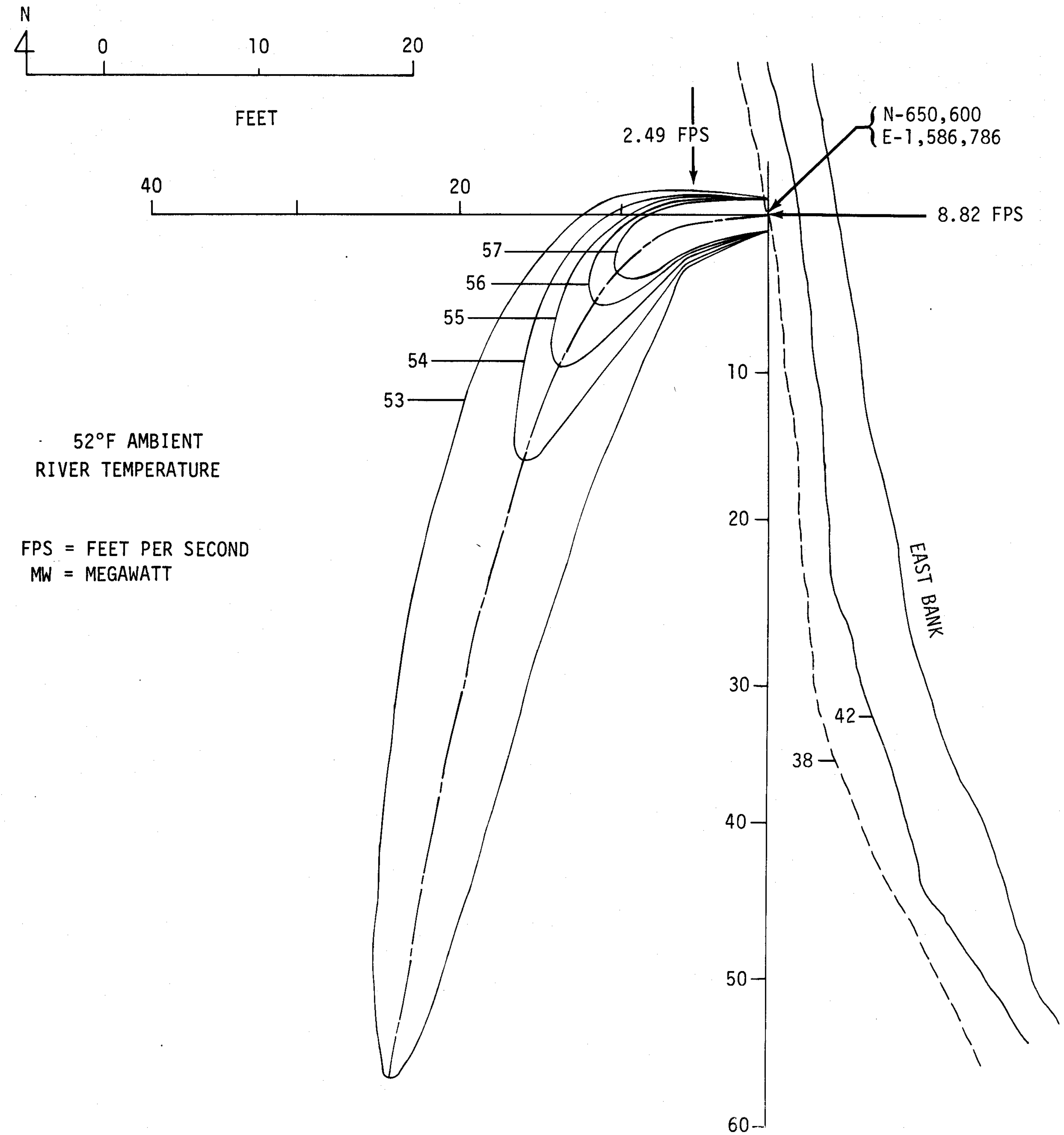
TEMPERATURE ISOTHERMS AT ULTIMATE 3,000 MW CAPACITY, ADVERSE WINTER AND MAXIMUM PLANT EFFLUENT RATE

FIGURE 5.1-5



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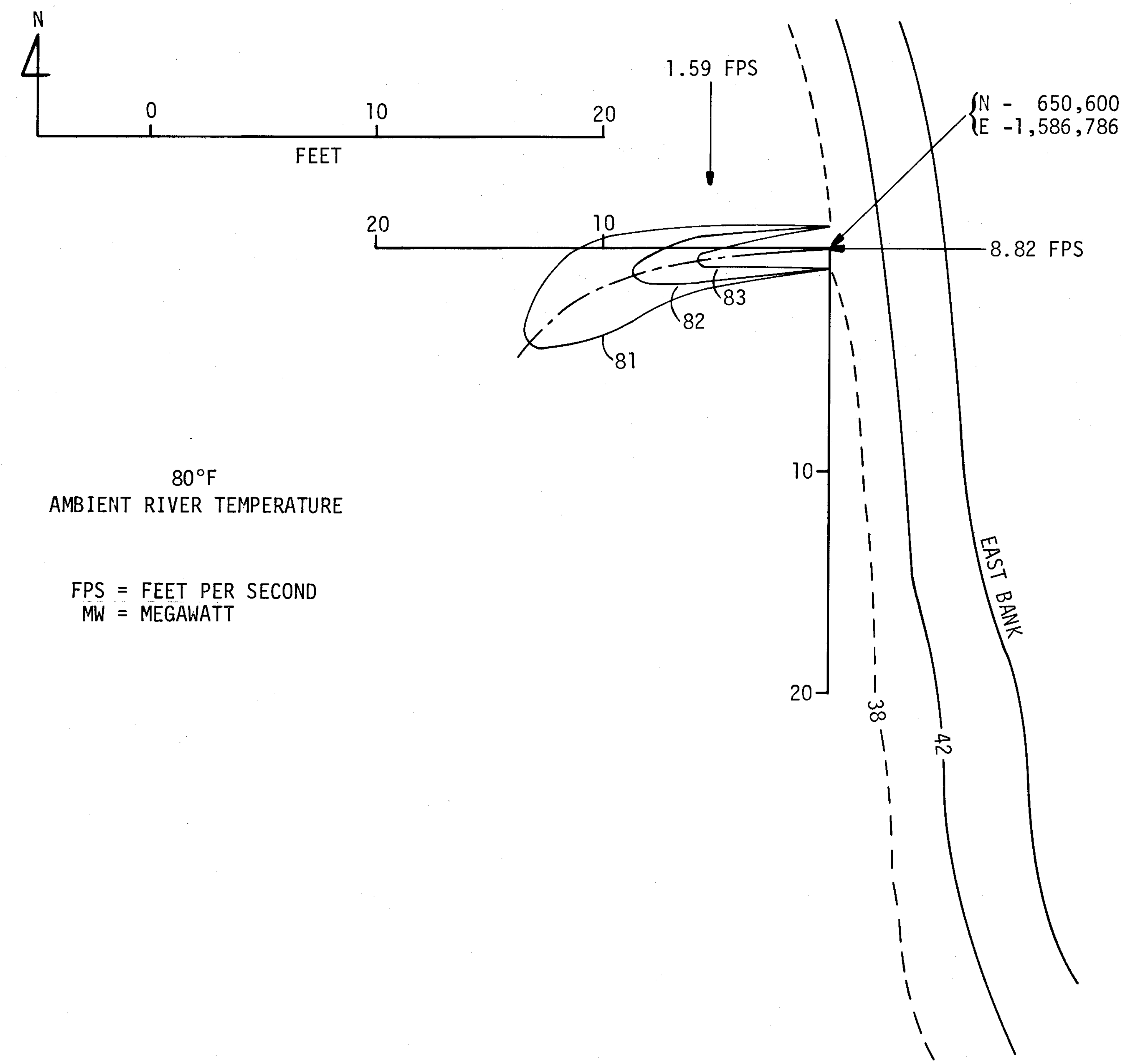
TEMPERATURE ISOTHERMS AT ULTIMATE 3,000 MW CAPACITY, AVERAGE WINTER AND AVERAGE PLANT EFFLUENT RATE

FIGURE: 5.1-6



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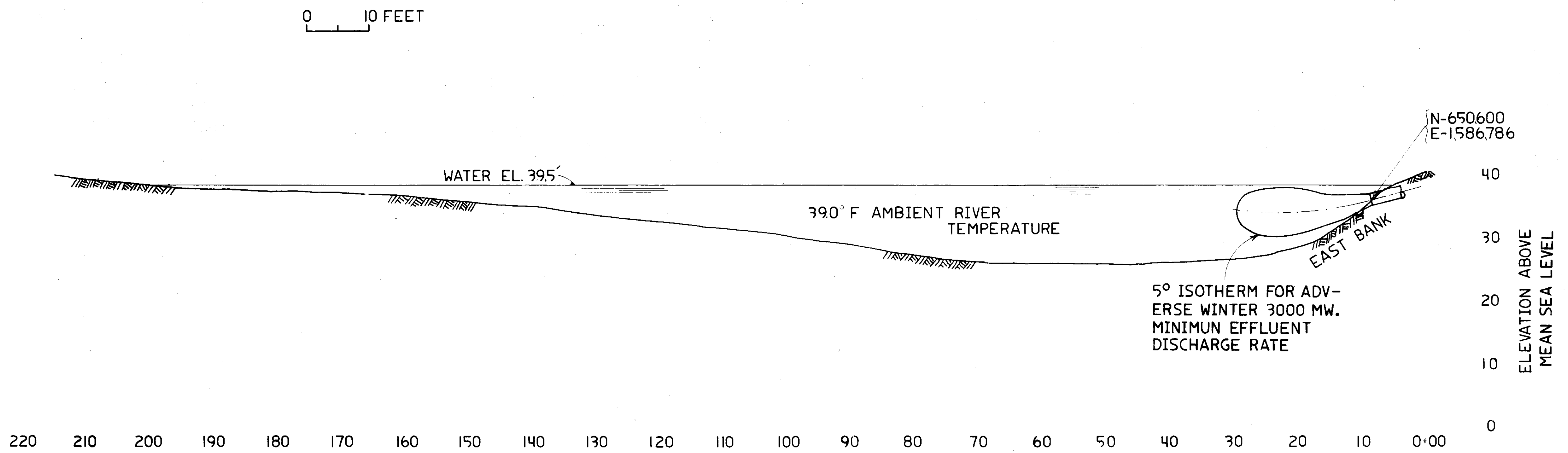
TEMPERATURE ISOTHERMS AT ULTIMATE 3,000 MW CAPACITY, AVERAGE SUMMER AND AVERAGE PLANT EFFLUENT RATE

FIGURE 5.1-7



RIVER CROSS SECTION AT THE DISCHARGE STRUCTURE

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GULF POWER CO.
CARYVILLE STEAM PLANT

TRANSVERSE RIVER CROSS SECTION SHOWING
THE MAXIMUM SIZE THERMAL PLUME

FIGURE 5.1-8

5.2 Effects of Chemical and Biocide Discharges

5.2.1 Water Quality Standards Governing Discharges

Results of natural ambient river water analysis are given in table 3.4-1. 3

The quality and quantity of the plant's waste water stream is discussed in subsection 3.5.3.4, "Plant Discharge."

The Florida Department of Pollution Control (FDPC) has established applicable water quality standards (1). As stated in chapter 17-3.05 of the Florida Administrative Codes (FAC), the only constituents of the plant effluent which are specifically limited by the water quality limits on these constituents, listed below, are applied "only after reasonable opportunity for mixture of wastes with receiving waters has been afforded" (1).

Constituents	FDPC Limit
Total Dissolved Solids	500 milligrams per liter (MG/L) a monthly average not be exceed 1,000 MG/L at any time
Chlorides	250 MG/L
pH	6.0 to 8.5

No specific criteria are given for sulfates and potassium. However, according to section 17-3.04(4), when these occur "in any amounts in any individual body of water, they shall be suspected of degrading the quality of the particular lake or stream." 3

The plant effluent will also be in compliance with applicable U.S. Environmental Protection Agency regulations.

5.2.2 Effluent Effects on Biota

For effects of chemical and biocide discharges on biota, refer to Section 2 of Appendix D. 3

5.2.3 Dispersion of Effluent in the River

Gulf used an analytical model to predict the mixing of the effluent in the river, as discussed below.

5.2.3.1 Discussion of the Analytical Model - Several analytical models are available for predicting plume configurations (2, 3, 4, 5, 6). After studying the river bottom topography, river hydrology, and the proposed discharge structure location, Gulf decided that the three-dimensional submerged discharge model (6), would give the most representative results.

The proposed discharge point is located on a concave bank where the river makes a sharp turn of approximately 90 degrees. Rather strong eddies and turbulence exist in the river due to the existence of a secondary flow (7), in the transverse direction across the river. These strong eddies tend to accelerate the mixing process for the effluent, but the effect of the eddies is neglected by the three-dimensional submerged discharge model (6). Therefore, the actual plume size will be smaller than predicted by this model, especially in the region where the jet velocity is close to the river velocity. Under low river flow conditions, the upper edge of the plume may reach the water surface some distance downstream of the discharge point, thereby restricting mixing somewhat. However, due to the existence of the secondary flow, which tends to keep the plume submerged, Gulf considers this model adequate.

5.2.3.2 Description of Cases Studied - Operation of the plant will result in different discharge rates with corresponding differences 3
in levels of discharge constituents depending on the level of plant operation. The largest plume will occur when the river flow rate is low because less water will be available for mixing and dilution. The 7-day/10-year low flow value generally recognized by the U.S. Geological Survey and the Northwest Florida Water Management District was also chosen for use in the predictions. From table 2.5-7, the 7-day/10-year low flow was taken as 870 cubic feer per second (CFS). At this flow rate, the discharge pipe centerline is estiamted to be submerged approximately three feet while the full river depth is estimated to be approximately 10 feet.

Gulf estimates that the plant effluent discharge rate may vary from 1.84 CFS to 7.41 CFS per 500 MW generating capacity. Due to the variability of the chemical constituents, generic type chemical plumes for various flow conditions are given.

Plumes analyzed include the following:

Case No.	MW	River Flow (CFS)	Plant Effluent Rate (CFS)	
1	500	870	7.41	3
2	1,000	870	3.68	
3	1,000	870	14.82	
4	3,000	870	11.04	
5	3,000	870	44.46	
6	3,000	1,700	27.72	
7	3,000	5,290	27.72	

No computation of the minimum effluent from a 500 MW plant size is possible because the three-dimensional submerged discharge model (6) will not give valid results when discharge velocities are near the river velocity. The 500 MW plant size plume will be smaller than

the 1,000 MW plant size plume, not only because the quantity of water discharged is less, but because the river current velocity is higher than the discharge velocity. The river current velocity tends to "pull" the discharged water from the outlet, resulting in much faster mixing with the river.

5.2.3.3 Results of Computations - Results of the computation in subsection 5.2.3.2 above have been analyzed and the concentration ratios plotted for the various combinations of flow conditions on 3
figures 5.2-1 through -7. With the concentration ratios given, one is able to determine the concentration of any constituent when the original concentration at the point of discharge is known.

Figures 5.2-3 and -5 are the worst-case plots of the predicted chemical plumes for plant sizes of 1,000 MW and 3,000 MW, respectively.

Both of the cases described above are for a low river flow rate. For higher and more normal river flow rates, the plume size will be slightly smaller than the corresponding case for low river flows. This is because both the river flow velocity and the water surface level will be higher, making the ambient turbulence stronger and additional dilution water available above the plume. Figures 5.2-6 and -7 are worst-cast 3,000 MW 3
plumes for river flows of 1,700 CFS and 5,290 CFS, respectively. The value of 1,700 CFS represents the daily average flow which is exceeded approximately 50 percent of the time, whereas the value of 5,290 CFS is the monthly average river flow rate based on 42 years of record.

5.2.3.4 Compliance With Water Quality Standards - Plant operation will result in the discharge of an effluent varying from a minimum of 1.84 CFS for 500 MW to a maximum of 44.46 CFS for 3,000 MW. The TDS 3
level at the point of discharge is slightly greater than 500 MG/L but will quickly be reduced to acceptable limits within a reasonable zone of mixing.

Normal variations and fluctuations in the quantity, quality, and temperature of the river water used for plant make-up water is not expected to significantly affect the level of concentrations in the plant effluent stream.

5.2.4 Drift

Nearly all of the waste heat from the Caryville steam plant will be rejected to the atmosphere by means of evaporative-type, natural-draft cooling towers. A small amount of circulating water is entrained and carried out of the tower by the saturated air leaving the tower. This small quantity of water is called drift. Gulf will purchase state-of-the-art drift eliminators for the plant's cooling towers. This means (a) that the total mass of drift emitted from the towers is expected to be less than 0.008 percent of the circulating water flow, and (b) that

the drop size distribution of the drift will be such that over 50 percent
of the drops will have a characteristic dimension of the less than 100
microns. The actual chemistry of the circulation water, which is the
same as the drift, is discussed in section 3.4, "Heat Dissipation System."
An actual breakdown of the variation in the various constituent levels in 3
the towers is given in table 3.5-2. The total amount of drift leaving the
towers for a 3,000 MW plant will be less than 90 GPM. Due to the natural
draft cooling tower,height, which will be in excess of 450 feet, the drift
will be dispersed over a large area, so that the concentration of deposited
drift will be very small. Since the drift will be low in quantity, and
consist mainly of concentrated river water. Gulf believes that drift is
not a serious problem at the Caryville site. For these same reasons,
the impact of drift on water supplies should be negligible.

At the present time, engineering studies are being performed by Gulf to evaluate cooling tower systems. When drift eliminator specifications have been finalized, Gulf will make estimates of drift deposition rates at various distances from the cooling towers using a drift deposition model developed by Pickard, Lowe, and Associates of Washington, D. C. The physics of this model were discussed during two symposia in 1974 (8, 9).

5.2.5 References

(1) "Pollution of Waters." Rules of the Florida Department of Pollution Control, Chapter 17-3, May 7, 1974.

(2) Motz, L. H. and B. A. Benedict. "Surface Jet Model for Heated Discharges." J. of Hydraulic Division, ASCE, Vol. 98, No. HY1, pp. 181-199, Jan., 1972.

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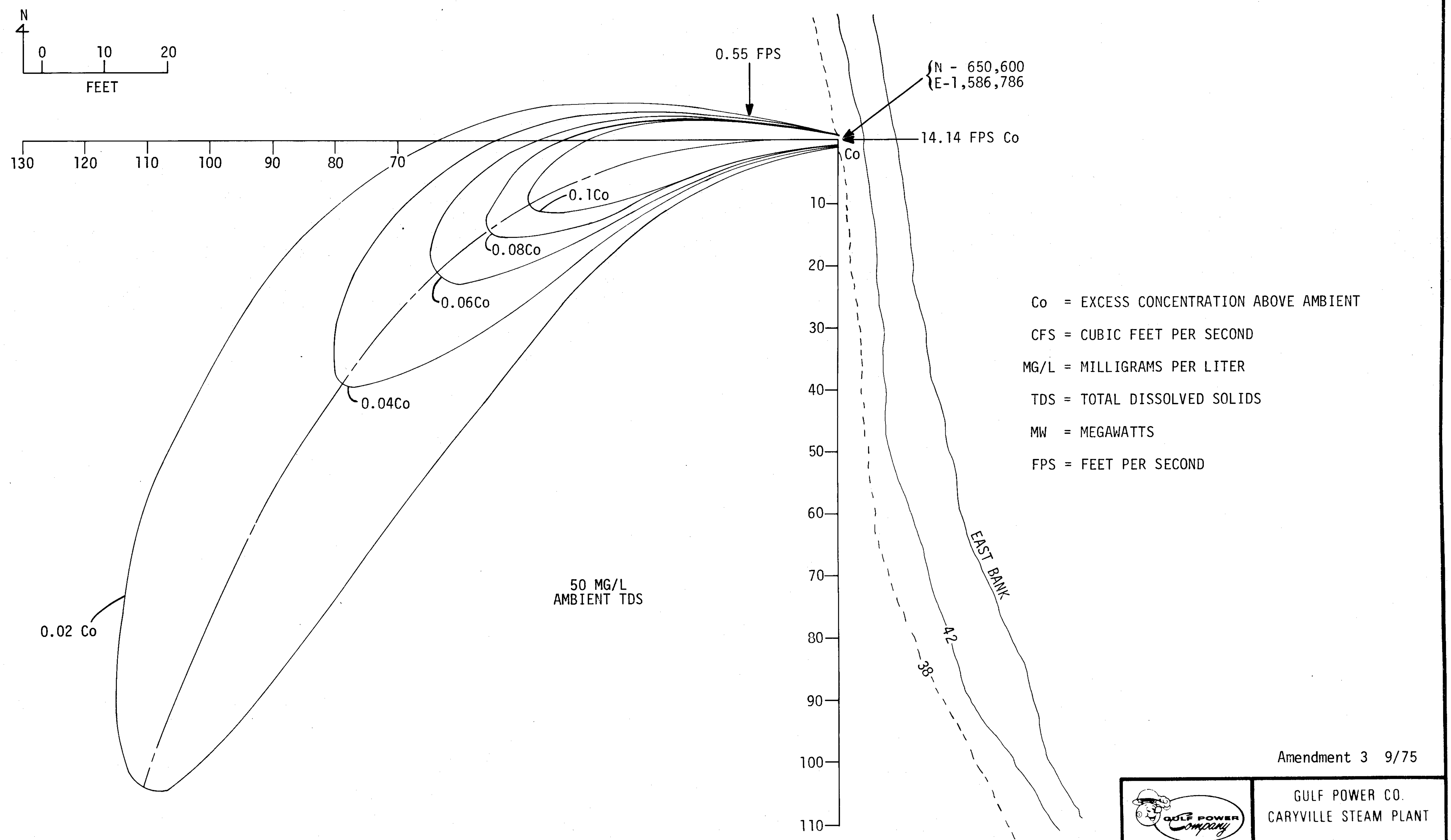
(9) Laskowski, S. M. A Mathematical Transport Model for Salt Distribution from a Salt Water Natural Draft Cooling Tower, Proc AM Meteorological Society and World Meteorological Organization Symposium on Atmospheric Diffusion and Air Pollution, Santa Barbara, California, 1974.



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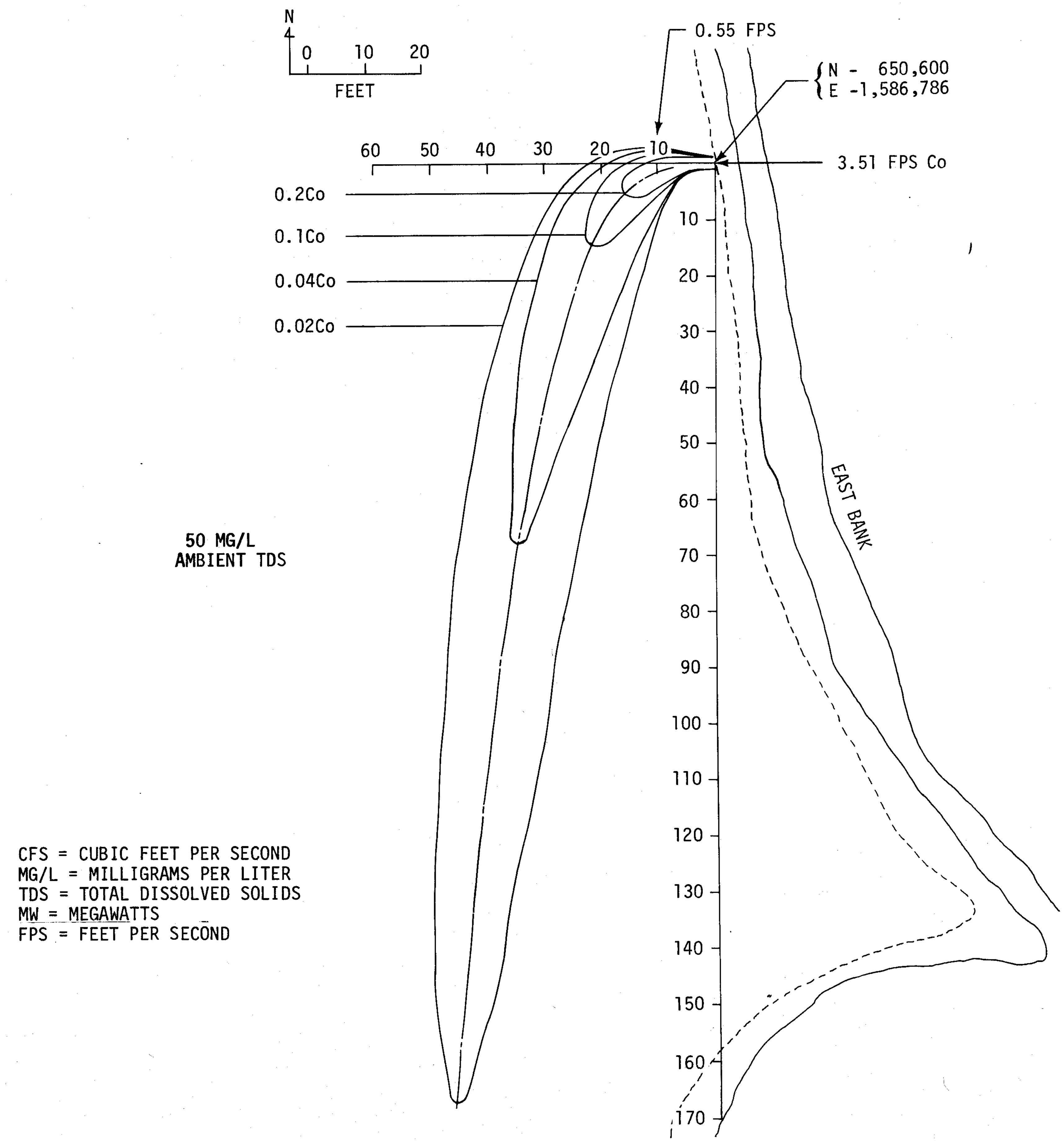
GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 870 CFS RIVER FLOW AND MAXIMUM EFFLUENT RATE FOR 3,000 MW

FIGURE 5-2-1



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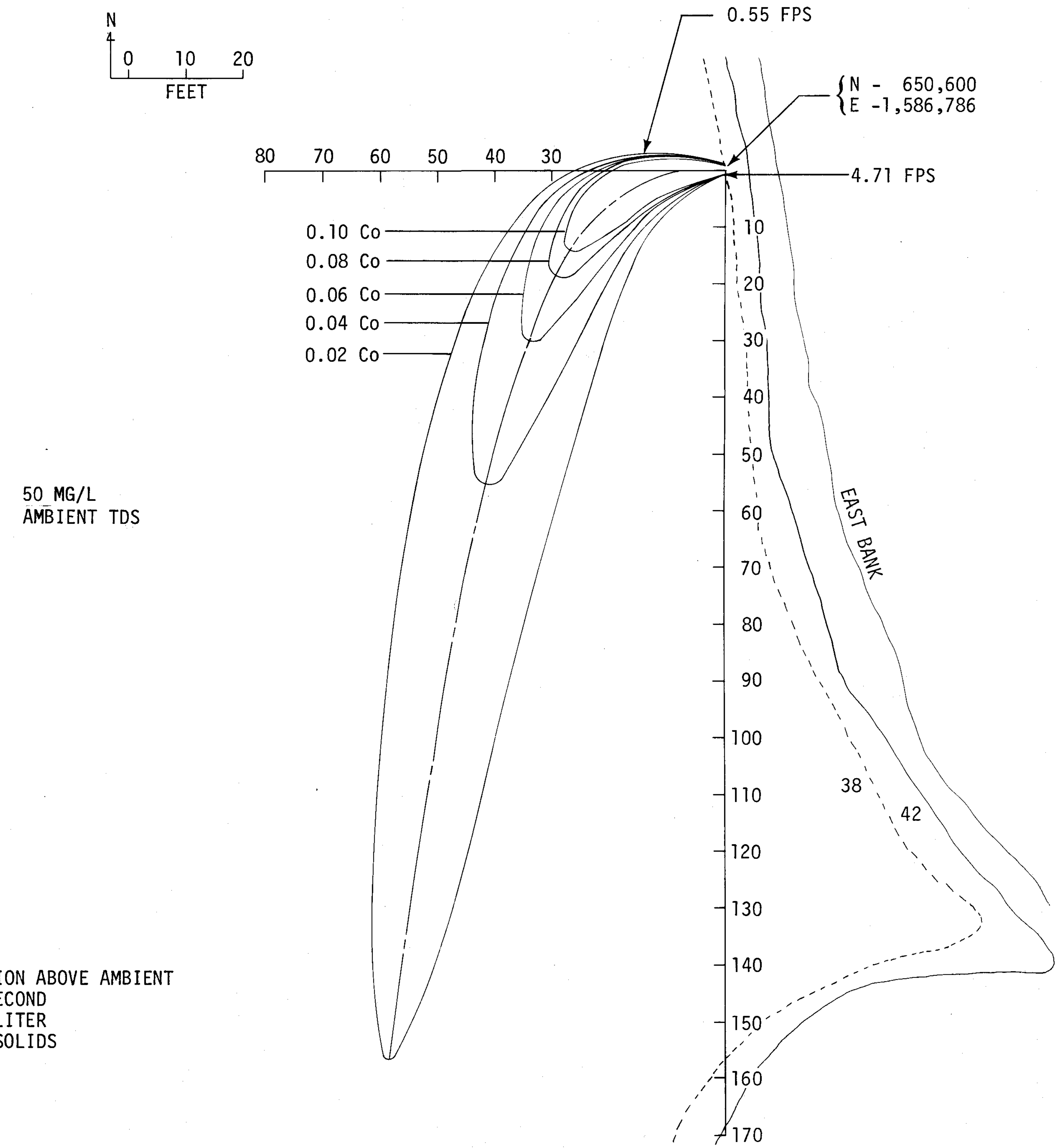
GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 870 CFS RIVER FLOW AND MINIMUM EFFLUENT RATE FOR 3,000 MW

FIGURE 5.2-2



Co = EXCESS CONCENTRATION ABOVE AMBIENT
CFS = CUBIC FEET PER SECOND
MG/L = MILLIGRAMS PER LITER
TDS = TOTAL DISSOLVED SOLIDS
MW = MEGAWATTS
FPS = FEET PER SECOND

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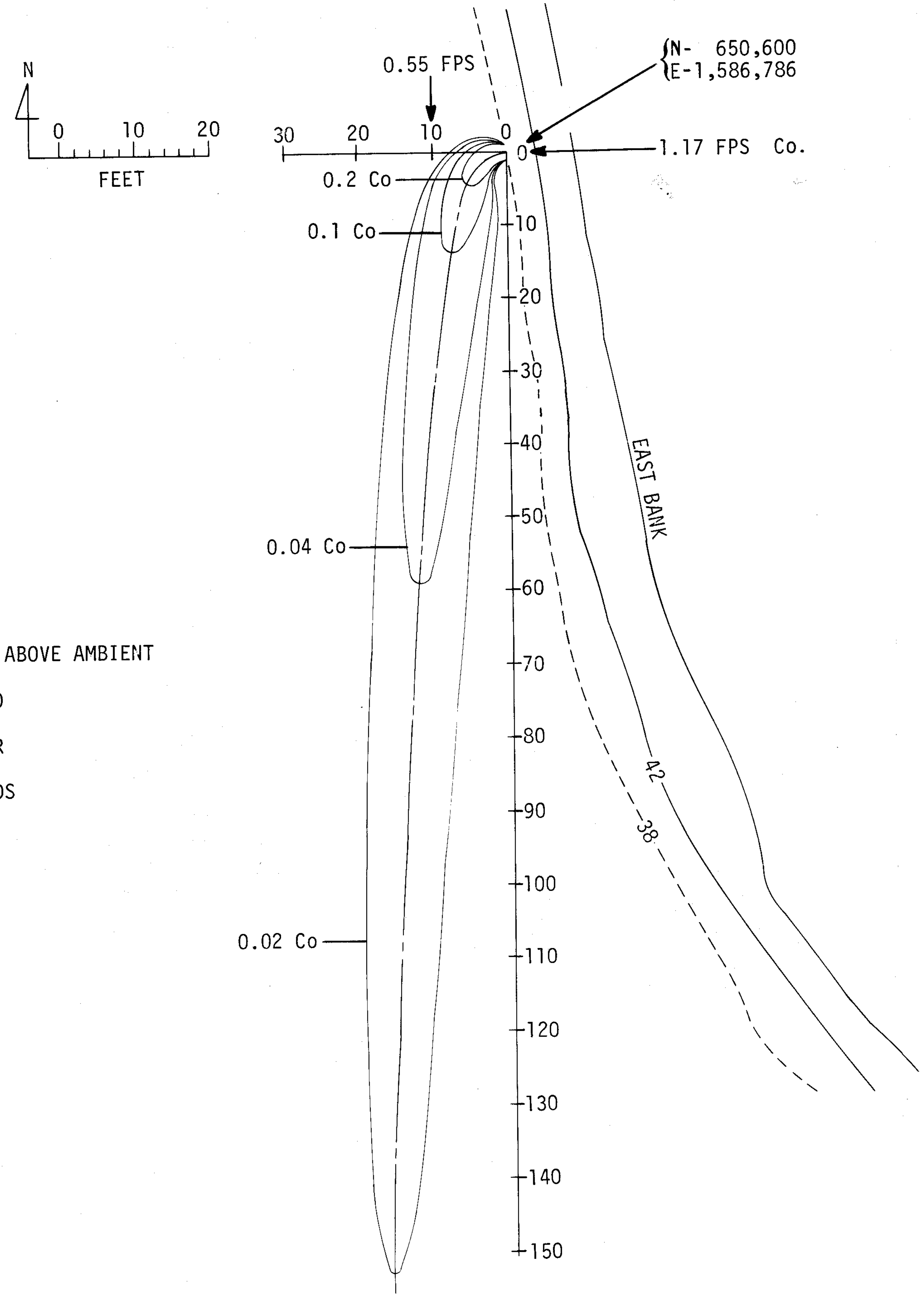
GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 870 CFS RIVER FLOW AND MAXIMUM EFFLUENT RATE 3,000 MW

FIGURE 5.2-3



50 MG/L
AMBIENT TDS

Co = EXCESS CONCENTRATION ABOVE AMBIENT

CFS = CUBIC FEET PER SECOND

MG/L = MILLIGRAMS PER LITER

TDS = TOTAL DISSOLVED SOLIDS

MW = MEGAWATTS

FPS = FEET PER SECOND

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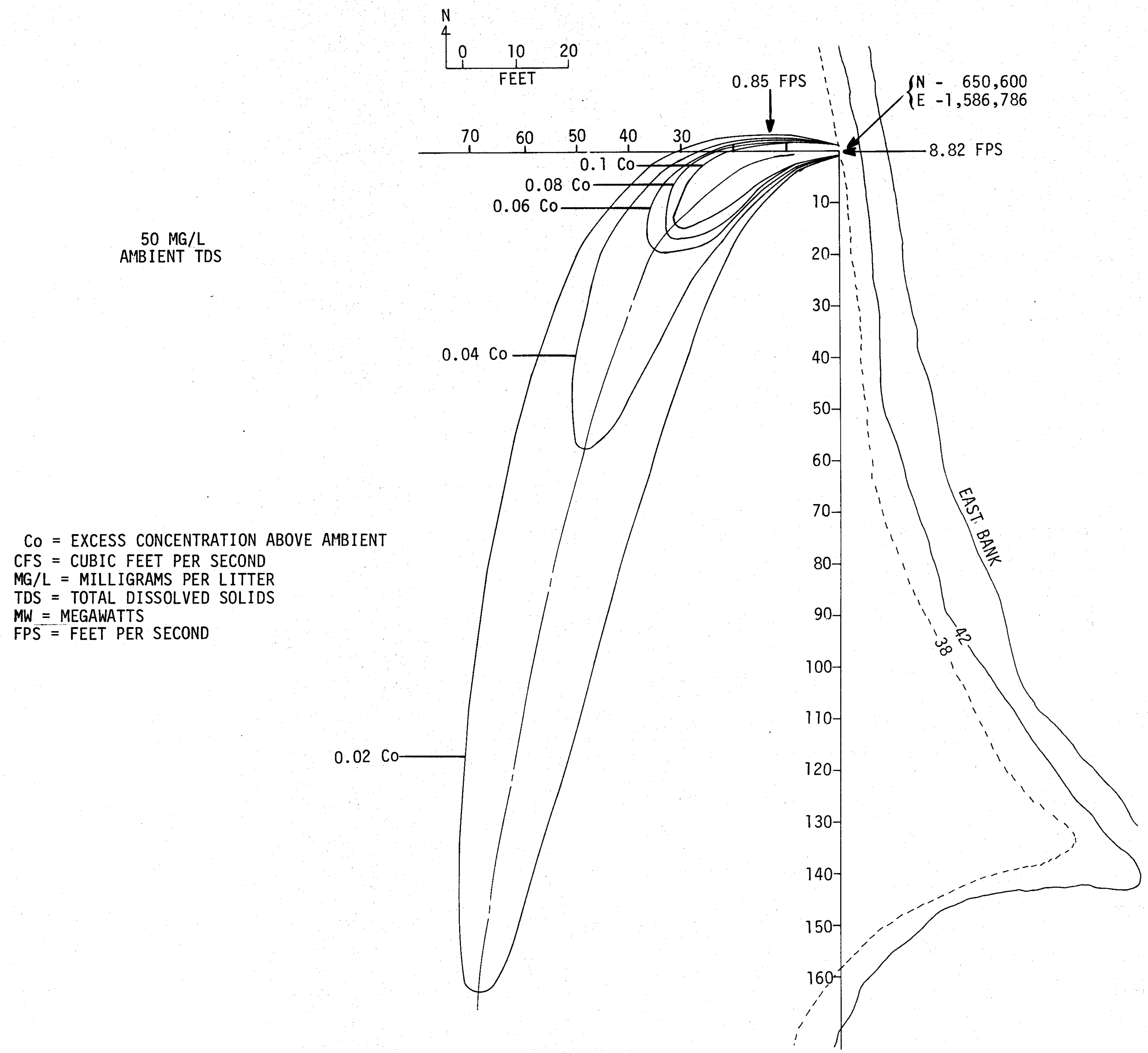
GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 870 CFS RIVER FLOW AND MINIMUM EFFLUENT RATE FOR 1,000 MW

FIGURE 5.2-4



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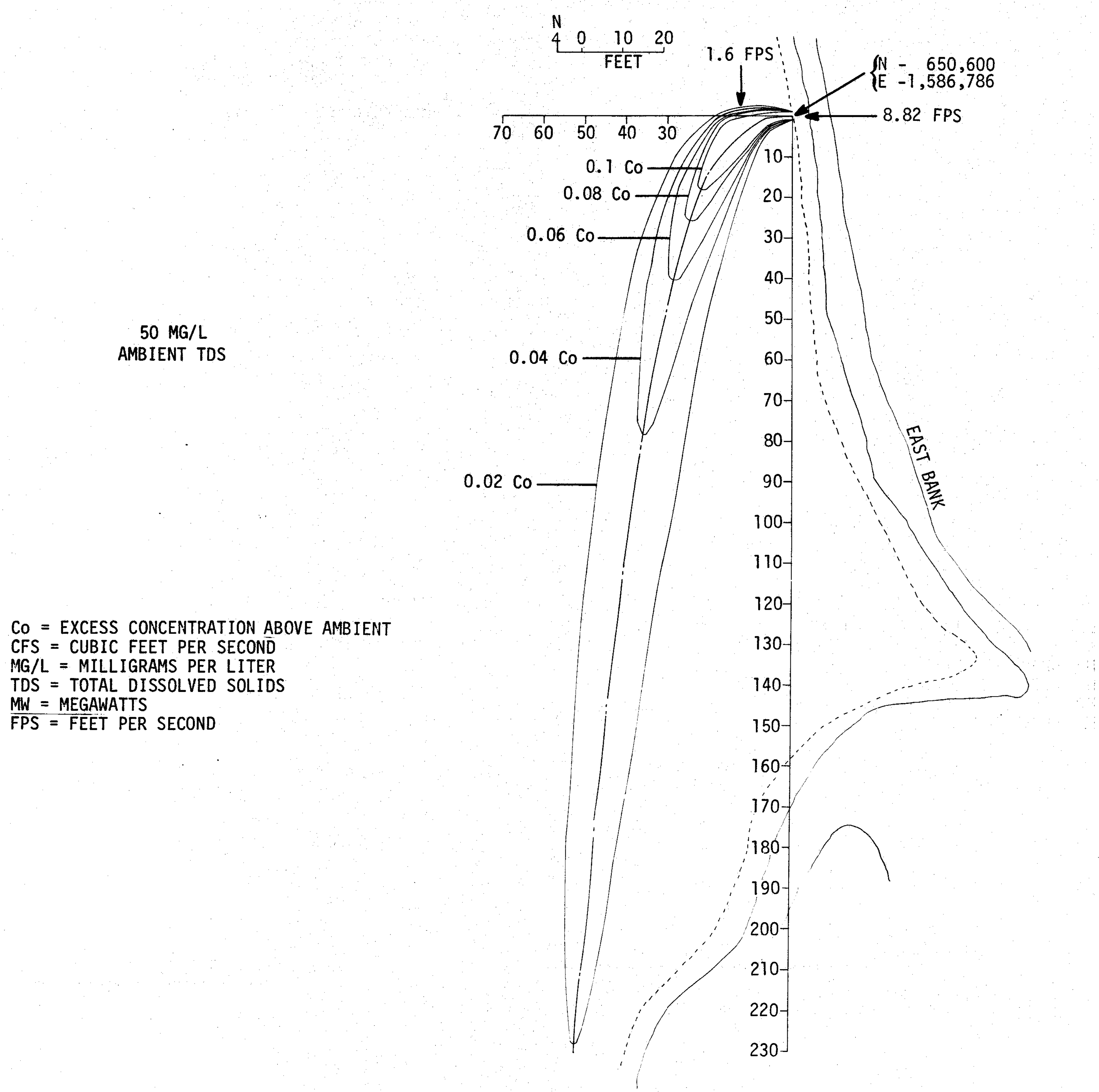
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINE AT 1,700 CFS RIVER FLOW AND AVERAGE EFFLUENT RATE 3,000 MW

FIGURE 5.2-5



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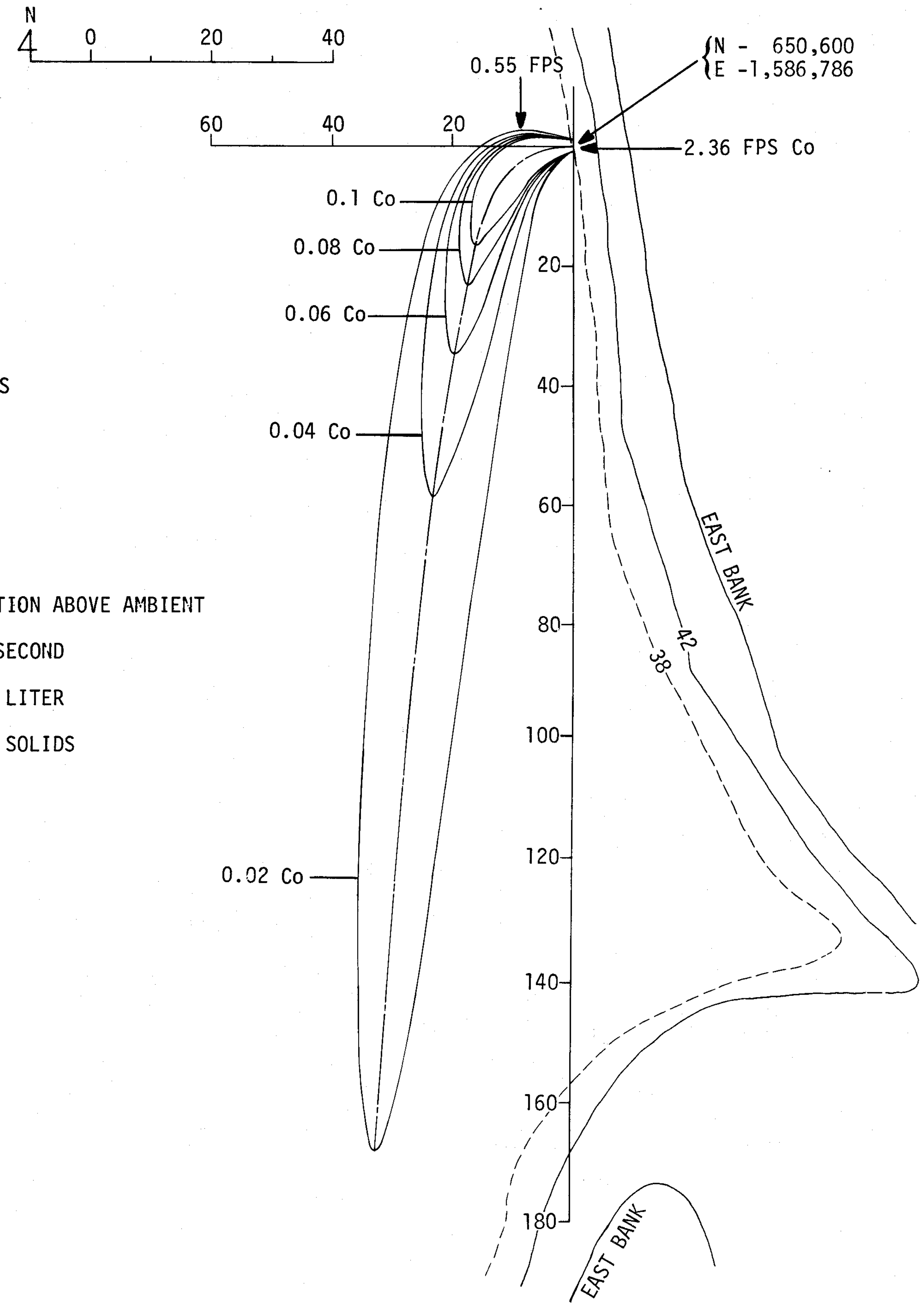
GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 5,290 CFS RIVER FLOW AND AVERAGE EFFLUENT RATE FOR 3,000 MW

FIGURE: 5.2-6



50 MG/L
AMBIENT TDS

Co = EXCESS CONCENTRATION ABOVE AMBIENT

CFS - CUBIC FEET PER SECOND

MG/L - MILLIGRAMS PER LITER

TDS - TOTAL DISSOLVED SOLIDS

MW - MEGAWATTS

FPS = FEET PER SECOND

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GULF POWER CO.
CARYVILLE STEAM PLANT

CONCENTRATION ISOLINES AT 870 CFS RIVER FLOW AND MAXIMUM EFFLUENT RATE FOR 500 MW

FIGURE 5.2-7

5.6 Other Effects

5.6.1 Environmental Effects of Plant Operation

Gulf expects no major adverse economic or land use impacts from operation of the proposed Caryville steam plant. However, a map inspection indicates a potential traffic inconvenience which could occur due to the increased operation of coal trains where the Louisville and Nashville railroad tracks cross Florida Highway No. 179.

5.6.2 Gulf Employee Residences

The approximately 150 Gulf employees will likely reside in the nearby cities of Bonifay and Chipley since more housing is available in these cities than within the five-mile radius area shown in figure 2.2-1. Table 5.6-1 lists the available information on existing housing in Chipley. Similar information on Bonifay is not available. New local housing developments such as Sunny Hills south of Chipley may be attractive to some plant employees.

5.6.3 Schools

Schools within the area where plant employee live could be affected by the influx of plant employee children depending on the schools' capacity at the time Gulf employees relocate to the area and on the number of school-age children expected.

5.6.4 Economic Impact

Economic benefits from plant operation will occur in the form of increased retail sales, increased bank deposits, and increased tax revenues. These economic benefits could make the area more attractive to industrial growth.

The plant employees and their families will purchase retail goods and services both locally and regionally. As noted in subsection 5.6.2 above, most plant employees will probably relocate to Bonifay and Chipley. Table 5.6-2 lists the sales in the respective counties for these cities and other counties where Gulf employees could purchase retail goods and services.

Plant operation payrolls of Gulf employees could also be added to local commercial banks, which would be a local economic benefit. Table 5.6-3 shows recent commercial bank deposits, by county, for area banks.

Local, State, and Federal taxes could also be benefited by plant operation. The greatest benefit will go to Washington and Holmes counties in the form of increased ad valorem taxes from the plant site property.

Since the forced draft fans are designed to be placed on the base slab with sound enclosures inside the main building, they will not produce any community noise problems.

C. Switchyard Noise - Large power transformers produce sound levels at a distance of three feet in the order of 80 to 90 dBA, and the sound specturm is predominated by low frequencies (<500 Hz). The primary characteristics of the noise emitted to the community are pure tones at even harmonics of the mains frequency, i.e., at 120 Hz, 240 Hz, etc. Audibility of these pure tones is the main contributor to community complaints (7).

D. Intermittent Source Noise - A number of intermittent sources of noise are essentially beyond the control of the operators at an electric utility plant. For example, a fault in the system can cause circuit breakers to open, over pressure on the boiler can open a safety valve, etc. The opening of a circuit breaker will produce a very short impulsive sound. Safety valves would normally not remain open for more than one to two minutes. The volume of the external public address system can be adjusted to provide sufficient levels for communication without creating community problems. 3

During the initial startup of any new plant, the steam blowdown of the entire system must be accomplished. Such a blowdown may require three days of high pressure steam vented to atmosphere. The duration of each phase of the blowdown will be one to two minutes each hour. Each time the units have to be restarted, intermittent venting also occurs. Normally, the initial blowdown would be performed during daytime hours whereas restarting may have to be accomplished at any hour. (Refer to subsection 4.2.1, "Boiler Blowdown Noise.")

From sound level studies performed during the start-up of units similar to those proposed by Gulf, a number of observations can be made. These are as follows:

A. The length of time required to place a unit on-line varies depending on how long the unit has been inoperative. If the unit has been off the line for several days, it must be pre-warmed (cold start-up) and steam venting continues for a longer period of time than if the unit can be returned to service within a few hours. Figure 5.6-4 shows the equivalent sound level in dBA, L_{eq}, on an hourly basis for (1) a typical 24-hour day as measured at 250 feet from the vent with the unit operating normally, (2) a "hot" start-up measured at the same point as (1) above, and (3) a "cold" start-up for a different unit measured at 1,000 feet from the unit. Steam venting is estimated to occur 12 times per year per unit. 3

B. Although high-frequency terms are predominant in the sound level spectrum, there are no discernible pure tones. Typical sound level spectrums as measured at various distances from the steam vent are presented in figure 5.6-5.

C. Data shown on figure 5.6-6 indicate the fluctuating characteristic of the steam noise at significant distances from the vent. Fluctuations in the dBA sound level, due primarily to meteorological conditions, are shown graphically in figure 5.6-7. Weather conditions present during the test were (1) temperature, 80^oF to 90^oF, (2) relative humidity, 75 percent to 95 percent, and (3) a crosswind of one to eight miles per hour. 3

D. Data on figure 5.6-6 also shows that the steam vent noise is directional. At approximately 2,000 feet, the sound level was 76 to 83 dBA directly in front of the vent, whereas at an angle in the range of 60^o, as measured from an extension of the centerline of the vent, the sound level was 57 to 60 dBA at approximately 2,500 feet. Most of the decrease was due to the directional characteristic of the noise emanating from the vent rather than the slightly greater distance.

In summary, a significant number of variables are associated with steam venting noise. However, sound level measurements related to steam venting of drum-type boilers have proved to be repeatable. The major impact would be on residences directly in line with the vent pipe. A large buffer zone, along with a wooded and rolling terrain, will reduce this impact.

5.6.6 References

(1) Beranek, L. L. Noise and Vibration Control, McGraw-Hill, 1971.

(2) Teplitzky, A. M. Electric Utility Noise in the Community, Inter-Noise 74 Conference, September 30 to October 2, 1974.

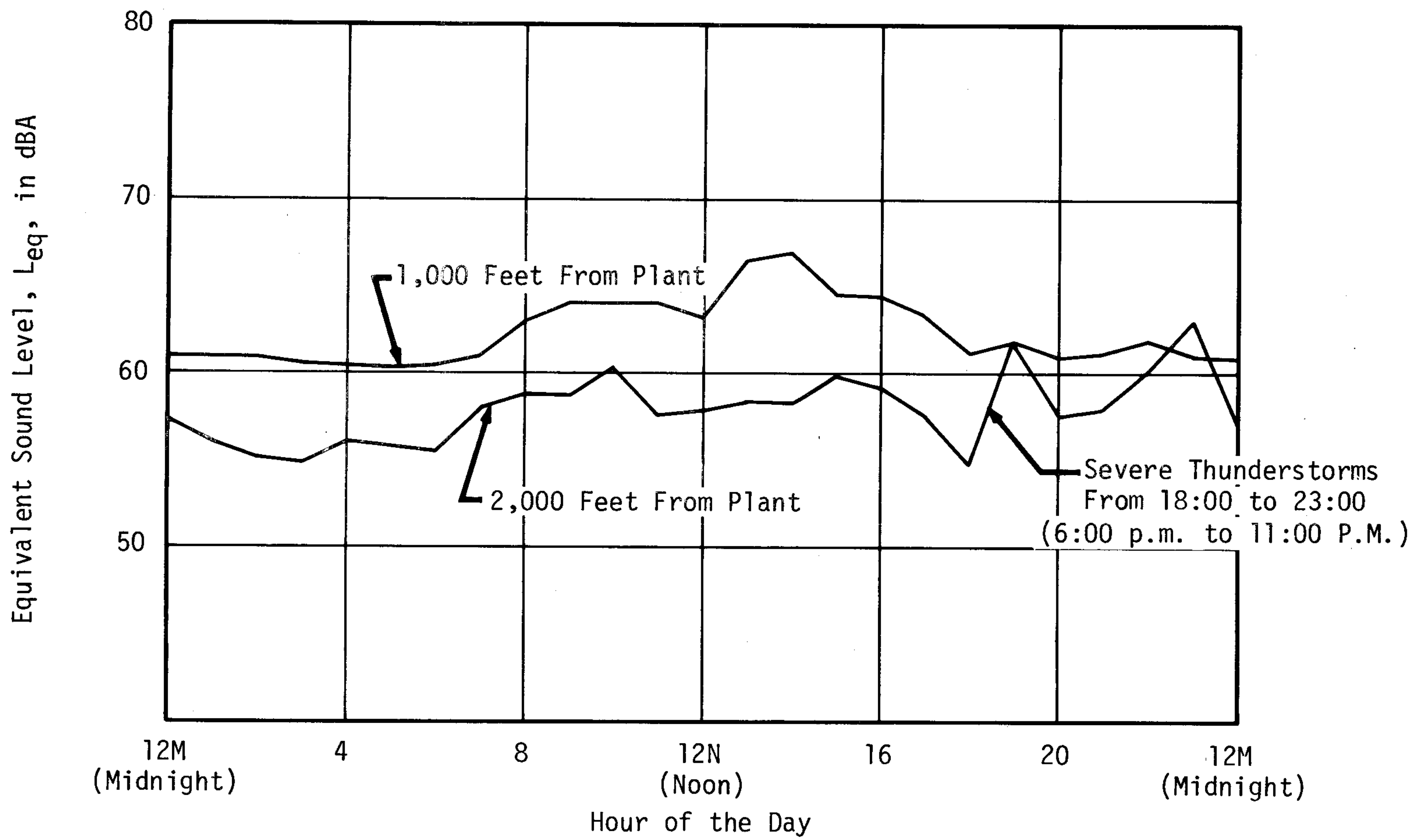
(3) Carlson, J. P. and A. M. Teplitzky. "Estimation and Impact of Environmental Noise from Natural Draft Cooling Towers." Noise Control Engineering, July-August, 1974.

(4) Capano, G. and W. E. Bradley. Acoustical Impact of Cooling Towers, Acoustical Society of America, April, 1974. (Also referenced in title block of figure 5.6-1.)

(5) Hickman, C. E. Sound Level Survey, Unit 1, Tennessee Valley Authority, Cumberland Steam Plant, Internal Southern Services, Inc., Document, 1973.

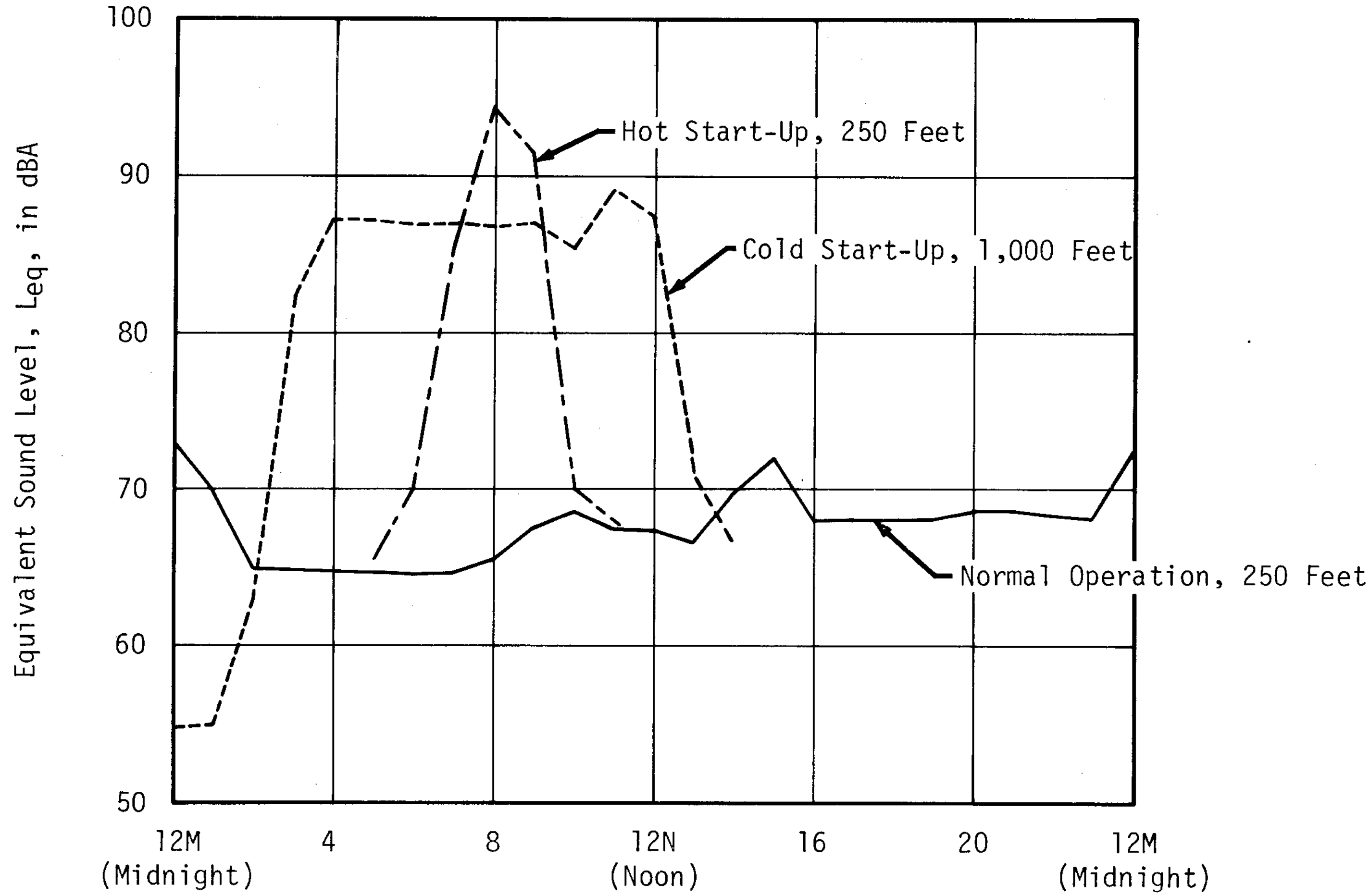
(6) Hickman, C. E. Noise Survey for Gulf Power Company, Internal Southern Services, Inc., Document, 1972.

(7) Schulz, M. W. Jr. and R. J. Ringlee. "Some Characteristics of Audible Noise of Power Transformers and Their Relationship to Audibility Criteria and Noise Ordinances." Power Apparatus and Systems (AIEE), June 1960.



Amendment 3 9/75

GULF POWER Company	GULF POWER CO. CARYVILLE STEAM PLANT	TYPICAL EQUIVALENT SOUND LEVELS, Leq, IN dBA AT 1,000 FEET AND 2,000 FEET FROM AN OPERATING PLANT FIGURE 5.6-4



Amendment 3 9/75

GULF POWER Company	GULF POWER CO CARYVILLE STEAM PLANT	EQUIVALENT SOUND LEVELS, Leq, IN dBA FOR HOT AND COLD START-UPS FIGURE 5.6-5

CLIENT:

JOB NO: DATE:

OBSERVERS:

INSTRUMENTATION

SLM: TYPE B&K 2209 SER. # 454249

TRANSDUCER: TYPE B&K 4145 SER. # 456988

ANALYZER: TYPE B&K 1613 SER. # 460875

CABLE: TYPE LENGTH

CALIBRATOR: TYPE B&K 4220 SER. # 457476

OTHER: Windscreen

TIME	CALIBRATION	TEMP.	%RH	MMHG	WIND MPH	WIND DIR.

PRIMARY NOISE SOURCE: Steam Vent

EQUIP. MAKE & MODEL:

CLIENT DESIGNATION:

OPERATING CONDITIONS: Unit in the process of being returned to service

SECONDARY NOISE SOURCE:

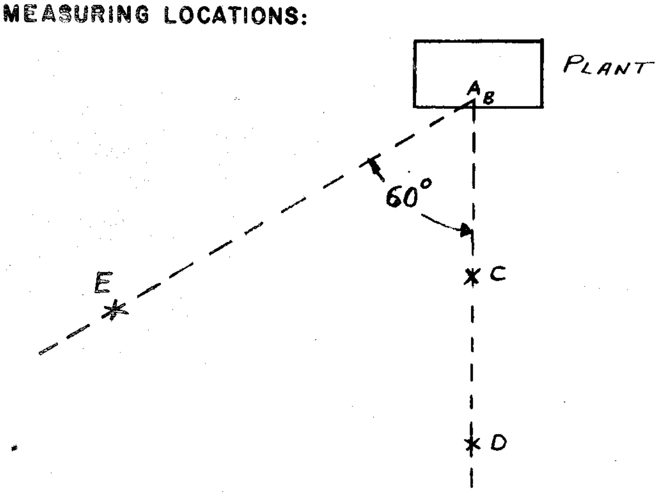
EQUIP. MAKE & MODEL:

CLIENT DESIGNATION:

OPERATING CONDITIONS:

TEST NO.	TIME	POSITION	CONDITIONS	SOUND PRESSURE LEVEL, dB RE 20μ N/M² rms										
				A SCALE LEVEL	OVER ALL LEVEL	OCTAVE BAND CENTER FREQUENCY, Hz.								
						31.5	63	125	250	500	1000	2000	4000	8000
1		A	3 feet from end of vent	136	134	95	95	105	112	116	120	129	132	126
2		B	15 feet from vent	123	122	86	93	99	100	105	111	123	129	113
3		C	1,000 feet from vent	86-93	86-93	63	67-70	72	69	75-82	82-87	82-88	75-85	65-72
4		D	2,000 feet from vent	76-83	76-82	60	60	62	68	70-73	73-79	68-70	62-66	47-53
5		E	2,500 feet from vent	57-60	65	60	60	55-60	51	51	50-53	50	39-41	33-35

DIAGRAM - SHOW MEASURING LOCATIONS:



RECOMMENDATIONS:

Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

FLUCTUATING, DIRECTIONAL CHARACTERISTIC OF STEAM VENT NOISE

FIGURE 5.6-6

TABLE IV-8

PERIPHYTON ORGANIC BIOMASS DETERMINATIONS FOR ARTIFICIAL SUBSTRATES INCUBATED FOR 29 DAYS (APRIL 14-MAY 13, 1975) CHOCTAWHATCHEE RIVER, CARYVILLE, FLORIDA

River Station[a]	Organic Matter g/m^2	Growth Rate[b] g/m^2 day	
L4	0.293	.01	
L4	1.360	.05	
L4	0.480	.02	
B1	1.333	.05	
B1	2.613	.09	
B1	1.706	.06	3
Mean	1.30	0.05	
Standard deviation	0.85	0.03	
Mean Value Station L4	0.71	0.03	
Standard Deviation	0.57	0.02	
Mean Value Station B1	1.88	0.07	
Standard Deviation	0.66	0.02	

[a] Artificial substrates for river stations T1, L3, T2, and T3 are not reported due to vandalism of flotation devices.

[b] Based on 29 day exposure period.

TABLE IV-9

PERIPHYTON COMMUNITY SPECIES DIVERSITY INDICES
CHOCTAWHATCHEE RIVER, CARYVILLE, FLORIDA

Station No.	Shannon-Weaver Species Diversity ($\overline{H}$)	Shannon-Evenness Values (J)
December 5, 1974 (Artificial Substrates)		
C1(R)	2.55	0.736
WP1(C)	1.86	0.560
C2(L)	2.77	0.787
C2(R)	2.67	0.793
C3(L)	1.65	0.508
C3(R)	2.36	0.644
C4(L)	3.11	0.772
C4(R)	2.95	0.769
Mean	2.49	0.700
Standard Deviation	0.51	0.11
March 13, 1975 (Artificial Substrates)[a]		
C1(R)	IC	
C2(L)	3.63	0.858
C2(R)	IC	
C4(L)	IC	
C4(R)	3.77	0.878
Mean	3.70	0.868
Standard Deviation	0.10	0.01
May 13, 1975 (Artificial Substrates)[a]		
L2		
L3		
L4	1.02	0.361
T1		
T2		
T3		
B1	1.39	0.49
Mean	1.21	0.425
Standard Deviation	0.26	0.09

TABLE IV-9 (Continued)

Station No.	Shannon-Weaver Species Diversity ($\bar{H}$)	Shannon-Evenness Values (J)
May 13, 1975 (Natural Substrates)[b]		
L1	3.26	0.852
L2	2.86	0.771
L3	2.72	0.723
L4	2.90	0.810
T1	2.69	0.720
T2	2.73	0.762
T3	3.38	0.843
B1	3.29	0.860
Mean	2.98	0.79
Standard Deviation	0.29	0.06

3

[a] glass slides

[b] hand squeezings of *Porella pinnata* Linn. (leafy liverwort) and *Brachelyma robustum* (Card) E. G. Britt

[c] IC = inadequate colonization of artificial substrate

species diversity index in a river system according to Odum (1971) reflects a stable ecosystem with long food chains or intricate food web systems. In the Choctawhatchee the high species diversity reflects, in part, periphyton growth along the bank environment where natural stress of erosion from current is less rigorous than elsewhere in the channel.

A cluster analysis of the similarity among groups of periphyton stations, using Morisita's index of faunal affinity, showed no logical groupings attributable to locations of the station or to the time stations were sampled. Therefore, the river and the interfacial wetlands are an environment which is diverse and a high degree of similarity would not be expected.

In river systems that are free of pollution, the diatom flora
normally has a great number of species with relatively few individuals 3
per species; a few species with a large number of individuals; and a number of very rare species. When the regression of species on individuals is plotted on a logarithmic scale, the population curve approaches a log normal distribution (Patrick, Hohn, and Wallace, 1954). Figure IV-9 presents the truncated normal curve for the Choctawhatchee periphyton community constructed from a species count of 8,405 diatom valves from periphyton sampled during December, 1974; March and May, 1975. This curve was compared to similar curves for diatom taxa recorded from a hard water river community, Silver Springs, Florida (Total hardness, 209 mg $CaCO_3$/1) and a soft water river community, Escambia River (Total hardness, 23 mg $CaCO_3$/1), (Hohn, 1961). The lower mode exhibited by the Choctawhatchee River and Silver Springs reflects a lower level of species distribution in these two systems as compared to the Escambia River system.

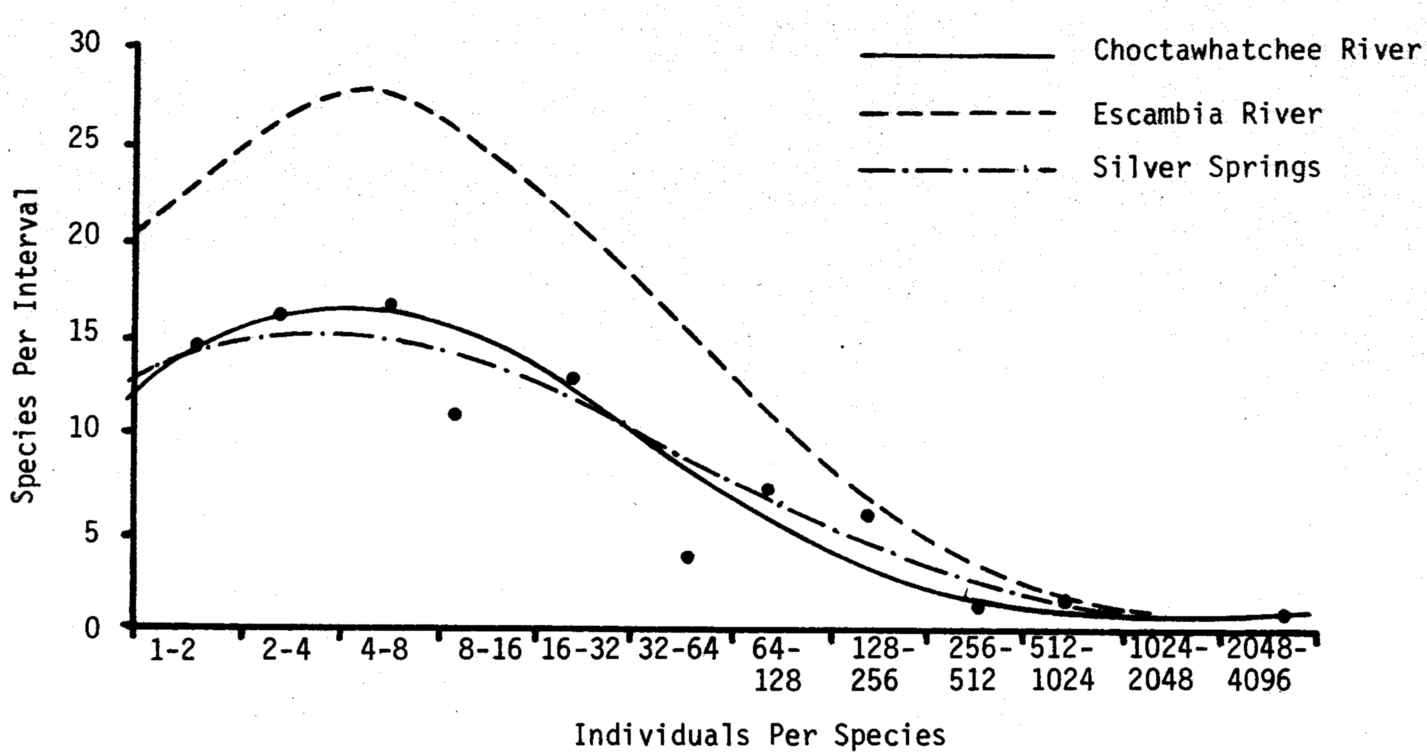


FIGURE IV-9. TRUNCATED NORMAL CURVE FOR COMPOSITE DIATOM POPULATIONS FROM ARTIFICIAL SUBSTRATES (4 WEEK INCUBATION PERIODS) AND NATURAL PERIPHYTON SUBSTRATES (i.e. PORELLA AND BRACHELYMA) FROM THE CHOCTAWHATCHEE RIVER, CARYVILLE, FLORIDA. COMPARED WITH SIMILAR CURVES FOR THE ESCAMBIA RIVER, FLORIDA (SOFT WATER), AND SILVER SPRINGS, FLORIDA (HARD WATER), FROM M. H. HOHN. 1961.

3

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These data indicate the presence of community stress in both the Silver Springs and Choctawhatchee River systems. In the Escambia River, a wide variety of species proliferate under optimal growth conditions. Marl buildup at Silver Springs and turbidity in the Choctawhatchee River stress these riverine communities, limiting the number of taxa present within each ecosystem.

The periphyton in the Choctawhatchee are diverse. The flora is mainly comprised of diatoms, many of which are characteristic of soft water conditions relatively free of organic pollution. Low productivity and low biomass indicate natural stresses on the periphyton community from turbidity and scour associated with flooding.

Predicted Effects of Plant Operation 3

The general thermal relationships for periphyton are the same as those affecting phytoplankton as discussed in the preceding section of this chapter. The cooling tower blowdown will not have a significant impact on the periphyton since the discharge plume will be restricted to near or mid-channel of the river. Therefore, the only effect on the periphyton would be due to the rise of less than 2°F downstream during "worst case" conditions. This would probably cause negligible effects on diversity and biomass organisms. The whole river increases in calcium and alkalinity are not sufficient to affect the community structure. The intermittant chlorine discharge will not produce residuals capable of significantly affecting periphyton populations.

The periphyton of the Choctawhatchee River are naturally kept at a low population level due to the flow characteristics, bottom characteristics, and turbidity in the river. They, therefore, are not considered

to form a substantial portion of the food base in relation to that entering from the drainage area of the river.

Calcium concentrations for example are only increased by 0.4 mg/l and alkalinity by 2.9 mg/l under the worst case condition of lowest autumn flow and maximum generating capacity. The increase in concentration does not extend the range of natural variation in the two parameters. The increase in alkalinity will not shift the pH range significantly to favor a change in algal types nor is the added inorganic carbon sufficient to increase productivity. The column addition will not change the river from a non-calcareous stream (<20 mg CA/l, Hynes, 1970); therefore, no increased growth or change in species composition will occur. 3

Introduction

Benthic organisms are a major biological component of river systems and form an important part of the aquatic food chain. They convert organic detritus to cell biomass which provides a food source for higher trophic levels. They are also important indicators of water quality in that many species are sensitive to environmental changes. Thus natural or man-induced fluctuations in the physical-chemical characteristics of a river system are reflected by shifts in benthic community structure.

Historically, benthic macroinvertebrates have been employed in environmental surveys because they have a relatively short life span -- a year or less usually -- and, therefore, reflect present and recent past conditions as they tend to remain at fixed locations. Because of the above 3
two factors benthic macroinvertebrates are useful as an integrated monitor of the environment.

Species composition (density and diversity) within a given geographical location of benthic organisms is dependent primarily on three factors -- water quantity, water quality, and substrate composition.

Water quantity places limits on which species can occur within a site. Some species prefer shallow well-lighted waters and some prefer deeper waters with less light. Some are adapted for a swift current that would sweep away those inhabiting slow moving waters. Seasonal changes of water flow and depth may regulate the species composition within a particular river reach.

Water quality is a significant factor in determining the assemblage of benthic species. Principal factors include dissolved oxygen levels,

temperature, hardness, and quantities of dissolved substances. The most important of these is oxygen level. Many species require oxygen saturated water in order to thrive, others can survive under near anaerobic conditions. Benthic organisms can also be limited by temperature extremes. The Aquatic Life Advisory Committee (1956) cited that benthic communities in the temperate zones are adapted to seasonal fluctuations of temperature between 0 and 32°C (32 - 90°F).

Substrate is the most important determinant in species composition (Hynes, 1960). There is a direct relationship between amount of available surface area and species abundance and diversity. That is to say, there are more hiding and foraging places in a rock or pebble bottom than in a sand or mud bottom. The amount of organic matter, particularly from plants, is also important. Aquatic plants increase the abundance and diversity of benthic 3
organisms viz. there is more surface area, more periphytonic food organisms, more food from the plants themselves, and more detritus. Beck (1954) indicates, "It became apparent after careful examination of many of the streams of Florida that diversity of fauna was primarily the result of one factor -- the diversity of habitat."

Methods

Benthic macroinvertebrates were sampled at a total of 16 stations (Figure IV-1). Stations L-1 through L-4 were collected at mid-channel. They were located upstream, within, and downstream of the expected thermal discharge plume on a longitudinal axis with the river. Transects T-1 through T-3 are perpendicular to the river's axis, and were also located upstream, within, and downstream of the impact area. Stations were sampled at the west bank, mid-channel, and east bank along each transect.

Station B was within the bypass channel north of the sawmill. Stations C-1 and L-2E were within the floodplain forest east of the river. Station C-1 was adjacent to the mesic island and C-2E was adjacent to the River. Notes concerning substrate composition were taken for each sample.

Replicates were collected at each station to determine the natural variability of benthic populations. Five replicates were collected at Stations L-1 through L-4, T-1 West and East, T-2 West, and T-3 Mid-channel and East, and at F-1.

Samples were collected with a Petite Ponar Dredge. In the field, each sample was washed in a U. S. Standard No. 30 bucket sieve and placed in wide-mouth jars. Rose Bengal dye was then added to each jar, staining the macroinvertebrates so that laboratory sorting (from detritus and sand) might be facilitated. Within one-half to one hour after staining each sample was preserved with formalin. 3

In the laboratory, all samples were washed again in a U. S. No. 30 sieve and distributed for sorting in a white enamel pan. All visible organisms were then removed and preserved in 70 percent ethanol in clear labeled vials. Larger invertebrates were identified with the aid of a stereoscopic microscope. Smaller groups (chironomids and oligochaetes) were mounted on microscope slides in polyvinylactophenol mounting medium for identification.

Taxonomic references utilized were Beck (1959, 1966, 1968, and 1969); Mason (1968); Berner (1950); Byers (1930), Brinkhurst (1969); Pennak (1953); Edmonson (1959) and Usinger (1969).

A species list of all stations was compiled for comparative purposes. These data were then analyzed to determine community structure utilizing concepts

of species diversity, species richness, evenness of species, species dominance, and faunal affinity.

The specific indices used were the Shannon-Weaver index of diversity ($\bar{H}$), evenness (J), Simpson's index of dominance (c), and Morista's index of faunal affinity, respectively. Finally, a cluster analysis based on the latter index was made to determine patterns of similarity among the benthic populations.

Results

Four principal benthic groups were found in the river sediments -- oligochaetes, other annelids (leeches), chironomids, and pelecypods (bivalve molluscs). Less abundant groups collected included ephemeropterans, plecopterans, dipterans and gastropods. The representatives of these latter groups were those forms associated with non-polluted water. The taxa found and their abundance are reported in Tables IV-10, 11 and 12, which group the stations into mid-river stations, near shore (or river's edge) stations, and still water stations, respectively. 3

Benthic samples were taken from natural substrates at stations as shown in Figure IV-1. Substrate in the main channel was a coarse sand with little clay or detritus. Samples collected from the banks of the river were of finer sand, with some clay and surface detritus. Some samples were taken from the outside bend of the river, near the recommended intake site, in a wide area where the natural levee is broken in many places allowing drainage from the floodplain and rim swamp. The physical characteristics near the shore at this site (T-2E) allow the accumulation of detritus, fine silt and clay (Chapter III,River Dynamics). The substrate at Station B-1, in the bypass

TABLE IV-10

BENTHIC ORGANISMS FOUND AT MID-RIVER STATIONS
REPORTED IN NUMBER OF INDIVIDUALS PER SQUARE METER

Species	L-1	L-2	L-3	L-4	T-1M	T-2M	T-3M	Total
CLAMS								
Corbicula manilensis Asiatic clam)	17.3		17.3					34.6
Musculium sp. (Fingernail clam)	181.4	28.8	51.8	14.4	43.2	72	43.2	434.8
MIDGE LARVAE								
Nilotanypus americanus	8.64							8.64
Corynoneura sp.	60.5							60.5
Cryptochironomus fulvus	8.64							8.64
"Parachironomus" sp.		14.4						14.4
Polypedilum fallax	8.64							8.64
Polypedilum sp. C	354.2	201.6	25.9		230.4	993.6	288	2093.7
Polypedilum sp.	69.1				28.8			97.9
Unidentified sp. 1	60.5		95					155.5
WORMS AND LEECHES								
Oligochaeta (Aquatic worms)	43.2	14.4	60.5				14.4	132.5
Helobdella nepheloidea (Leech)			8.64					8.64
MISCELLANEOUS								
Asellus sp. (Isopod)	8.64							8.64
Hydrachna sp. (Water mite)				14.4				14.4
Podura aquatica		14.4			14.4			28.8
Stenonema sp.	8.64							8.64
Unidentified Zygopteran (Damselfly)			8.64					8.64
Unidentified Hemipteran (Water bug)			8.64					8.64
Polycentropus sp.			8.64					8.64
Unidentified Dysticid	51.8							51.8
Stenelmis sp.	51.8							51.8
Bezzia setulosa							14.4	14.4

Table IV-10 (continued)

Species	L-1	L-2	L-3	L-4	T-1M	T-2M	T-3M	Total
Palpomyia tibialis							14.4	14.4
Unidentified Culicid	43.2				28.8	14.4		86.4
Σ (individuals)	976.2	273.6	285.1	28.8	345.6	1080	374.4	3363.7
Σ (species)	15	5	9	2	5	3	5	44

3

TABLE IV-11

BENTHIC ORGANISMS FOUND AT RIVER EDGE STATIONS
REPORTED IN NUMBER OF INDIVIDUALS PER SQUARE METER

Species	T-1E	T-2E	T-3E	T-1W	T-2W	T-3W	Total
CLAMS							
Corbicula manilensis (Asiatic clam)			28.8	17.3			46.1
Musculium sp. (Fingernail clam)	60.5	57.6	28.8	17.3	14.4	8.6	187.2
MIDGE LARVAE							
Nilotanypus americanus			14.4				14.4
Rheotanytarsus exiguus		14.4					14.4
Cryptochironomus fulvus		14.4					14.4
"Parachironomus" sp.	8.6						8.6
Polypedilum sp. C	60.5		115.2	129.6			305.3
Polypedilum sp.		14.4	14.4	8.6		17.3	54.7
Unidentified Chironomidae					14.4		14.4
WORMS AND LEECHES							
Oligochaeta (Aquatic worms)	34.6		43.2	17.3	100.8		195.
Helobdella nepheloidea (Leech)					28.8		28.8
MISCELLANEOUS							
Asellus sp. (Isopod)		14.4					14.4
Hydrachna sp. (Water mite)		14.4					14.4
Isoperla sp.		28.8					28.8
Dolania sp.						51.8	51.8
Pseudiron sp.						8.6	8.6
Hexagenia limbata		158.4					158.4
Hydropsyche sp.		14.4					14.4
Unidentified Coleopteran						8.6	8.6
Bezzia setulosa			14.4			8.6	23
Unidentified Culicid		14.4				8.6	23
Chrysops sp.		14.4					14.4
Lyogyrus sp.				8.6			8.6
Σ (individuals)	164.2	360	259.2	198.7	158.4	112.1	1252.6
Σ (species)	4	11	7	6	4	7	39

TABLE IV-12

BENTHIC ORGANISMS FOUND IN STILL WATERS OF SEMI-PERMANENT OR SEASONAL STATUS, REPORTED IN NUMBER OF INDIVIDUALS PER SQUARE METER

Species	B-1	C-1	L-2E	TOTAL	
CLAMS					
Musculium sp. (Fingernail clam)	10.8		129.6	140.4	
MIDGE LARVAE					
Ablabesmyia aspera		14.4		14.4	
Procladius sp.	10.8	14.4		25.2	
Tanytarsus sp.	43.2			43.2	
Chironomus sp. A	54	14.4		68.4	
Chironomus sp. B	32.4			32.4	
Cryptochironomous fulvus	108	14.4		122.4	
Cryptotendipes sp.	10.8			10.8	
Microtendipes sp.		57.6		57.6	
Paracladopelma sp.	54	14.4		68.4	3
Paralanterborniella nigrahalterale	10.8			10.8	
Polypedilum sp. C	529.2	14.4		543.6	
Tribelos sp.	10.8	28.8		39.6	
Unidentified chironomidae	32.4			32.4	
WORMS AND LEECHES					
Oligochaeta (Aquatic worms)	442.8	230.4	129.6	802.8	
Helobdella nepheloidea (Leech)			21.6	21.6	
MISCELLANEOUS					
Hyalella azteca (amphipod)			21.6	21.6	
Podura aquatica	75.6			75.6	
Hexagenia limbata	10.8			10.8	
Stenonema sp.	10.8			10.8	
Unidentified Ephemeropteran			21.6	21.6	
Bezzia setulosa	10.8			10.8	

Table IV-12 (continued)

Species	B-1	C-1	L-2E	TOTAL
Unidentified Culicid	32.4			32.4
<u>Campeloma</u> sp.			129.6	129.6
<u>Pleurocera</u> sp.	10.8			10.8
Σ (individuals)	1501.2	403.2	453.6	2358
Σ (species)	19	9	6	

3

channel, was gray clay and detritus. This slow-moving to stagnant area of water allows clay and detritus from the river, the floodplain and the sawmill to accumulate.

Floodplain stations (C-1 and L-3E) were a mud of fine clay and silt sediment with large amounts of detritus. As at Station B-1, water movement was normally slow to stagnant.

Tables IV-10, 11 and 12 indicate that the natural substrates in this river reach support a low macroinvertebrate population. This is due to the shifting sandy substrate which provides a restrictive habitat, and limits the types of benthic organisms which can survive. The community structure indices (Table IV-13) are similar for mid-channel stations indicating no inherent upstream or downstream difference from that in the area of the proposed discharge. However, there was a definite pattern across the channel 3
transects. Mid-river stations showed a lower diversity, less evenness and greater degree of dominance than the near-shore stations. This is to be expected, since faster current mid-river would cause the substrate to be more unstable; the water is also deeper. For example, comparison can be made between West and East (W & E) with the middle station on T-1, 2 and 3.

Aquatic worms can burrow just under the sands and avoid the current. Some midge larvae can construct cases just under the sand, with only their heads protruding in order to gather food. Clams, and some snails, can move along just under the surface of sands and avoid the current. When feeding, clams open their shells slightly perpendicular to the direction of flow, and siphon food-bearing water into their buccal cavities. Leeches are flat and narrow, move by expansion and contraction, and forage at the sand/water interface.

TABLE IV-13

POPULATION STRUCTURE INDICES FOR CHOCTAWHATCHEE RIVER MACROBENTHOS

Station and Location (See Figure IV-1)	Shannon-Weaver Diversity Index X, Base e ($\bar{H}$)	Shannon-Weaver Evenness Value (J)	Simpson's Index of Dominance (c)
Upstream			
L-1	2.086	0.770	0.188
L-2	0.918	0.570	0.567
T-1E	1.222	0,881	0.317
T-1M	1.076	0.669	0.476
T-1W	1.189	0.663	0.453
Discharge Area			
L-3	1.906	0.828	0.192
L-3E	1.512	0.884	0.251
T-2E	1.876	0.782	0.241
T-2M	0.378	0.272	0.830
T-2W	1.027	0.741	0.458
Downstream			
T-3E	1.624	0.835	0.261
T-3M	0.818	0.508	0.614
T-3W	1.644	0.845	0.261
L-4	0.693	1.000	0.500
Others			
B-1 Bypass	2,007	0.670	0.221
C-1 Swamp	1.491	0.679	0,362

Benthic organisms have a different set of environmental conditions within the bypass channel at Station B-1. Here the water is less turbulent; the substrate is a mud of clay, silt, and organic matter; water temperatures tend to be higher and dissolved oxygen levels are lower. There are usually more macroinvertebrates in mud than in sand or silt, because of the increased organic matter and microbenthic organisms that provide food. Oligochaetes are dominant; total numbers and numbers of species at B-1 are highest of any station.

A cluster analysis using Morisita's index of faunal affinity was used to determine similarity among stations. These results are expressed as a phenogram in Figure IV-10. The figure shows distinct grouping of stations with similar taxa and population relationships ([L-1, T-3E, T-1E], [L-2, T-3M, T-2M, T-1M, T-1W], etc.), as represented by similarity values from 0 -1.
Intergroup similarity is shown by vertical connecting lines showing average 3
similarities in descending value beginning with L-1 and terminating with T-3W.

Since the river bed within the study area is a relatively uniform, shifting, abrasive sand, it is not surprising that the diversity and abundance of benthic organisms are low. Rocks or plants which could be used as refuge are absent and mud is not available for burrowing. Large and medium-sized organisms are, therefore, absent. Small organisms are able to survive by adaptation to the natural stress of poor substrate, swift current, and periodic flooding.

The distribution of organisms in the natural substrates indicates a majority (56.6 percent) of chironomid larvae -- of these, <u>Polypedilum</u> sp. account for 74.5 percent of the midges and 42.5 percent of the total number of benthic invertebrates. Midge larvae dominate the mid-river stations and

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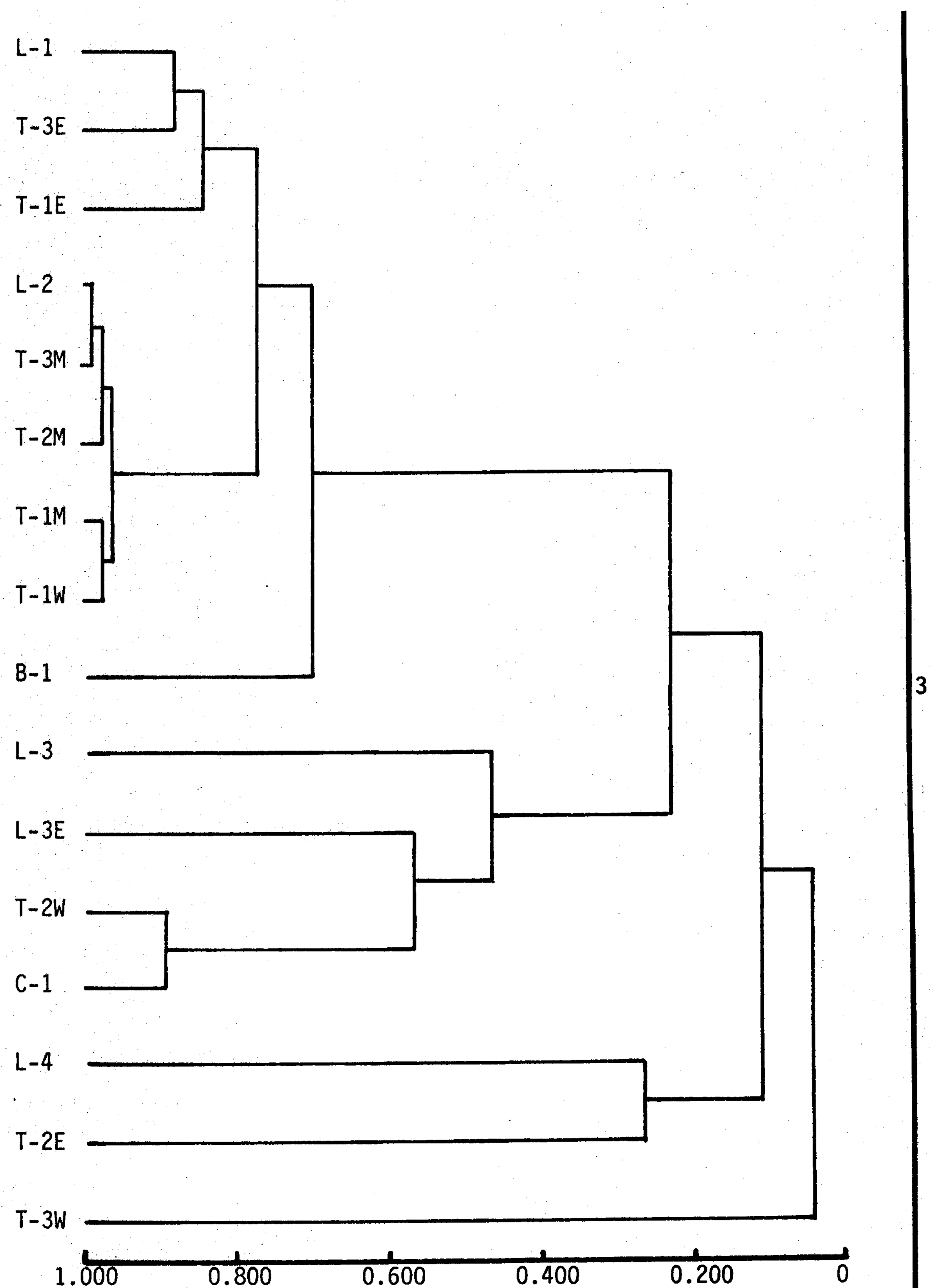


FIGURE IV-10. CLUSTER DIAGRAM OF SIMILARITY VALUES FOR CHOCTAWHATCHEE RIVER MACROBENTHOS COPHENETIC CORRELATION COEFFICIENT = 0.938

5.6 Other Effects

5.6.1 Environmental Effects of Plant Operation

Gulf expects no major adverse economic or land use impacts from operation of the proposed Caryville steam plant. However, a map inspection indicates a potential traffic inconvenience which could occur due to the increased operation of coal trains where the Louisville and Nashville railroad tracks cross Florida Highway No. 179.

5.6.2 Gulf Employee Residences

The approximately 150 Gulf employees will likely reside in the nearby cities of Bonifay and Chipley since more housing is available in these cities than within the five-mile radius area shown in figure 2.2-1. Table 5.6-1 lists the available information on existing housing in Chipley. Similar information on Bonifay is not available. New local housing developments such as Sunny Hills south of Chipley may be attractive to some plant employees.

5.6.3 Schools

Schools within the area where plant employee live could be affected by the influx of plant employee children depending on the schools' capacity at the time Gulf employees relocate to the area and on the number of school-age children expected.

5.6.4 Economic Impact

Economic benefits from plant operation will occur in the form of increased retail sales, increased bank deposits, and increased tax revenues. These economic benefits could make the area more attractive to industrial growth.

The plant employees and their families will purchase retail goods and services both locally and regionally. As noted in subsection 5.6.2 above, most plant employees will probably relocate to Bonifay and Chipley. Table 5.6-2 lists the sales in the respective counties for these cities and other counties where Gulf employees could purchase retail goods and services.

Plant operation payrolls of Gulf employees could also be added to local commercial banks, which would be a local economic benefit. Table 5.6-3 shows recent commercial bank deposits, by county, for area banks.

Local, State, and Federal taxes could also be benefited by plant operation. The greatest benefit will go to Washington and Holmes counties in the form of increased ad valorem taxes from the plant site property.

Sales taxes, use taxes, and gasoline taxes will also increase.

5.6.5 Sound Levels During Plant Operation

During plant operation, the main contributors to the sound level will be cooling towers, noises emanating from the turbine/boiler building, various switchyard sources, and intermittent noise sources. (Refer to A, B, C, and D below.) Numerous atmospheric conditions and ground coverings enter the evaluation of sound level attenuation as a function of frequency and distance from the source (1). The high-frequency terms are more subject to error at long distances but they, in turn, are attenuated much more than the low-frequency terms. As a result, the high-frequency terms seldom are critical in estimating sound levels at distances over 1,000 feet. Pure tones represent the most severe problem associated with community reaction to noise.

A. Cooling Tower Noise - Since many noise ordinances are written in terms of A-weighted sound levels, a number of studies have been performed to determine the dBA (decibels on the "A" scale) sound level as a function of distance from cooling towers (2,3,4). Figure 5.6-1 shows a typical range of cooling tower noise emissions for a 600 to 800 MW plant without effects of topography or meteorology (2). The sound levels beyond approximately 1,000 feet are extrapolated values.

Figures 5.6-2 and -3 show actual sound level data obtained around a natural draft cooling tower and a mechanical draft cooling tower, respectively. Note from the data given on figures 5.6-2 and -3 that the sound levels are broadband and that no significant pure tones exist.

B. Turbine/Boiler Building Noise - Although the sound level inside the turbine hall may be in the mid-90 dBA range, the exterior walls typically used in power plant construction should reduce this by approximately 20 dBA. Measurements taken at several existing plants verify this reduction (5, 6). As a comparison, the sound level at the base of the cooling towers will be approximately 85 dBA. Outside the turbine enclosure the sound level should be approximately 75 dBA. Therefore, the additional sound level contribution due to the turbogenerators as measured at the site boundary should be small.

Typical equivalent sound levels, designated L_{eq}, in dBA are plotted hourly on figure 5.6-4 for locations 1,000 feet and 2,000 feet from an operating plant. The variations in sound level are quite small and the slight increase during the daytime hours are on the coal pile, etc. Severe thunderstorms produced perturbations during one evening test. 3

Since the forced draft fans are designed to be placed on the base slab with sound enclosures inside the main building, they will not produce any community noise problems.

C. Switchyard Noise - Large power transformers produce sound levels at a distance of three feet in the order of 80 to 90 dBA, and the sound specturm is predominated by low frequencies (<500 Hz). The primary characteristics of the noise emitted to the community are pure tones at even harmonics of the mains frequency, i.e., at 120 Hz, 240 Hz, etc. Audibility of these pure tones is the main contributor to community complaints (7).

D. Intermittent Source Noise - A number of intermittent sources of noise are essentially beyond the control of the operators at an electric utility plant. For example, a fault in the system can cause circuit breakers to open, over pressure on the boiler can open a safety valve, etc. The opening of a circuit breaker will produce a very short impulsive sound. Safety valves would normally not remain open for more than one to two minutes. The volume of the external public address system can be adjusted to provide sufficient levels for communication without creating community problems. 3

During the initial startup of any new plant, the steam blowdown of the entire system must be accomplished. Such a blowdown may require three days of high pressure steam vented to atmosphere. The duration of each phase of the blowdown will be one to two minutes each hour. Each time the units have to be restarted, intermittent venting also occurs. Normally, the initial blowdown would be performed during daytime hours whereas restarting may have to be accomplished at any hour. (Refer to subsection 4.2.1, "Boiler Blowdown Noise.")

From sound level studies performed during the start-up of units similar to those proposed by Gulf, a number of observations can be made. These are as follows:

A. The length of time required to place a unit on-line varies depending on how long the unit has been inoperative. If the unit has been off the line for several days, it must be pre-warmed (cold start-up) and steam venting continues for a longer period of time than if the unit can be returned to service within a few hours. Figure 5.6-4 shows the equivalent sound level in dBA, L_{eq}, on an hourly basis for (1) a typical 24-hour day as measured at 250 feet from the vent with the unit operating normally, (2) a "hot" start-up measured at the same point as (1) above, and (3) a "cold" start-up for a different unit measured at 1,000 feet from the unit. Steam venting is estimated to occur 12 times per year per unit. 3

B. Although high-frequency terms are predominant in the sound level spectrum, there are no discernible pure tones. Typical sound level spectrums as measured at various distances from the steam vent are presented in figure 5.6-5.

C. Data shown on figure 5.6-6 indicate the fluctuating characteristic of the steam noise at significant distances from the vent. Fluctuations in the dBA sound level, due primarily to meteorological conditions, are shown graphically in figure 5.6-7. Weather conditions present during the test were (1) temperature, $80^{o}F$ to $90^{o}F$, (2) relative humidity, 75 percent to 95 percent, and (3) a crosswind of one to eight miles per hour. 3

D. Data on figure 5.6-6 also shows that the steam vent noise is directional. At approximately 2,000 feet, the sound level was 76 to 83 dBA directly in front of the vent, whereas at an angle in the range of 60^{o}, as measured from an extension of the centerline of the vent, the sound level was 57 to 60 dBA at approximately 2,500 feet. Most of the decrease was due to the directional characteristic of the noise emanating from the vent rather than the slightly greater distance.

In summary, a significant number of variables are associated with steam venting noise. However, sound level measurements related to steam venting of drum-type boilers have proved to be repeatable. The major impact would be on residences directly in line with the vent pipe. A large buffer zone, along with a wooded and rolling terrain, will reduce this impact.

5.6.6 References

(1) Beranek, L. L. Noise and Vibration Control, McGraw-Hill, 1971.

(2) Teplitzky, A. M. Electric Utility Noise in the Community, Inter-Noise 74 Conference, September 30 to October 2, 1974.

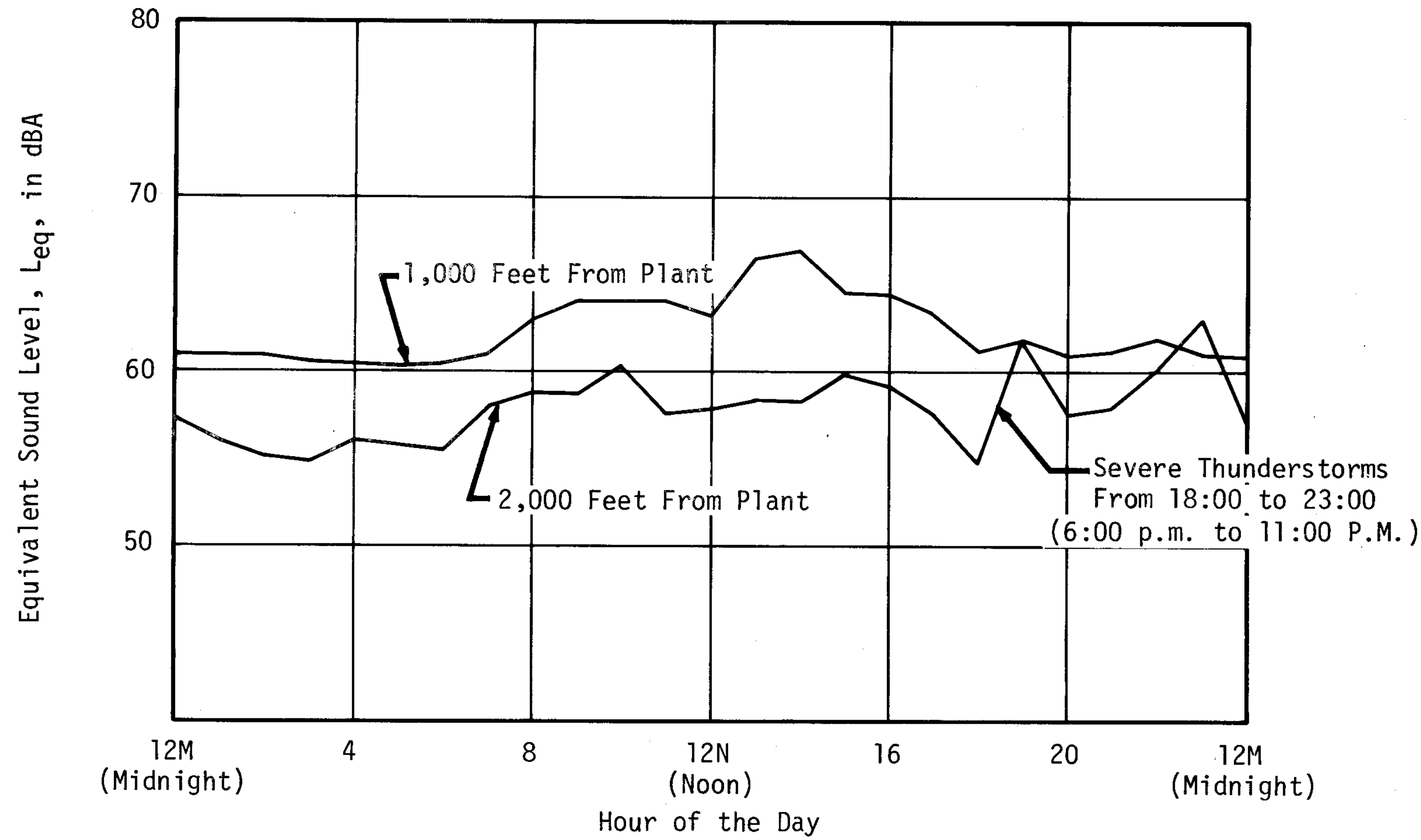
(3) Carlson, J. P. and A. M. Teplitzky. "Estimation and Impact of Environmental Noise from Natural Draft Cooling Towers." Noise Control Engineering, July-August, 1974.

(4) Capano, G. and W. E. Bradley. Acoustical Impact of Cooling Towers, Acoustical Society of America, April, 1974. (Also referenced in title block of figure 5.6-1.)

(5) Hickman, C. E. Sound Level Survey, Unit 1, Tennessee Valley Authority, Cumberland Steam Plant, Internal Southern Services, Inc., Document, 1973.

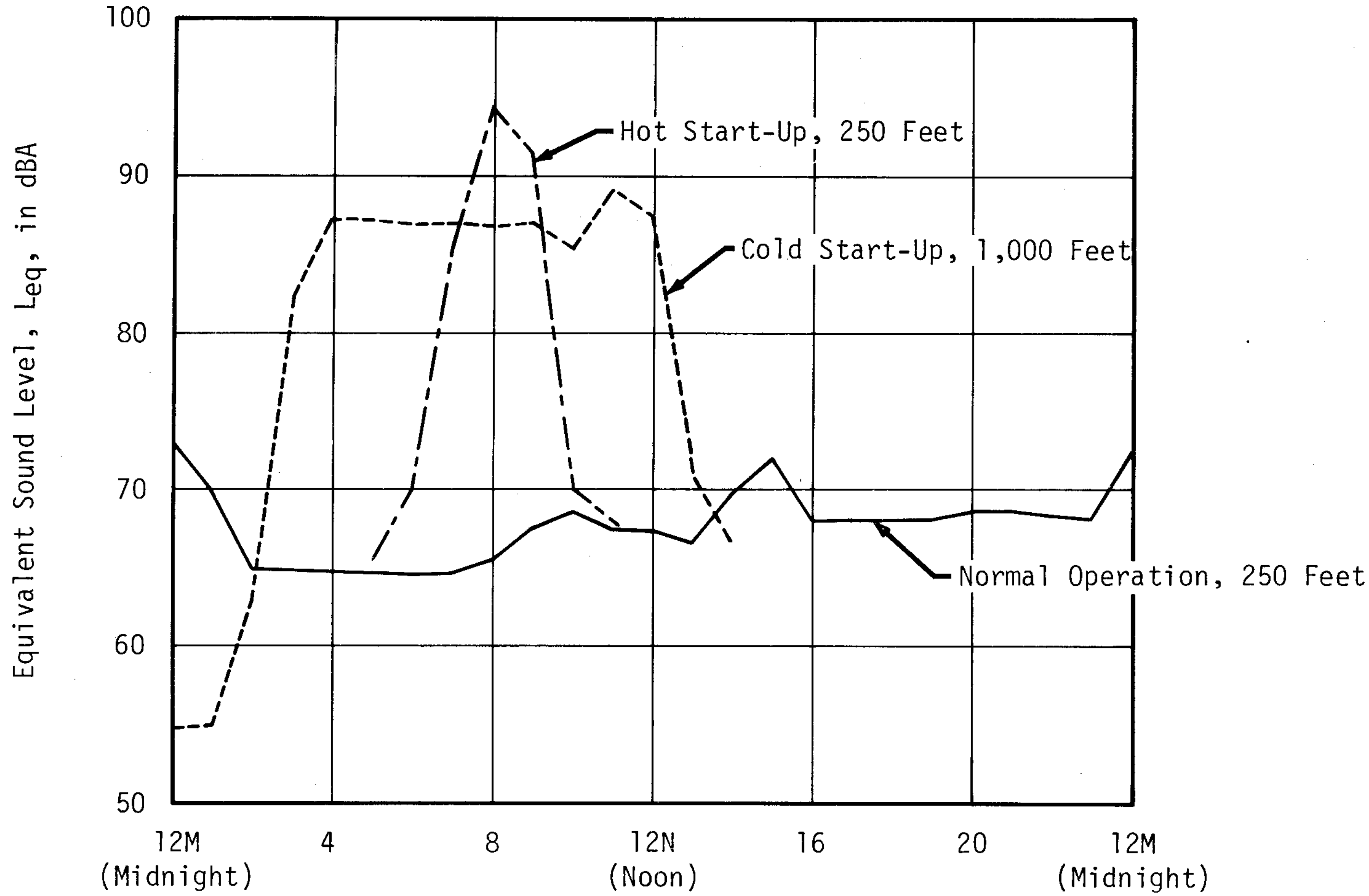
(6) Hickman, C. E. Noise Survey for Gulf Power Company, Internal Southern Services, Inc., Document, 1972.

(7) Schulz, M. W. Jr. and R. J. Ringlee. "Some Characteristics of Audible Noise of Power Transformers and Their Relationship to Audibility Criteria and Noise Ordinances." Power Apparatus and Systems (AIEE), June 1960.



Amendment 3 9/75

	GULF POWER CO. CARYVILLE STEAM PLANT	TYPICAL EQUIVALENT SOUND LEVELS, Leq, IN dBA AT 1,000 FEET AND 2,000 FEET FROM AN OPERATING PLANT FIGURE 5.6-4



Amendment 3 9/75

Gulf Power Company	GULF POWER CO CARYVILLE STEAM PLANT	EQUIVALENT SOUND LEVELS, Leq, IN dBA FOR HOT AND COLD START-UPS FIGURE 5.6-5

CLIENT: ______

JOB NO: ______ DATE: ______

OBSERVERS: ______

INSTRUMENTATION

SLM: TYPE B&K 2209 SER. # 454249

TRANSDUCER: TYPE B&K 4145 SER. # 456988

ANALYZER: TYPE B&K 1613 SER. # 460875

CABLE: TYPE ______ LENGTH ______

CALIBRATOR: TYPE B&K 4220 SER. # 457476

OTHER: Windscreen

PRIMARY NOISE SOURCE: Steam Vent

EQUIP. MAKE & MODEL: ______

CLIENT DESIGNATION: ______

OPERATING CONDITIONS: Unit in the process of being returned to service

SECONDARY NOISE SOURCE: ______

EQUIP. MAKE & MODEL: ______

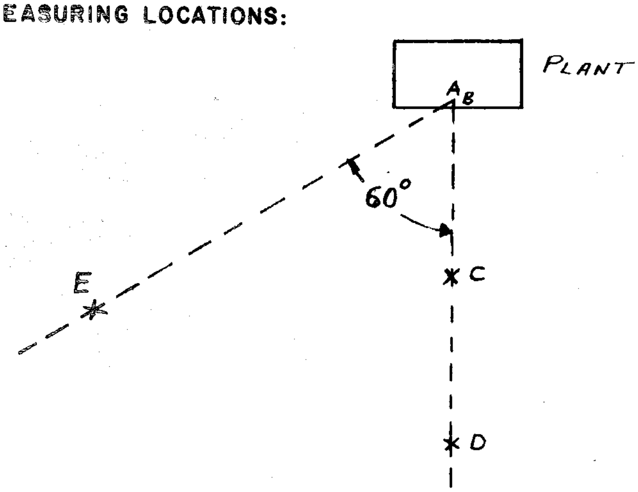
CLIENT DESIGNATION: ______

OPERATING CONDITIONS: ______

TIME	CALIBRATION	TEMP.	%RH	MMHG	WIND MPH	WIND DIR.

TEST NO.	TIME	POSITION	CONDITIONS	SOUND PRESSURE LEVEL, dB RE 20μ N/M² rms										
				A SCALE LEVEL	OVER ALL LEVEL	OCTAVE BAND CENTER FREQUENCY, Hz.								
						31.5	63	125	250	500	1000	2000	4000	8000
1		A	3 feet from end of vent	136	134	95	95	105	112	116	120	129	132	126
2		B	15 feet from vent	123	122	86	93	99	100	105	111	123	129	113
3		C	1,000 feet from vent	86-93	86-93	63	67-70	72	69	75-82	82-87	82-88	75-85	65-72
4		D	2,000 feet from vent	76-83	76-82	60	60	62	68	70-73	73-79	68-70	62-66	47-53
5		E	2,500 feet from vent	57-60	65	60	60	55-60	51	51	50-53	50	39-41	33-35

DIAGRAM - SHOW MEASURING LOCATIONS:



RECOMMENDATIONS: ______

Amendment 3 9/75

GULF POWER CO.
CARYVILLE STEAM PLANT

FLUCTUATING, DIRECTIONAL CHARACTERISTIC OF STEAM VENT NOISE

FIGURE 5.6-6

TABLE IV-8

PERIPHYTON ORGANIC BIOMASS DETERMINATIONS FOR ARTIFICIAL SUBSTRATES INCUBATED FOR 29 DAYS (APRIL 14-MAY 13, 1975) CHOCTAWHATCHEE RIVER, CARYVILLE, FLORIDA

River Station[a]	Organic Matter g/m^2	Growth Rate[b] g/m^2 day
L4	0.293	.01
L4	1.360	.05
L4	0.480	.02
B1	1.333	.05
B1	2.613	.09
B1	1.706	.06
Mean	1.30	0.05
Standard deviation	0.85	0.03
Mean Value Station L4	0.71	0.03
Standard Deviation	0.57	0.02
Mean Value Station B1	1.88	0.07
Standard Deviation	0.66	0.02

[a]Artificial substrates for river stations T1, L3, T2, and T3 are not reported due to vandalism of flotation devices.

[b]Based on 29 day exposure period.

3

TABLE IV-9

PERIPHYTON COMMUNITY SPECIES DIVERSITY INDICES
CHOCTAWHATCHEE RIVER, CARYVILLE, FLORIDA

Station No.	Shannon-Weaver Species Diversity ($\overline{H}$)	Shannon-Evenness Values (J)
December 5, 1974 (Artificial Substrates)		
C1(R)	2.55	0.736
WP1(C)	1.86	0.560
C2(L)	2.77	0.787
C2(R)	2.67	0.793
C3(L)	1.65	0.508
C3(R)	2.36	0.644
C4(L)	3.11	0.772
C4(R)	2.95	0.769
Mean	2.49	0.700
Standard Deviation	0.51	0.11
March 13, 1975 (Artificial Substrates)[a]		3
C1(R)	IC	
C2(L)	3.63	0.858
C2(R)	IC	
C4(L)	IC	
C4(R)	3.77	0.878
Mean	3.70	0.868
Standard Deviation	0.10	0.01
May 13, 1975 (Artificial Substrates)[a]		
L2		
L3		
L4	1.02	0.361
T1		
T2		
T3		
B1	1.39	0.49
Mean	1.21	0.425
Standard Deviation	0.26	0.09

Station No.	Shannon-Weaver Species Diversity ($\bar{H}$)	Shannon-Evenness Values (J)
May 13, 1975 (Natural Substrates)[b]		
L1	3.26	0.852
L2	2.86	0.771
L3	2.72	0.723
L4	2.90	0.810
T1	2.69	0.720
T2	2.73	0.762
T3	3.38	0.843
B1	3.29	0.860
Mean	2.98	0.79
Standard Deviation	0.29	0.06

[a] glass slides

[b] hand squeezings of Porella pinnata Linn. (leafy liverwort) and Brachelyma robustum (Card) E. G. Britt

[c] IC = inadequate colonization of artificial substrate

species diversity index in a river system according to Odum (1971) reflects a stable ecosystem with long food chains or intricate food web systems. In the Choctawhatchee the high species diversity reflects, in part, periphyton growth along the bank environment where natural stress of erosion from current is less rigorous than elsewhere in the channel.

A cluster analysis of the similarity among groups of periphyton stations, using Morisita's index of faunal affinity, showed no logical groupings attributable to locations of the station or to the time stations were sampled. Therefore, the river and the interfacial wetlands are an environment which is diverse and a high degree of similarity would not be expected.

In river systems that are free of pollution, the diatom flora normally has a great number of species with relatively few individuals 3
per species; a few species with a large number of individuals; and a number of very rare species. When the regression of species on individuals is plotted on a logarithmic scale, the population curve approaches a log normal distribution (Patrick, Hohn, and Wallace, 1954). Figure IV-9 presents the truncated normal curve for the Choctawhatchee periphyton community constructed from a species count of 8,405 diatom valves from periphyton sampled during December, 1974; March and May, 1975. This curve was compared to similar curves for diatom taxa recorded from a hard water river community, Silver Springs, Florida (Total hardness, 209 mg $CaCO_3$/1) and a soft water river community, Escambia River (Total hardness, 23 mg $CaCO_3$/1), (Hohn, 1961). The lower mode exhibited by the Choctawhatchee River and Silver Springs reflects a lower level of species distribution in these two systems as compared to the Escambia River system.

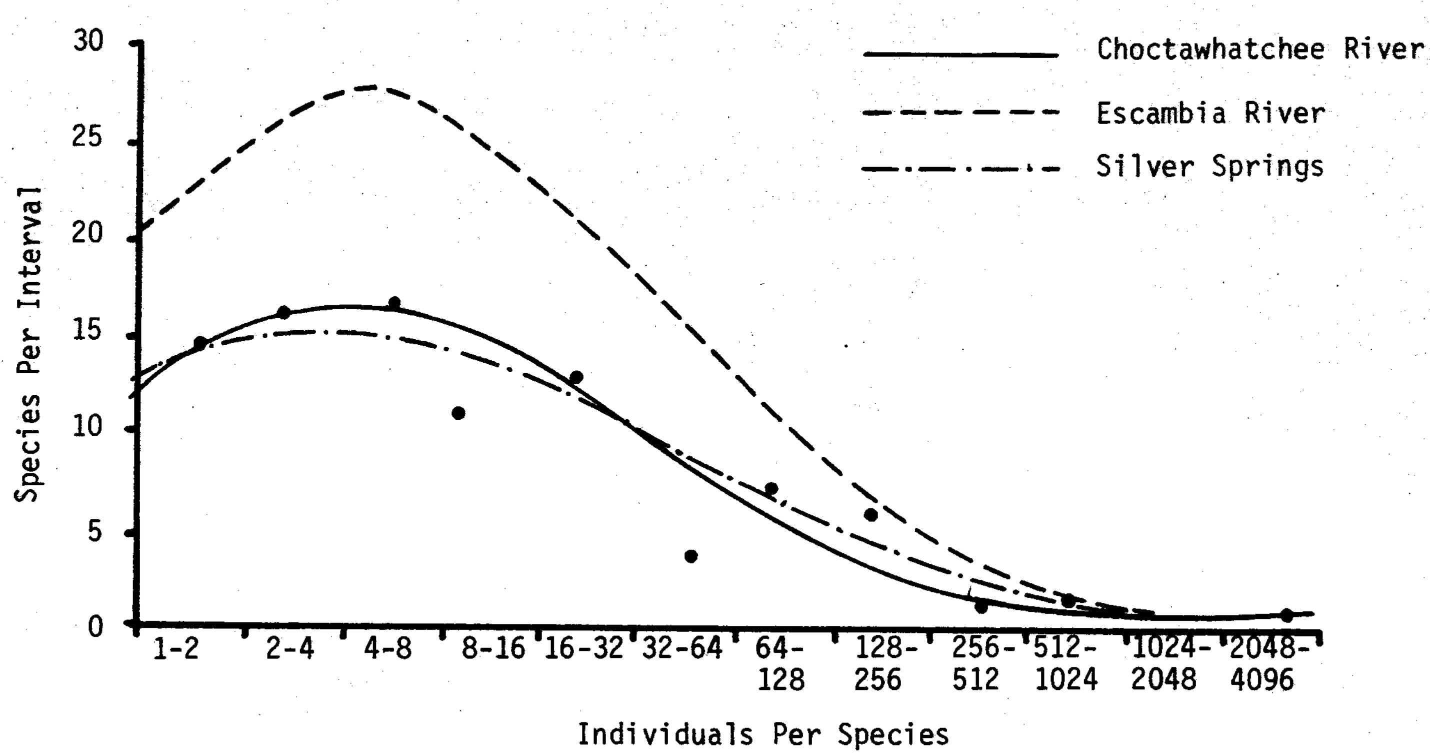


FIGURE IV-9. TRUNCATED NORMAL CURVE FOR COMPOSITE DIATOM POPULATIONS FROM ARTIFICIAL SUBSTRATES (4 WEEK INCUBATION PERIODS) AND NATURAL PERIPHYTON SUBSTRATES (i.e. PORELLA AND BRACHELYMA) FROM THE CHOCTAWHATCHEE RIVER, CARYVILLE, FLORIDA. COMPARED WITH SIMILAR CURVES FOR THE ESCAMBIA RIVER, FLORIDA (SOFT WATER), AND SILVER SPRINGS, FLORIDA (HARD WATER), FROM M. H. HOHN. 1961.

3

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These data indicate the presence of community stress in both the Silver Springs and Choctawhatchee River systems. In the Escambia River, a wide variety of species proliferate under optimal growth conditions. Marl buildup at Silver Springs and turbidity in the Choctawhatchee River stress these riverine communities, limiting the number of taxa present within each ecosystem.

The periphyton in the Choctawhatchee are diverse. The flora is mainly comprised of diatoms, many of which are characteristic of soft water conditions relatively free of organic pollution. Low productivity and low biomass indicate natural stresses on the periphyton community from turbidity and scour associated with flooding.

Predicted Effects of Plant Operation 3

The general thermal relationships for periphyton are the same as those affecting phytoplankton as discussed in the preceding section of this chapter. The cooling tower blowdown will not have a significant impact on the periphyton since the discharge plume will be restricted to near or mid-channel of the river. Therefore, the only effect on the periphyton would be due to the rise of less than 2°F downstream during "worst case" conditions. This would probably cause negligible effects on diversity and biomass organisms. The whole river increases in calcium and alkalinity are not sufficient to affect the community structure. The intermittant chlorine discharge will not produce residuals capable of significantly affecting periphyton populations.

The periphyton of the Choctawhatchee River are naturally kept at a low population level due to the flow characteristics, bottom characteristics, and turbidity in the river. They, therefore, are not considered

to form a substantial portion of the food base in relation to that entering from the drainage area of the river.

Calcium concentrations for example are only increased by 0.4 mg/l and alkalinity by 2.9 mg/l under the worst case condition of lowest autumn flow and maximum generating capacity. The increase in concentration does not extend the range of natural variation in the two parameters. The increase in alkalinity will not shift the pH range 3
significantly to favor a change in algal types nor is the added inorganic carbon sufficient to increase productivity. The column addition will not change the river from a non-calcareous stream (<20 mg CA/l, Hynes, 1970); therefore, no increased growth or change in species composition will occur.

Benthic Macroinvertebrates

Introduction

Benthic organisms are a major biological component of river systems and form an important part of the aquatic food chain. They convert organic detritus to cell biomass which provides a food source for higher trophic levels. They are also important indicators of water quality in that many species are sensitive to environmental changes. Thus natural or man-induced fluctuations in the physical-chemical characteristics of a river system are reflected by shifts in benthic community structure.

Historically, benthic macroinvertebrates have been employed in environmental surveys because they have a relatively short life span -- a year or less usually -- and, therefore, reflect present and recent past conditions as they tend to remain at fixed locations. Because of the above two factors benthic macroinvertebrates are useful as an integrated monitor of the environment.

Species composition (density and diversity) within a given geographical location of benthic organisms is dependent primarily on three factors -- water quantity, water quality, and substrate composition.

Water quantity places limits on which species can occur within a site. Some species prefer shallow well-lighted waters and some prefer deeper waters with less light. Some are adapted for a swift current that would sweep away those inhabiting slow moving waters. Seasonal changes of water flow and depth may regulate the species composition within a particular river reach.

Water quality is a significant factor in determining the assemblage of benthic species. Principal factors include dissolved oxygen levels,

temperature, hardness, and quantities of dissolved substances. The most important of these is oxygen level. Many species require oxygen saturated water in order to thrive, others can survive under near anaerobic conditions. Benthic organisms can also be limited by temperature extremes. The Aquatic Life Advisory Committee (1956) cited that benthic communities in the temperate zones are adapted to seasonal fluctuations of temperature between 0 and 32°C (32 - 90°F).

Substrate is the most important determinant in species composition (Hynes, 1960). There is a direct relationship between amount of available surface area and species abundance and diversity. That is to say, there are more hiding and foraging places in a rock or pebble bottom than in a sand or mud bottom. The amount of organic matter, particularly from plants, is also
important. Aquatic plants increase the abundance and diversity of benthic 3
organisms viz. there is more surface area, more periphytonic food organisms, more food from the plants themselves, and more detritus. Beck (1954) indicates, "It became apparent after careful examination of many of the streams of Florida that diversity of fauna was primarily the result of one factor -- the diversity of habitat."

Methods

Benthic macroinvertebrates were sampled at a total of 16 stations (Figure IV-1). Stations L-1 through L-4 were collected at mid-channel. They were located upstream, within, and downstream of the expected thermal discharge plume on a longitudinal axis with the river. Transects T-1 through T-3 are perpendicular to the river's axis, and were also located upstream, within, and downstream of the impact area. Stations were sampled at the west bank, mid-channel, and east bank along each transect.

Station B was within the bypass channel north of the sawmill. Stations C-1 and L-2E were within the floodplain forest east of the river. Station C-1 was adjacent to the mesic island and C-2E was adjacent to the River. Notes concerning substrate composition were taken for each sample.

Replicates were collected at each station to determine the natural variability of benthic populations. Five replicates were collected at Stations L-1 through L-4, T-1 West and East, T-2 West, and T-3 Mid-channel and East, and at F-1.

Samples were collected with a Petite Ponar Dredge. In the field, each sample was washed in a U. S. Standard No. 30 bucket sieve and placed in wide-mouth jars. Rose Bengal dye was then added to each jar, staining the macroinvertebrates so that laboratory sorting (from detritus and sand) 3
might be facilitated. Within one-half to one hour after staining each sample was preserved with formalin.

In the laboratory, all samples were washed again in a U. S. No. 30 sieve and distributed for sorting in a white enamel pan. All visible organisms were then removed and preserved in 70 percent ethanol in clear labeled vials. Larger invertebrates were identified with the aid of a stereoscopic microscope. Smaller groups (chironomids and oligochaetes) were mounted on microscope slides in polyvinylactophenol mounting medium for identification.

Taxonomic references utilized were Beck (1959, 1966, 1968, and 1969); Mason (1968); Berner (1950); Byers (1930), Brinkhurst (1969); Pennak (1953); Edmonson (1959) and Usinger (1969).

A species list of all stations was compiled for comparative purposes. These data were then analyzed to determine community structure utilizing concepts

of species diversity, species richness, evenness of species, species dominance, and faunal affinity.

The specific indices used were the Shannon-Weaver index of diversity ($\bar{H}$), evenness (J), Simpson's index of dominance (c), and Morista's index of faunal affinity, respectively. Finally, a cluster analysis based on the latter index was made to determine patterns of similarity among the benthic populations.

Results

Four principal benthic groups were found in the river sediments -- oligochaetes, other annelids (leeches), chironomids, and pelecypods (bivalve molluscs). Less abundant groups collected included ephemeropterans, plecopterans, dipterans and gastropods. The representatives of these latter groups were those forms associated with non-polluted water. The taxa found and 3
their abundance are reported in Tables IV-10, 11 and 12, which group the stations into mid-river stations, near shore (or river's edge) stations, and still water stations, respectively.

Benthic samples were taken from natural substrates at stations as shown in Figure IV-1. Substrate in the main channel was a coarse sand with little clay or detritus. Samples collected from the banks of the river were of finer sand, with some clay and surface detritus. Some samples were taken from the outside bend of the river, near the recommended intake site, in a wide area where the natural levee is broken in many places allowing drainage from the floodplain and rim swamp. The physical characteristics near the shore at this site (T-2E) allow the accumulation of detritus, fine silt and clay (Chapter III, River Dynamics). The substrate at Station B-1, in the bypass

TABLE IV-10

BENTHIC ORGANISMS FOUND AT MID-RIVER STATIONS REPORTED IN NUMBER OF INDIVIDUALS PER SQUARE METER

Species	L-1	L-2	L-3	L-4	T-1M	T-2M	T-3M	Total
CLAMS								
Corbicula manilensis Asiatic clam)	17.3		17.3					34.6
Musculium sp. (Fingernail clam)	181.4	28.8	51.8	14.4	43.2	72	43.2	434.8
MIDGE LARVAE								
Nilotanypus americanus	8.64							8.64
Corynoneura sp.	60.5							60.5
Cryptochironomus fulvus	8.64							8.64
"*Parachironomus*" sp.		14.4						14.4
Polypedilum fallax	8.64							8.64
Polypedilum sp. C	354.2	201.6	25.9		230.4	993.6	288	2093.7
Polypedilum sp.	69.1				28.8			97.9
Unidentified sp. 1	60.5		95					155.5
WORMS AND LEECHES								
Oligochaeta (Aquatic worms)	43.2	14.4	60.5				14.4	132.5
Helobdella nepheloidea (Leech)			8.64					8.64
MISCELLANEOUS								
Asellus sp. (Isopod)	8.64							8.64
Hydrachna sp. (Water mite)				14.4				14.4
Podura aquatica		14.4			14.4			28.8
Stenonema sp.	8.64							8.64
Unidentified Zygopteran (Damselfly)			8.64					8.64
Unidentified Hemipteran (Water bug)			8.64					8.64
Polycentropus sp.			8.64					8.64
Unidentified Dysticid	51.8							51.8
Stenelmis sp.	51.8							51.8
Bezzia setulosa							14.4	14.4

Table IV-10 (continued)

Species	L-1	L-2	L-3	L-4	T-1M	T-2M	T-3M	Total	
Palpomyia tibialis							14.4	14.4	
Unidentified Culicid	43.2				28.8	14.4		86.4	3
Σ (individuals)	976.2	273.6	285.1	28.8	345.6	1080	374.4	3363.7	
Σ (species)	15	5	9	2	5	3	5	44	

TABLE IV-11

BENTHIC ORGANISMS FOUND AT RIVER EDGE STATIONS
REPORTED IN NUMBER OF INDIVIDUALS PER SQUARE METER

Species	T-1E	T-2E	T-3E	T-1W	T-2W	T-3W	Total
CLAMS							
Corbicula manilensis (Asiatic clam)			28.8	17.3			46.1
Musculium sp. (Fingernail clam)	60.5	57.6	28.8	17.3	14.4	8.6	187.2
MIDGE LARVAE							
Nilotanypus americanus			14.4				14.4
Rheotanytarsus exiguus		14.4					14.4
Cryptochironomus fulvus		14.4					14.4
"Parachironomus" sp.	8.6						8.6
Polypedilum sp. C	60.5		115.2	129.6			305.3
Polypedilum sp.		14.4	14.4	8.6		17.3	54.7
Unidentified Chironomidae					14.4		14.4
WORMS AND LEECHES							
Oligochaeta (Aquatic worms)	34.6		43.2	17.3	100.8		195.[illegible]
Helobdella nepheloidea (Leech)					28.8		28.8
MISCELLANEOUS							
Asellus sp. (Isopod)		14.4					14.4
Hydrachna sp. (Water mite)		14.4					14.4
Isoperla sp.		28.8					28.8
Dolania sp.						51.8	51.8
Pseudiron sp.						8.6	8.6
Hexagenia limbata		158.4					158.4
Hydropsyche sp.		14.4					14.4
Unidentified Coleopteran						8.6	8.6
Bezzia setulosa			14.4			8.6	23
Unidentified Culicid		14.4				8.6	23
Chrysops sp.		14.4					14.4
Lyogyrus sp.				8.6			8.6
Σ (individuals)	164.2	360	259.2	198.7	158.4	112.1	1252.6
Σ (species)	4	11	7	6	4	7	39

TABLE IV-12

BENTHIC ORGANISMS FOUND IN STILL WATERS OF SEMI-PERMANENT OR SEASONAL STATUS, REPORTED IN NUMBER OF INDIVIDUALS PER SQUARE METER

Species	B-1	C-1	L-2E	TOTAL
CLAMS				
Musculium sp. (Fingernail clam)	10.8		129.6	140.4
MIDGE LARVAE				
Ablabesmyia aspera		14.4		14.4
Procladius sp.	10.8	14.4		25.2
Tanytarsus sp.	43.2			43.2
Chironomus sp. A	54	14.4		68.4
Chironomus sp. B	32.4			32.4
Cryptochironomous fulvus	108	14.4		122.4
Cryptotendipes sp.	10.8			10.8
Microtendipes sp.		57.6		57.6
Paracladopelma sp.	54	14.4		68.4
Paralanterborniella nigrahalterale	10.8			10.8
Polypedilum sp. C	529.2	14.4		543.6
Tribelos sp.	10.8	28.8		39.6
Unidentified chironomidae	32.4			32.4
WORMS AND LEECHES				
Oligochaeta (Aquatic worms)	442.8	230.4	129.6	802.8
Helobdella nepheloidea (Leech)			21.6	21.6
MISCELLANEOUS				
Hyalella azteca (amphipod)			21.6	21.6
Podura aquatica	75.6			75.6
Hexagenia limbata	10.8			10.8
Stenonema sp.	10.8			10.8
Unidentified Ephemeropteran			21.6	21.6
Bezzia setulosa	10.8			10.8

3

Table IV-12 (continued)

Species	B-1	C-1	L-2E	TOTAL
Unidentified Culicid	32.4			32.4
Campeloma sp.			129.6	129.6
Pleurocera sp.	10.8			10.8
Σ (individuals)	1501.2	403.2	453.6	2358
Σ (species)	19	9	6	

channel, was gray clay and detritus. This slow-moving to stagnant area of water allows clay and detritus from the river, the floodplain and the sawmill to accumulate.

Floodplain stations (C-1 and L-3E) were a mud of fine clay and silt sediment with large amounts of detritus. As at Station B-1, water movement was normally slow to stagnant.

Tables IV-10, 11 and 12 indicate that the natural substrates in this river reach support a low macroinvertebrate population. This is due to the shifting sandy substrate which provides a restrictive habitat, and limits the types of benthic organisms which can survive. The community structure indices (Table IV-13) are similar for mid-channel stations indicating no inherent upstream or downstream difference from that in the area of the proposed discharge. However, there was a definite pattern across the channel transects. Mid-river stations showed a lower diversity, less evenness and greater degree of dominance than the near-shore stations. This is to be expected, since faster current mid-river would cause the substrate to be more unstable; the water is also deeper. For example, comparison can be made between West and East (W & E) with the middle station on T-1, 2 and 3. 3

Aquatic worms can burrow just under the sands and avoid the current. Some midge larvae can construct cases just under the sand, with only their heads protruding in order to gather food. Clams, and some snails, can move along just under the surface of sands and avoid the current. When feeding, clams open their shells slightly perpendicular to the direction of flow, and siphon food-bearing water into their buccal cavities. Leeches are flat and narrow, move by expansion and contraction, and forage at the sand/water interface.

TABLE IV-13

POPULATION STRUCTURE INDICES FOR CHOCTAWHATCHEE RIVER MACROBENTHOS

Station and Location (See Figure IV-1)	Shannon-Weaver Diversity Index X, Base e ($\bar{H}$)	Shannon-Weaver Evenness Value (J)	Simpson's Index of Dominance (c)
Upstream			
L-1	2.086	0.770	0.188
L-2	0.918	0.570	0.567
T-1E	1.222	0,881	0.317
T-1M	1.076	0.669	0.476
T-1W	1.189	0.663	0.453
Discharge Area			
L-3	1.906	0.828	0.192
L-3E	1.512	0.884	0.251
T-2E	1.876	0.782	0.241
T-2M	0.378	0.272	0.830
T-2W	1.027	0.741	0.458
Downstream			
T-3E	1.624	0.835	0.261
T-3M	0.818	0.508	0.614
T-3W	1.644	0.845	0.261
L-4	0.693	1.000	0.500
Others			
B-1 Bypass	2,007	0.670	0.221
C-1 Swamp	1.491	0.679	0.362

3

Benthic organisms have a different set of environmental conditions within the bypass channel at Station B-1. Here the water is less turbulent; the substrate is a mud of clay, silt, and organic matter; water temperatures tend to be higher and dissolved oxygen levels are lower. There are usually more macroinvertebrates in mud than in sand or silt, because of the increased organic matter and microbenthic organisms that provide food. Oligochaetes are dominant; total numbers and numbers of species at B-1 are highest of any station.

A cluster analysis using Morisita's index of faunal affinity was used to determine similarity among stations. These results are expressed as a phenogram in Figure IV-10. The figure shows distinct grouping of stations with similar taxa and population relationships ([L-1, T-3E, T-1E], [L-2, T-3M, T-2M, T-1M, T-1W], etc.), as represented by similarity values from 0 -1. Intergroup similarity is shown by vertical connecting lines showing average 3
similarities in descending value beginning with L-1 and terminating with T-3W.

Since the river bed within the study area is a relatively uniform, shifting, abrasive sand, it is not surprising that the diversity and abundance of benthic organisms are low. Rocks or plants which could be used as refuge are absent and mud is not available for burrowing. Large and medium-sized organisms are, therefore, absent. Small organisms are able to survive by adaptation to the natural stress of poor substrate, swift current, and periodic flooding.

The distribution of organisms in the natural substrates indicates a majority (56.6 percent) of chironomid larvae -- of these, <u>Polypedilum</u> sp. account for 74.5 percent of the midges and 42.5 percent of the total number of benthic invertebrates. Midge larvae dominate the mid-river stations and

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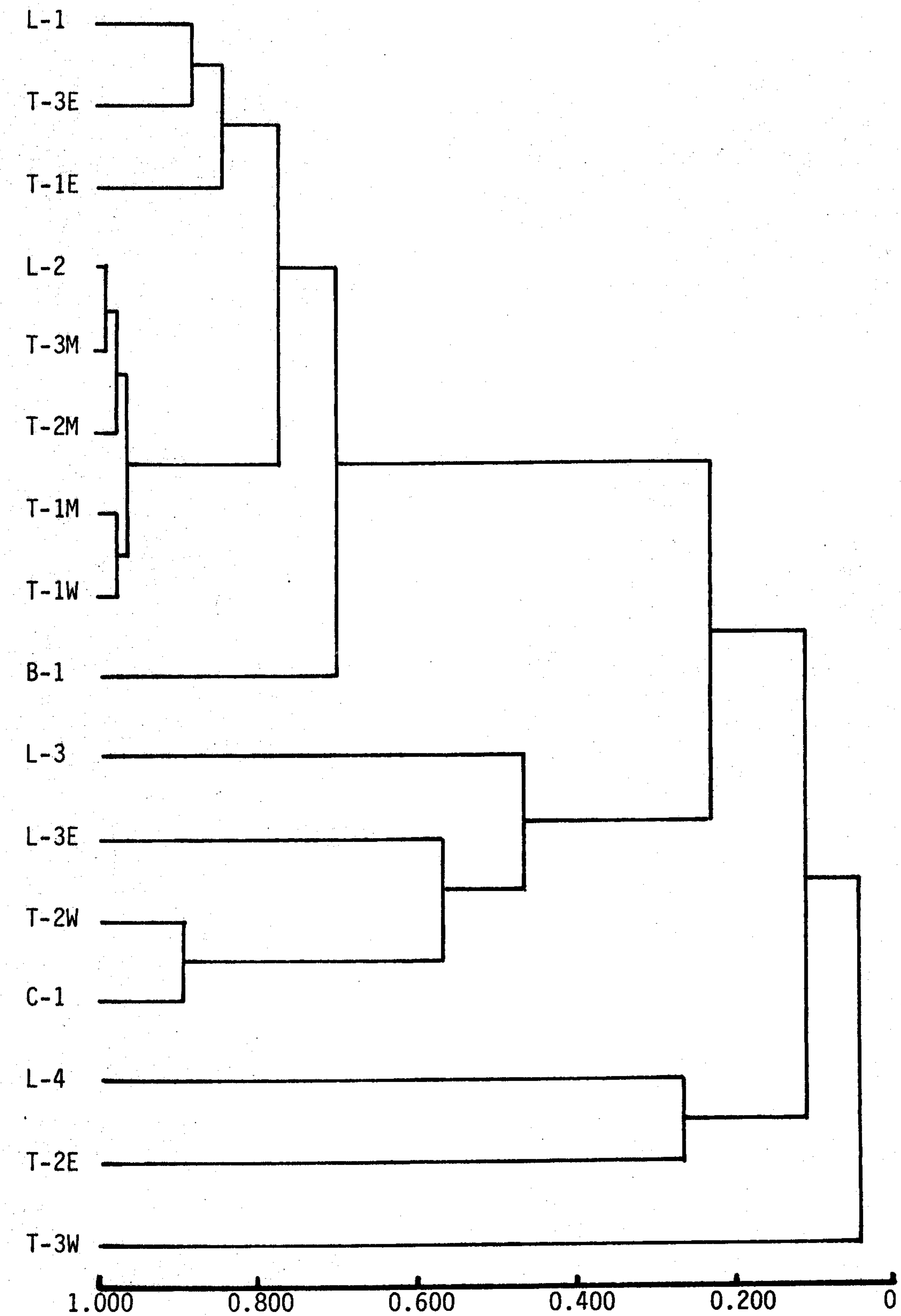
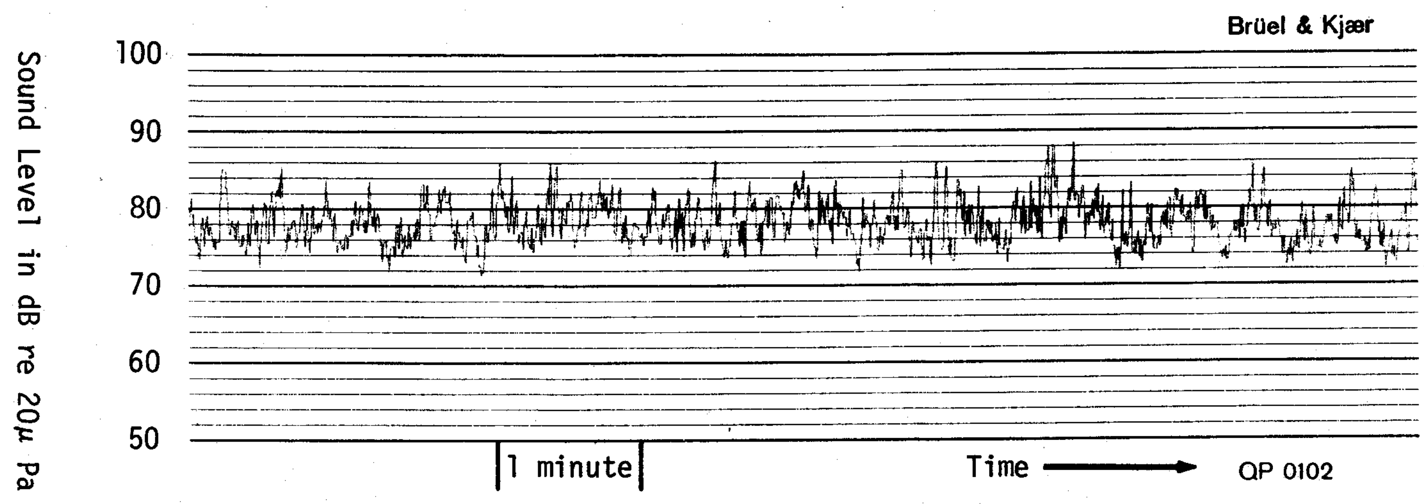
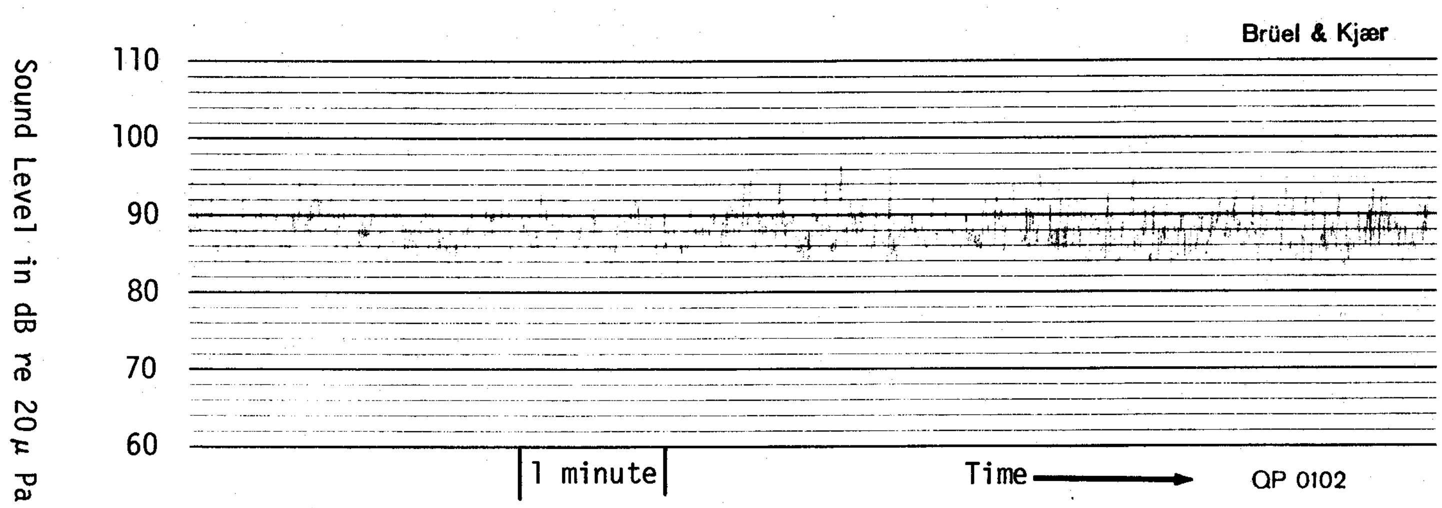


FIGURE IV-10. CLUSTER DIAGRAM OF SIMILARITY VALUES FOR CHOCTAWHATCHEE RIVER MACROBENTHOS COPHENETIC CORRELATION COEFFICIENT = 0.938

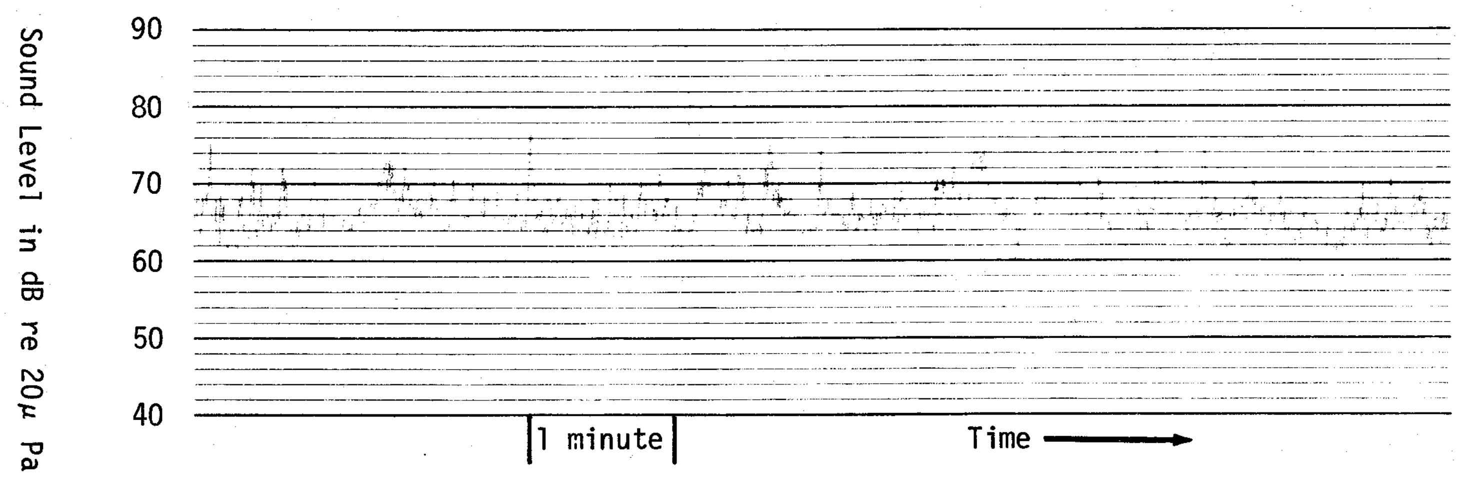
3



(a) Sound Level in dBA at 2,000 Feet From a Steam Vent During Start- Up



(b) Sound Level in dBA at 1,000 Feet From a Steam Vent During Start-Up



(c) Sound Level in dBA at 1,000 Feet From a Steam Vent After The Unit Is On-Line

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GULF POWER CO.
CARYVILLE STEAM PLANT

SOUND LEVELS IN dBA ASSOCIATED WITH THE START-UP OF A STEAM GENERATING PLANT

FIGURE 5.6-7

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

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6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

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Therefore, under static nonartesian conditions, if the fresh ground water has a specific gravity of 1.0 and the sea water has a specific gravity of 1.025, the contact between the salt water and the overlying fresh water at any place is depressed 40 feet below sea level for every foot that the water table stands above sea level. For example, consider figure 6.4-3 where a lense of fresh water is surrounded on the sides and bottom by salt water. Under pre-pumping conditions, the fresh water/salt water interface lies at a depth of 40 feet below sea level. After pumping begins, a cone of depression forms in the water table and the fresh water/salt water interface begins to move upward as an inverted cone. If pumped at a rate large enough to cause the water table to drop to sea level, the cones would meet at that point. The well, however, would be producing salt water as soon as the interface rose as high as the bottom of the well. Under artesian conditions, the same general principal may hold. If the confining bed is completely impervious and the head of water in the aquifer is not large enough to push the salt water back to the submarine outcrop of the aquifer, the condition is one of equilibrium between two bodies of water of different densities. (See figure 6.4-4.) Under this condition, there is no discharge of fresh water into the sea. Hence, there is no hydraulic gradient, the head of the water in the aquifer is the same at all points, and the piezometric surface becomes an even surface at some height above sea level (3). If, however, the head of water is sufficiently great, a hydraulic gradient will be established in the aquifer, the salt water will be pushed back to the submarine outcrop, and fresh water will escape into the sea. (See figure 6.4-5.)

Relating the preceeding discussion to a basin, it can be seen in the Caryville area that if a large cone of depression were created in the potentiometric surface of the Floridan aquifer, there would be some upward warping of the salt water/fresh water interface provided there were no intervening impermeable strata between the part of the aquifer from which water was being withdrawn and the interface. It is not known whether an impermeable strata of this magnitude exists in the Caryville area. But, there will not be a serious upward movement of the salt water/fresh water interface for the following reasons: (a) The salt water/ fresh water interface under predevelopment conditions is estimated to be between the depths of 840 to 890 feet. This is based on a concentration of 1,000 parts per million of sodium chloride (NaCL). With these conditions, considerable drawdowns could be imposed on the system before salt water encroachment would become a problem. (b) Transmissibilities of the Floridan Aquifer are large; therefore, drawdowns in the potentiometric surface in the vicinity of the proposed production wells would be small. Gulf will use pumping test results to plan construction, spacing, and production of water supply wells to guard against salt water intrusion. The ground water monitoring program described in subsection 2.5.1.1, "Sinks and Ponds," includes analysis for chlorides. 2

6.4.2 Ash Pond Seepage Monitoring and Collecting Well System

As discussed in section 2.4, "Geology," the overburden in the ash pond area consists of lenticular sand, clay, and gravel. The clay beds are not continuous. Therefore, area wide, the overburden acts as a single water-bearing unit with a shallow water table. Locally, the clay lenses prevent or disrupt vertical flow within the unit. A highly irregular Karstic limestone surface exists beneath the overburden. This ranges in depth from less than 100 feet to over 200 feet. (See figure 2.4-19.) In some places the limestone is overlain by impermeable clays. In other places it is overlain by permeable sands. Therefore, potential hydrological connection exists between the shallow aquifer and the underlying limestone or deeper aquifer.

The water table map for the area shows that the general gradient and therefore the direction of movement of water in the shallow aquifer is towards the west from the ash disposal area. (See figures 2.5-17, -17a, -18, and -18a.) Transmissibility and storage coefficients were computed from shallow aquifer pumping test data. This shows the underflow to be approximately 12,000 gallons per day per mile of width at 100 percent gradient in the shallow aquifer.

The installation and use of large production wells (2,500 to 3,000 GPM 3
total) developed in lower aquifers will probably cause some coning of the shallow water table.

Several small wells will be installed in the shallow aquifer north, west, and south of the ash pond. These wells will be screened or otherwise developed from the top of the normal water table downward in order to recover water from the upper part of the water table. These wells will superimpose cones of depression on top of any cone created by the larger production wells. Therefore, any seepage from the ash pond will flow downward to the shallow water table and then on top of, or in, the upper part of the shallow water table to the collector wells. Since the natural gradient and the cones of depression-induced gradients are all to the west from the ash ponds, the majority, if not all, of the seepage will be collected by the small wells.

It is anticipated that six collector wells will be used. Each will be equipped to pump at least 2,000 gallons per day (1.4 GPM). The water from each well will be sampled and analyzed on a regular basis for ash pond leachates and compared with analysis of samples taken from other wells in the area, both during and before plant operation. The monitoring well effluent will be used as make-up in the plant systems.

In addition to the monitoring of water from the collector wells, observation wells will be installed and monitored to ensure that the gradient is being maintained in such a way to induce any seepage from the ash ponds into the collector wells. 3

Analysis of ash pond effluents will be made to determine the concentrations of various constituents. These results will provide an indication of the quality of any leachate and also an indication as to which constituents might present a problem.

6.4.3 References

(1) Cooper, H. H., "Type curves for nonsteady radial flow in an infinite leaky artesian aquifer." Shortcuts and special problems in aquifer tests: U. S. Geol. Survey Water-Supply Paper 1545-C, ed. by R. Bentall, pp. C48-C55, 1963.

(2) Hantush, M. S. and C. E. Jacob. "Non-steady radial flow in an infinite leaky aquifer." Am. Geophys. Union Trans., Vol. 36, No. 1, pp. 95-100, 1955.

(3) Stringfield, V. T. "Artesian water in Tertiary limestone in the southeastern states." U. S. Geol. Survey Prof. Paper 517, p. 226, 1966.

AMENDMENT STATUS PAGE

Periodically throughout the life of this document, new pages will be added, some existing pages will be deleted, and some existing pages will be amended and replaced. Such changes are called amendments and are accomplished to reflect updated information and agreements between Gulf Power Company and various regulatory agencies.

Insert latest amended pages and dispose of superseded pages in accordance with the amended page status indicated below.

NOTES: A. A zero in the amendment number column indicates an original page. An arabic number in this column indicates the latest amendment number to a page.

B. On an amended text or table page, that portion of the text or table affected by the latest amendment is indicated by a vertical line and an amendment number in the outer margin of the page, and the latest amendment number and date is shown at the bottom of that page.

C. Amendments to figures (illustrations) are indicated by the latest amendment number and its date above the title block.

D. Occasionally a page of text, a table, or a figure may be replaced which has been amended only, for example, to correct a misspelled word or to improve its visual appearance. Such a page will not have the vertical line, amendment number, etc.

E. To improve readability of the following tabular information, a double-space break separates every fifth entry.

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APPENDICES

The information contained in the following appendices explains in greater detail the material to which it applies, or it lists in tabular form detailed findings from field investigations, or it presents the formulas used in gathering and presenting data. In all cases, the appendix material supplements one or more sections in the Site Certification Application. Reference is made in the narrative portion of a section to a particular appendix.

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SECTION 1 OF APPENDIX A

The following pages contain appendix material to section 2.3, "Regional Historic, Scenic, Cultural, and Natural Landmarks." 3

AN ARCHAEOLOGICAL AND HISTORICAL SURVEY
OF THE
GULF POWER COMPANY
CARYVILLE PLANT SITE

Performed for the Gulf Power Company

under contract by

Bureau of Historic Sites and Properties

Division of Archives, History and Records Management

Florida Department of State 3

William D. Browning
Survey Archaeologist
June, 1975

Miscellaneous Project Report Series No. 25

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*At Gulf Power Company's request, this figure is not included.

Introduction

Late in 1974 the Division of Archives, History and Records Management was contacted by Gulf Power Company regarding cultural resources on a proposed power plant site in Holmes and Washington counties. The area was archaeologically unknown, and a reconnaissance survey was recommended. A proposal for such a project to inventory, record and assess project impact on any archaeological and historical resources on the tract was sent to Gulf Power. 3
The proposed work was approved in January, 1975, and field work was begun in March.

Two survey archaeologists, William D. Browning and R. Bruce Council, were employed for the two and one-half month field investigation; the author was employed for an additional six weeks to analyze materials and prepare the final report. The financial support and cooperation of Gulf Power Company are gratefully acknowledged.

Survey Techniques

The field investigation of the Gulf Power Company Caryville Plant Site involved two separate, but related, surveys: 1) the plant site proper; and 2) the associated transmission line corridors. Each of the two different survey techniques are discussed briefly below.

The Caryville Plant Site consisted of 1452.3 acres, and an intake/discharge corridor from the proposed plant site to the Choctawhatchee River which encompassed 8 acres. All of the 1460+ acres were surveyed, except for a 153 acre tract at the southwest corner of the plant site belonging to Messrs. Waynard M. Carey and Willis C. Wilson, among others. Permission was not obtained from the owners for access to the 153 acre tract. 3

All roads on the plant site were travelled by foot, as were all accessible areas which appeared to have archaeological potential, based on the U.S.G.S. Caryville, Florida, (1950) topographic map. The terrain immediately south of the Hathaway Mill, or Little Gum, Creek was not thoroughly surveyed because of the dense ground cover and minimum of access roads.

Archaeological sites were defined from the surface scatter of lithic and/or ceramic artifacts. There were no definite criteria used for determining what was an archaeological site and what was not. In some instances a small quantity of material, generally with a minimum of one worked object, was called a site, while occasionally an area which yielded a larger quantity of material was not considered a site. Factors such as the amount of

exposed land surface and artifact density (number of specimens/ area of surface scatter) played an important part in determining what was an archaeological site.

In the case of the Cypress Knoll Site Complex several concentrations of surface material were tentatively defined as "activity areas" rather than individual archaeological sites. The determination was based on the similarity of the recovered materials and the proximity of the artifact concentrations to one another. As used in this report, an activity area represents a physically separate area of a site or site complex, where one or another type of cultural activity was carried out. The site complex was composed of several such activity areas. The separate activity areas appeared to represent a single cultural occupation by a number of related groups or a series of subsequent occupations, as, for example, succeeding generations of the same group of individuals seasonally returning to the same general area.

The transmission line corridors consisted of approximately 65.25 miles of existing right-of-way and 38.75 miles of proposed right-of-way. All accessible sections of the existing power line corridors which were tentatively planned for expansion were surveyed. However, very few stretches along the propcsed corridors were surveyed, because they had not yet been staked-out and were for the most part on private property. Only those sections of the proposed corridors which intersected existing roads, as shown on the aerial photographs suppled by the utilities company, were surveyed.

FIGURE 1

ARCHAEOLOGICAL RESOURCES, SITE LOCATION MAP*

3

*At Gulf Power Company's request, this figure is not included.

Surveying of the transmission line corridors, both existing and proposed, was done primarily from a vehicle. Time did not permit as thorough a survey to be done as that of the plant site proper.

Summary of Results and Recommendations

The archaeological and historical survey of the Gulf Power Company Caryville Plant Site, and its related transmission line corridors, represents the first archaeological project of any kind to be attempted along the upper Choctawhatchee River drainage system in Florida. The results of the survey, while productive in terms of the number of sites located, only records the presence of sites. Little is accomplished towards an understanding of the prehistoric people of the upper Choctawhatchee River 3
drainage. Recommendations for the testing of each site located during the survey are based on the assumption that each archaeological site has the potential for adding new, significant data about the area.

Due to the fact that little is known about the prehistory of the region, as mentioned above, all of the sites located during the survey are recommended for at least test excavation, if they are to be threatened by plant construction. Those sites which are not threatened, or which can be avoided during plant construction, should be preserved, and require no testing.

Forty-nine previously unrecorded aboriginal sites were located on the Caryville Plant Site and related power line corridors, both existing and tentatively planned. There follows a list of all of

the sites, along with the aspects of plant construction which will endanger each, and the recommendations for their preservation and/or excavation. The recommendations are stated in terms of 3 categories depending on significance and endangerment.

Category 1 indicates that limited test excavations, consisting of the digging of from one to several squares, should be carried out at the site. Category 2 indicates that a more extensive testing is required at the site, short of full-scale excavation. Category 3 indicates that a full-scale excavation should be undertaken. The priority rating are based on such factors as the horizontal dimensions of the surface scatter of artifacts, the present condition of the surrounding environs, and the apparent potential of the site for producing archaeologically significant data. However, it should be understood that the recommendation categories 3
for individual sites are not inflexible. The recommendation for one site could be changed while it was being excavated or because of the results obtained from the excavation of another site.

Site #	Site Name	Type of Threat	Recommendation
8Ho27	Southwest Plant	Det. Pond "B" Outfall, road and embankments	1
8Ho28	Evans Road III	Sludge Basins (2)	1
8Ho29	West Plant	Expansion of Transmission Line R-O-W	2
8Ho30	Cypress Ridge East	Construction of Parking Lot and Ash Disposal Area "B" with road and embankment	1
8Ho31	Cypress Knoll C-3	Rerouted Transmission Line R-O-W and Ash Disposal Area "B"	3

8Ho32	Cypress Knoll C-1	Construction Rail Road and Construction Road	3	
8Ho33	Cypress Knoll C-2	Construction Laydown Area	2	
8Ho34	Cypress Knoll L-1	Construction Laydown Area	2	
8Ho35	Cypress Knoll L-2	Rerouted Transmission Line R-O-W and Ash Disposal Area "B"	2	
8Ho36	Cypress Knoll L-3	Ash Disposal Area "B"	1	
8Ho37	Cypress Knoll C-4	Ash Disposal Area "B"	3	
8Ho38	Cypress Knoll C-5	Ash Disposal Area "B"	1	
8Ho39	Pine Lane	Ash Disposal Area "B"	1	
8Ho40	West Central Knoll	Coal Storage Area	1	
8Ho41	Dust Hills	NONE	1	
8Ho42	East Island	Expansion of Transmission Line R-O-W	1	3
8Ho43	South Slough	Ash Disposal Area "B"	3	
8Ho44	East Slough	Ash Disposal Area "B"	2	
8Ho45	Hathaway Quarry	NONE	2	
8Ho46	West Slough	Ash Disposal Area "B"	2	
8Ho47	North Quarry Road	NONE	3	
8Ho48	Hathaway Crossroads	Ash Disposal Area "B"	1	
8Ho49	Hathaway Ridge	Ash Disposal Area "B"	1	
8Ho50	Hathaway Mill Creek 2	Ash Disposal Area "B"	3	
8Ho51	Hathaway Mill Creek 1	Ash Disposal Area "B"	3	
8Ho52	Mill Road 1	(not on G.P.C. property)	1	
8Ho53	Mill Road 2	(not on G.P.C. property)	1	
8Ho54	East River Line	Expansion of Transmission line R-O-W	1	
8Ho55	Buckhead Island	Expansion of Transmission Line R-O-W	3	

8Ho56	River Road	Expansion of Trans-mission Line R-O-W	1	
8Ho57	Pine Knoll	Expansion of Trans-mission Line R-O-W	2	
8Ho58	Bay Hill	Construction of Trans-mission Line R-O-W	1	
8Ho59	Martins Bay	Construction of Trans-mission Line R-O-W	1	
8Ho60	Maize Corridor	Expansion of Trans-mission Line R-O-W	2	
8Ho61	Central Ridge	Det. Pond "A" Coal Run-off	1	
8Ho62	Feeder	NONE	1	
8Ws24	Evans Road II	Clg. Twr. Unit 1-2 (?)	1	
8Ws25	Evans Road I	Clg. Twr. Unit 1-2 (?)	1	
8Ws26	Evans Ridge	Ash Disposal Area "A" Embankments	2	3
8Ws27	Pine Tent	NONE	1	
8Ws28	Horse Marsh	NONE	1	
8Ws29	Holmes Creek South	Construction of Trans-mission Line R-O-W	3	
8Ws30	Chapel Branch	Construction of Trans-mission Line R-O-W	3	
8Ws31	Brink Hill	Construction of Trans-mission Line R-O-W	1	
8Ws32	Holmes Bluff	Construction of Trans-mission Line R-O-W	1	
8Ws33	Mill Lake	Expansion of Trans-mission Line R-O-W	1	
8Ws34	Mill Branch	Expansion of Trans-mission Line R-O-W	3	
8Ws35	Pine Chair	Ash Disposal Area "A"	1	
8By72	Pine Log Forest	Expansion of Trans-mission Line R-O-W	2	

Regional Prehistory and History

The Gulf Power Company Caryville Plant Site and related transmission line corridors lie in the Northwest Gulf Coast culture area (Goggin 1947:83-84), in which several archaeological traditions and periods have been identified. From earliest to latest, with their approximate dates, the traditions and periods are: the Big Game Hunting Tradition (Paleo-Indian period, pre-8000 B.C.); the Archaic Tradition (Early, 8000-5000 B.C., Middle 5000-2000 B.C., and Late Archaic, 2000-1000 B.C. periods); the Woodland Tradition (Deptford, 1000-500 B.C., Santa Rosa-Swift Creek, 500 B.C. to A.D. 500, and Weeden Island A.D. 500-1200 A.D., periods); the Mississippian Tradition (Fort Walton period, A.D. 1200-1650), and the Historic Leon-Jefferson period, A.D. 1650- 3
1725.

The earliest period, the Paleo-Indian, was defined by the appearance of characteristic lanceolate projectile points and other associated stone objects. The migratory groups of Indians of the period roamed the Pleistocene grasslands hunting large game animals. Even though the Big-Game hunters depended primarily on many now extinct species of megafauna, smaller animals and other wild foodstuffs were also eaten (Willey 1966:37-38).

Following the termination of the Pleistocene and the disappearance of its megafauna, the Early Archaic stage of cultural development appeared in Eastern North America. It was a period of transition between the earlier Big-Game Hunting and Archaic Traditions, and was marked by the appearance of broad-bladed,

stone projectile points which were often barbed, notched, or stemmed. The Indians who fashioned those characteristic points were migratory hunters and gatherers who depended on small game, fish, shellfish, and wild foodstuffs for subsistence (1966: 60, 249).

Around 5000 B.C., ground and polished, utilitarian and non-utilitarian, stone objects appeared, which marked the beginning of the Middle Archaic period. Many of the stone objects related to woodworking because the Indians of the period were heavily dependent on the forest environment (1966:60).

There was an apparent increase in the sedentism of the Indian groups throughout the Archaic Tradition culture periods. Each succeeding Archaic period reflected less seasonal migration from one type of food resource station to another and an increasing 3
trend toward semi-permanent or permanent residence (1966:60).

The Late Archaic period, 2000-1000 B.C., was marked by the appearance of fiber-tempered ceramics, the first pottery to appear anywhere in the Americas. The ware, which was called Norwood in the Northwest Gulf Coast culture area (Phelps 1965:65-69), was tempered with rootlet fibers or grass to strengthen it. Its most common vessel form, medium-deep, round bowls with slightly flaring sides, was similar to the stone vessels of the preceding Middle Archaic period (1966:256-257).

Deptford, the first Woodland Tradition culture period, followed the termination of the Late Archaic period in Northwest Florida. The Woodland Tradition and the Deptford period were marked by the appearance of sand or grit tempered ceramics and the construction of such earthworks as burial mounds. Agriculture, also, had at least begun during the period (1966:267).

The small, autonomous groups of Deptford Indians lived in sedentary communities near permanent water sources. They depended for subsistence on agriculture, hunting, fishing, and collecting. As the large quantities of shell refuse in their middens indicated, shellfish played an important part in their diet (Willey 1949:353).

Following the Deptford period, the second Woodland Tradition culture period, Santa Rosa-Swift Creek, (500 B.C. - A.D. 500), appeared. The period was marked by the introduction of such ceramic types as Swift Creek Complicated Stamped (Early Variety), Franklin Plain, types of the Crystal River Series, and the Santa Rosa Series incised and rocker stamped types (Willey 1949:366). East of the Apalachicola River, only the Swift Creek Series types were found, and west of the river both Swift Creek Series and 3
Santa Rosa Series types were found (Phelps 1969b:14-24).

Hopewell ceramics, resembling those from the lower Mississippi Valley, were also present at many Santa Rosa-Swift Creek sites, and may have diffused to Northwest Florida from that area. Other Hopewell influences evident during the period may have travelled a more direct route from the Ohio Valley, the developmental center of Hopewell culture (Willey 1966:286-287).

The Indians of the Santa Rosa-Swift Creek period lived in communities, located near water sources, which were politically and religiously autonomous. There was generally a burial mound associated with each community, although in some instances a single mound may have been used by two or more communities, which combined to form a small political nucleus (Willey 1949:368-9).

The subsistence economy was based on the same resources as

that of the preceding Deptford period. Agricultural products, however, probably became more important while the products of hunting, fishing, and gathering declined in importance.

The last Woodland Tradition culture period, Weeden Island, appeared at the close of the Santa Rosa-Swift Creek period, ca. A.D. 500. Until recently, Weeden Island was divided into two periods; the first period, A.D. 500-800, was marked by the appearance of certain Weeden Island ceramic types and the continuation of Swift Creek Complicated Stamped (Late Variety), and the second period, A.D. 800-1200, was marked by the appearance of the type Wakulla Check Stamped and the disappearance of the Swift Creek Complicated stamped potteries (Willey 1949:396-397).
More recently, efforts were made toward chronologically redefining 3
the Weeden Island sequence because the original definition was insufficient to explain recent observations (Percy and Brose 1974).

There was an apparent increase in the size of the Indian population from the beginning to the end of the Weeden Island periods, as well as a tendency for individual sites to cluster into increasingly larger communities. As agriculture became more and more important as a food source, groups of Weeden Island peoples became more and more sedentary within restricted areas (Brose and Percy 1974:7-18).

The Fort Walton period, a Mississippian Tradition culture period, followed the termination of the Weeden Island periods, ca. A.D. 1200, in the Northwest Gulf Coast culture area. The period was partially defined by the appearance of ceramic types belonging to the Fort Walton Series and Pensacola Series. The

latter was a shell-tempered regional variant which occurred more frequently toward the west end of the culture area. With the exception of the type Wakulla Check Stamped, Weeden Island Series potteries disappeared at the beginning of the Fort Walton period (Willey 1949:452).

The majority of Fort Walton period Indians apparently shifted from the coast to the more fertile inland regions and constructed communities with large, flat-topped mounds, which served as elevated foundations for important buildings, arranged around central plazas. Burial mounds became relatively minor features at the larger sites (Willey 1966:292), which might have indicated a decline in the importance of religious leaders and an increase in the importance of political, or secular, leaders (Willey 1949:455). 3

A reduction in the ratio of ceremonial sites to occupational sites from Weeden Island to Fort Walton times, as well as the ethnohistorical accounts of the sixteenth century, suggested that there was a greater degree of politico-religious cohesion during the Fort Walton period than earlier. The combination of a large area, several communities, and a capital town may have formed a political assemblage, such as a federation (Willey 1949:455).

The first fully historic period, the Leon-Jefferson, emerged at the close of the Fort Walton period in the Northwest Archaeological Gulf Coast culture area around A.D. 1650. The Leon-Jefferson period was marked by the introduction of several new ceramic types, including Mission Red Filmed, Aucilla Incised, and Jefferson ware, which was a series of complicated stamped types. There were also minor occurrences of Ocmulgee Fields Incised, Alachua Cob-marked, and Lamar Complicated Stamped, which

indicated contact with other late culture elsewhere in the Southeast. Some Fort Walton period ceramics, such as Fort Walton Incised and Leon Check Stamped, continued into the historic period. European trade goods, such as Spanish olive-jar fragments, glass, and metal objects, were present in Leon-Jefferson period sites (Willey 1949:488).

The subsistence economy of the Leon-Jefferson period was based primarily on maize agriculture, which was practiced on fertile, inland hilltops. The agricultural settlements were located around Spanish missions, forts, and/or trading posts, which were the centers of Leon-Jefferson society, until it was destroyed by English-Creek raids at the beginning of the eighteenth century (Willey 1949:488).

Environment 3

The Gulf Power Company Carville Plant Site is located in Holmes and Washington Counties, Florida. The physiography of the counties is divided into two units, the River Valley and Coastal Plains Provinces; however, the plant site is located in the first province only. The River Valley Province includes the Choctawhatchee River, its alluvial terraces and tributaries, and certain Tertiary Sediments (Vernon 1942:5).

The plant site proper is described in the applicant's terrestrial ecological studies as covered with depressions which may or may not retain water at varying times of the year. Many sandhills (maximum elevation 130') also occur on the property Law 1974:9). The soils in the Holmes County half of the plant site are of the Dothan-Ardilla, Fuquay-Dothan, and Bibb Associations,

ranging from nearly level to steep, moderately well to excessively drained soils that are sandy throughout or sandy with loamy subsoils (General Soils Atlas 1974:35). Areas which are relatively high and well drained, such as the sandhills, as well as xerophytic (xeric) scrub and pine communities. The more depressed areas support cypress and other types of bayhead communities, and mesic mixed hardwood and pine communities (Law 1974:13-77).

Present vegetative communities are mostly subseres, or secondary succession stages from previously disturbed or removed climax communities. While the existing vegetation may or may not reproduce that on the site during the time of prehistoric occupation, it is still useful in showing natural drainage patterns and can usually indicate what kind of climax will occur in particular areas if the succession is not arrested. 3

From this kind of information it is possible to categorize sites, and habitation, in terms of microenvironments, and discover patterning of settlements. On the plant site, four types of communities are recorded. Xerophytic vegetative communities occur in well drained areas where the soil has little ability to retain moisture. Hydrophytic (hydric) communities occur in and around standing water, and mesophytic vegetative communities occur in areas which are in the center of the moisture continuum. A fourth type of community, the ecotone, occurs at the boundary between two other types of vegetative communities.

In order to determine the environmental settlement patterning, percentages of the total plant site area, which was approximately 1500 acres, were obtained for each type of vegetative community. The percentages of the xeric, mesic, and hydric communities were

obtained by measuring the perimeter of each vegetative community and allowing an average width of 50' for their respective ecotones. Ecotone percentages were obtained by subtracting each ecotone subtotal from the adjacent vegetative communities, in relation to their total occurrence. Percentage figures for the three types of communities and two types of ecotones, xeric/mesic and mesic/hydric, were then determined.

Archaeological sites were plotted on the vegetation map included in the terrestrial ecological studies, and the number of sites in each community computed. The percentage of the total site population in each community was then determined and compared to the percentages of each type of vegetative community (see Figure 2).

The index of environmental settlement patterning was obtained by dividing the area percent of each vegetative community into the site percent of each community. An index figure of 1 indicated that settlement patterning was random with respect to vegetation. A figure of less than 1 indicated that a community was avoided, and a figure of more than 1 indicated that a community was favored for settlement. 3

The index figures indicated that both types of ecotones, as well as the mesic communities, were favored by the Indians. The ecotones allowed for the exploitation of two environmental niches with less expenditure of energy than settlement in any other type of vegetative community would have allowed. Mesophytic communities, which also had a high index figure, were climatically more stable than xeric or hydric communities and had a greater diversity of plant and animal life. Obviously, Indians were not living in swamps and/or ponds, as reflected by the low index figure for

hydrophytic communities, or in extremely arid areas, as reflected in the low index figure for xerophytic communities.

Vegetation Community	Area in Acres	% of Total Area	Number of Sites	% of Total Sites	Index % Sites / % Area	
Hydrophytic	423	28.2	1	3.1	0.11	3
Mesophytic	402	26.9	15	46.9	1.80	
Xerophytic	417	27.9	2	6.3	0.23	
Hydric/Mesic Ecotone	164	11.0	10	31.2	2.84	
Xeric/Mesic Ecotone	104	7.0	4	12.5	1.78	
Totals	1500	100.0	32	100.0		

Figure 2 Site Distribution According to Vegetation

8Ho27 Southwest Plant Site
SW¼ of SW¼ of SW¼ of Section 36, T5N, R16W

The Southwest Plant site, elevated 90 feet above mean sea level, occupies the lower east slope of a ridge. The area of the surface scatter is covered in all directions by a mixed growth of scrub bushes and grass, except to the north where there is a planted pine community. A seasonal, unnamed creek or slough flows approximately 50 meters away, to the southwest.

The small, lithic sample of surface materials came from a part of the ridge slope measuring roughly 50 meters square. Ample sections of the ground surface were visible because of the sparse, secondary flora; the terrain had been extensively altered in the past and the previous vegetation removed. No vertical
dimensions were obtained for the site. Soils exposed over the 3
entire area, as well as in the profiles of several stump holes, were coarse, grainy sands, ranging from white to yellowish tan in color.

No definite statements can be made about the typology or cultural placement of the site because of the non-recovery of culturally diagnostic artifacts. All of the collected material is non-utilized chipping waste.

The Southwest Plant site is not recommended for extensive excavation or preservation. The numerous disturbances in the area, such as roads, fire lanes, and stump holes, indicate that the cultural stratigraphy has been extensively damaged. However, the site should be tested with one or two excavated squares before it is disturbed further.

Artifact Assemblage:

lithics: 8 non-utilized waste flakes.

8Ho28, Evans Road III Site
SW¼ of SE¼ of SE¼ of Section 36, T5N, R16W

This small site is situated in a "valley" or wet bottomlands, at an elevation of 80 feet, between two parallel ridges. It originally occupied the crest of a small knoll, which recently was graded flat, destroying the cultural stratigraphy and scattering the artifactual material. Assorted scrub bushes now cover the area. An unnamed, seasonal stream flows west of the site at an approximate distance of 250-300 meters.

Materials were recovered from the top of the flattened knoll
and along its edges, where soil had been redeposited during the 3
grading of the crest. The surface scatter was limited to a roughly circular area 25 meters in diameter. Exposed soils consisted of white to yellowish tan, coarse, angular sands.

All of the recovered material is flint debitage, which is culturally undiagnostic. No definite statements, therefore, concerning the site's typology or cultural placement can be made.

Neither preservation nor detailed excavation is recommended for the Evans Road III site. The indications are that most of its cultural stratigraphy is destroyed; additional testing should be limited to one or two excavated squares before the site is destroyed.

Artifact Assemblage:

lithics: 40 non-utilized waste flakes

8Ho29 West Plant Site
NE¼ of NE¼ of SE¼ of Section 35, T5N, R16W

The West Plant site occupies the lower north slope of a ridge, at an approximate elevation of 80 feet. The entire ridge slope was stripped of its larger flora in the past and mixed scrub and grasses now cover the area; hydric hardwoods lie west and north of the surface scatter, along the peripheries of two permanent, unnamed ponds. Both water sources are roughly 15 meters distant.

The surface material was recovered at the base of the sparsely covered ridge, along a dirt road and an existing power line corridor (both oriented east-west). The scatter of artifacts was limited to an area measuring 25 meters (north-south) by 50 meters (east-west). No vertical dimensions were obtained for the site, 3 although exposed soils ranged from white to yellowish tan, grainy sands.

No positive statements can be made regarding the typology or cultural placement of the site, because of the small size of the recovered surface sample. All of the lithic material is non-diagnostic chipping refuse and the ceramics are only indicative of a post-1000 B.C. date.

The West Plant site is recommended for preservation or excavation, whichever is more practical for the Gulf Power Company. Based on the condition of the area's stratigraphy, it is likely that significant archaeological data remain at the site. This information would be lost if the site were to suffer additional disturbance.

Artifact Assemblage:

ceramic: 3 check stamped, sand and grit tempered potsherds
1 plain, sand and grit tempered potsherd

lithics: 7 non-utilized waste flakes

8Ho30 Cypress Ridge East Site
NW¼ of NW¼ of SW¼ of Section 36, T5N, R16W

This site, with an approximate elevation of 100 feet, occupies the crest, and to a lesser degree the west slope, or a ridge line which is intersected by an existing powerline corridor. Most of the larger surface vegetation has been removed south of the corridor, while north of it mixed hardwoods and pines predominate. A dirt road (north-south) passes along the crest of the ridge. A permanent pond lies to the east, about 100 meters from the site.

The thin surface scatter of material was contained in an area measuring 150 meters (north-south) by 100 meters (east-west). No absolute vertical dimensions were obtained for the site, although several tests with a manual soil auger indicated a possible cul- 3
tural stratigraphy similar to that of the "Cypress Knoll Site Complex" components, which lie only short distances to the north and east. Soils exposed along the powerline corridor, the road, and with the auger were coarse sands, ranging in color from white to yellowish tan.

None of the recovered lithic material is culturally diagnostic. No statements, therfore regarding the site's typology or cultural affiliation can be made at the present time.

The Cypress Ridge East site is not recommended for either extensive excavation or preservation. Before the site is damaged further a test square or two should be excavated to better understand its significance.

Artifact Assemblage:

lithics: 28 non-utilized waste flakes

8Ho31 Cypress Knoll C-3 Site (or "Activity area")
SE¼ of SW¼ of NW¼ of Section 36, T5N, R16W

The Cypress Knoll C-3 site, or activity area, is situated on a small knoll, which is elevated 80 feet above the mean sea level, at the base of a ridge. Hardwoods are found in all directions and a permanent pond lies to the southeast, 150 meters from the site. Two perpendicular dirt roads (north-south and east-west) cross at the crest of the rise. Vegetation has been cleared from the northwest quadrant of the knoll.

The surface scatter is distributed over an area measuring approximately 75 meters (east-west) by 100 meters (north-south). The one test pit placed in the area demonstrates at least 35 cm. of possible cultural stratigraphy. Soils exposed in the test
hole and on the surface of the cleared quadrant range from white 3
to yellowish tan, coarse, granular sands.

Although no decorated potsherds were found on the surface, the sand tempering of the recovered plain sherds suggest a Weeden Island occupation, circa A.D. 500 to 1200, for the area. None of the recovered lithics are culturally diagnostic.

The Cypress Knoll C-3 site, or activity area, is in the path of the proposed rerouted transmission lines. In that some disturbance of the area's stratigraphy is to be expected in the process of constructing new powerline corridors the C-3 site should be preserved or tested archaeologically before its cultural significant data is lost.

Artifact Assemblage:

ceramic: 10 plain, sand tempered potsherds

lithics: 114 non-utilized waste flakes (1 from test hole #1)
1 utilized flake

8Ho32, Cypress Knoll C-1 Site (or "Activity Area")
NW¼ of NE¼ of SW¼ of Section 36, T5N, R16W

The Cypress Knoll C-1 site, or activity area, occupies two small knolls, the higher (western) being elevated 80 feet and the lower (eastern) five feet less, along an existing powerline corridor. A slash pine community partially covers the northern portion of the area; mixed hardwoods partially cover the southern portion. Permanent ponds lie to the west and south, each at an approximate distance of ten meters from the western rise. A seasonal slough lies 25 meters east of the eastern rise. A dirt road (north-south) crosses the crest of the higher knoll.

The surface scatter of artifacts along the powerline corridor and dirt road is limited to an area roughly 100 meters square. 3
Five test holes placed along the knolls indicate a possible cultural stratigraphy varying from 45 to 85 cm. in depth. Soils exposed during test holing operations range from white to yellowish tan, coarse, angular sands.

The ceramic artifacts recovered from the surface and test hole #2 do not exhibit enough variability in either design motif or tempering to place the site more specifically than in the general Woodlands horizon. The potsherds could be indicative of cultural periods ranging from late Deptford (ca. 600 B.C.), through Swift Creek (500 B.C. to A.D. 500), to the close of Weeden Island (A.D. 1200). None of the lithic material is culturally diagnostic.

As depicted on the Gulf Power Company development map for the plant site proper, the Cypress Knoll C-1 site, or activity area, is threatened both by a segment of the construction railroad and

the embankments around the construction laydown area. As the visibily richest and deepest component of the site complex, this site should be preserved or extensively excavated before either type of construction activity is allowed to further damage the area's cultural stratigraphy.

Artifact Assemblage:

ceramic: 17 plain, sand and grit tempered potsherds (5 from test hole #2) 3

16 plain, sand tempered potsherds

4 complicated stamp, sand tempered potsherds

3 check stamped, sand tempered potsherds

1 check stamped, sand and grit tempered potsherd

2 unidentified stamped, sand tempered potsherds

lithics: 60 non-utilized waste flakes (1 from test hole #1)

8Ho33 & 34 Cypress Knoll C-2/L-1 Sites (or "Activity Areas")
SW¼ of SW¼ of NE¼ of Section 36, T5N, R16W

The Cypress Knoll C-2 and L-1 sites, or activity area, occupy the crest and west slope of a ridge, elevated approximately 100 feet above mean sea level, which is oriented north-south. The ceramic site, C-2, is bounded by hardwoods to the east and slash pine communities to the west and north; the lithic site, L-1, is bounded by slash pines to the south and hardwoods to the north. Seasonal ponds are located to the south and west of the C-2 site and east and west of the L-1. A dirt road (north-south) intersects both areas. The stratigraphy of the ceramic area has been disturbed by clearing activities and that of the lithic area by the construction and maintainance of a powerline corridor 3
(east-west).

There is no natural topographic break between the two sites, or activity areas. A stand of planted pines, bordering C-2 on the north and L-1 on the south, artificially separates the two areas, however, ceramics are found only on the southern, or C-2, site. Recovered surface materials are confined to areas measuring 100 meters (east-west) by 75 meters (north-south) and 300 meters (east-west) by 150 meters (north-south), on the C-2 and L-1 areas respectively. Two test holes placed in the limits of the ceramic surface scatter indicate at least 30 cm. of possible cultural stratigraphy; extensive testing with a manual soil auger shows a similar stratigraphy at the lithic area.

One of the potsherds from the surface of the C-2 site appears to have been stamped, but, the design motif is too weathered to make a positive identification. The probable stamping of this

sand and grit tempered sherd, and the sand and/or sand and grit tempering of the remaining sherds, indicate either a Deptford, (circa 1000 B.C. to 500 B.C.), or late Weeden Island, (ca. A.D. 1000 to 1200), placement for the ceramic area.

Most of the material from the L-1 site is non-diagnostic flint or chert debris. The one projectile point fragment recovered is not a readily identifiable type, although its general size and shape suggest an Archaic date. The combined C-2/L-1 sites, or activity areas, may represent the partial overlapping of an earlier Archaic occupation (L-1) by a later Deptford or late Weeden Island occupation (C-2).

Both the Cypress Knoll C-2 and L-1 sites are situated in the proposed construction laydown area for the Caryville steam generating plant. Presumably, construction activities would destroy all 3
of the shallow cultural stratigraphy in the immediate area, and some attempt at a more thorough archaeological testing should be made before the placement of the laydown area.

Artifact Assemblage:

ceramic: 9 plain, sand tempered potsherds
3 plain, grit and sand tempered potsherds
1 unidentified, grit and sand tempered, stamped potsherd
13 ironstone ware potsherds (modern)

lithics: 58 non-utilized waste flakes
2 utilized flakes
1 unidentified unifacial tool
1 basal half of a medium size, stemmed projectile point

8Ho35, Cypress Knoll L-2 Site (or "Activity Area")
NE¼ of SW¼ of NW¼ of Section 36, T5N, R16W

The small Cypress Knoll L-2 site, or activity area, is located on the top of a low knoll with an elevation of 90 feet. Planted pines cover the eastern half of the rise and assorted hardwoods cover the western half. A dirt road, oriented north-south, passes between the two floral communities and ends at the northern edge of the knoll. Permanent ponds lie to the north and south, both at an approximate distance of 200 meters.

The visible surface scatter is confined to an area 30 meters square. Two test pits placed in the surface distribution of material demonstrate a depth of 40 cm. for the possible cultural stratigraphy. Soils exposed during test holing range from white to yellowish tan, coarse sands. 3

No diagnostic artifacts were found on the surface of the area or in the test holes. Therefore, cultural placement of the L-2 site is presently impossible.

As plotted on the Gulf Power Company map for the proposed development of the plant site proper, the Cypress Knoll L-2 site lies along a planned transmission line rerouted to clear a future ash pit. Additional archaeological testing should be undertaken since the site is defined as a component of the larger "Cypress Knoll Site Complex," before the rerouting of the lines damages any remaining cultural stratigraphy.

Artifact Assemblage:

lithics: 27 non-utilized waste flakes (1 from test hole #2)

8Ho36 Cypress Knoll L-3 (or "Activity Area")
NW¼ of SW¼ of NW¼ of Section 36, T5N, R16W

The Cypress Knoll L-3 site, or activity area, occupies the upper slope of a ridge, at an elevation of 80 feet. Mixed hardwoods and pines cover the area, although limited clearing of the larger trees occurred at some point in the recent past. A dirt road (east-west) bisects the partial clearing which contains the surface scatter of artifacts. Permanent ponds lie to the northeast and southwest, both approximately 250 meters from the site.

The thin scatter of surface material was limited to a small area 50 meters square. No test holes were dug in the area, but numerous tests with a manual soil auger demonstrated a stratigraphy 3
similar to that of the other Cypress Knoll sites.

All of the recovered artifacts are flint debitage, and are not diagnostic. Therefore, no statements about the L-3 site's cultural placement or typology can be made.

According to the developmental map for the plant site environs, the Cypress Knoll L-3 site, or activity area, lies in the projected (future) ash disposal area "B." Efforts should be made to preserve and/or excavate the site, which is by definition a component of the larger "Cypress Knoll Site Complex", because some damage to the area's remaining cultural stratigraphy is anticipated in the future.

Artifact Assemblage:

lithics: 12 non-utilized waste flakes

8Ho37 Cypress Knoll C-4 Site (or "Activity Area")
NW¼ of SW¼ of NW¼ of Section 36, T5N, R16W

The Cypress Knoll C-4 site, or activity area, lies on a small knoll elevated 70 feet above the mean sea level. The western half of the rise, cleared of vegetation in the past, is covered with grasses and scattered scrub; the eastern half, cleared in the more recent past, lacks vegetation. Mixed hardwoods lie at the eastern edge of the knoll, between it and a permanent pond, approximately 75 meters away. A dirt road (north-south) crosses the crest of the elevation.

The surface scatter of artifacts is confined to a roughly circular area, with an approximate diameter of 60 meters. Cultural stratigraphy, as demonstrated by the placement of two test 3
holes in the knoll, extends to a minimum depth of 45 cm.

All of the ceramics recovered from the surface have badly weathered exteriors, and their design motifs are difficult to determine. Several of the potsherds appear to be check stamped and may be indicative of either the Deptford, 1000 B.C. to 500 B.C., or the late Weeden Island, ca. A.D. 1000 to 1200, periods. With one sand tempered exception, all of the sherds are sand and grit tempered.

Most of the recovered lithic material is undiagnostic flint debitage. The one significant stone artifact recovered is an intact, Pinellas type projectile point (Bullen 1968:12). Pinellas points are described by Bullen as late prehistoric chronological markers, circa A.D. 1300 (Bullen 1968:12). Such a date is within the probable range of the late Weeden Island period; however, there

is some question as to the correct temporal span of Pinellas points in inland, northwest Florida

The Cypress C-4 site, or activity area, is situated in the (future) ash disposal area "B". The site should be preserved or excavated thoroughly because it is one of the more artifactually dense components of the Cypress Knoll Site Complex. 3

Artifact Assemblage:

ceramic: 35 unidentified, sand and grit tempered potsherds
6 check stamped, sand and grit tempered potsherds
1 plain, sand tempered potsherd

lithics: 82 non-utilized waste flakes (1 from test hole #1 and 1 from test hole #2)
1 projectile point, type: Pinellas

8Ho38 Cypress Knoll C-5 Site (or "Activity Area")
SW¼ of NW¼ of NW¼ of Section 36, T5N, R16W

The Cypress Knoll C-5 site, or activity area, at an approximate elevation of 80 feet, is located on a ridge crest which has been extensively altered by clearing activities. Mixed hardwoods border the area on all sides, except to the south. A permanent pond lies to the southeast, at a distance of 250 meters, and a small creek flows to the north, 75 meters distant. A dirt road approaches from the south and bisects the surface scatter.

The distribution of surface material was limited to an area measuring 80 meters (north-south) by 20 meters (east-west). There were no test holes placed in the activity area, however, extensive testing with the manual soil auger revealed a cultural stratigraphy
similar to that of the other Cypress Knoll areas. 3

The only culturally diagnostic artifact recovered at the C-5 site was a check stamped, sand tempered potsherd, which may be from either the Deptford or late Weeden Island culture periods. This was the only potsherd found on the surface. The non-diagnostic nature of the lithic material did not allow a more definite statement about the area's cultural placement to be made.

The Cypress Knoll C-5 site, or activity area, is located in the proposed (future) ash disposal area "B". Even though this is one of the more disturbed of the Cypress Knoll components it should be tested further to determine its relationship to the larger site complex. Additional damage to the remaining cultural stratigraphy is to be expected in the future.

Artifact Assemblage:

ceramic: 1 check stamped, sand tempered potsherd

lithic: 9 non-utilized waste flakes
1 distal (blade) end of a projectile point

8Ho39 Pine Lane Site
NE¼ of NW¼ of NW¼ of Section 36, T5N, R16W

The Pine Lane site, elevated approximately 80 feet above the mean sea level, lies along the north slope of a short ridge line, at the northern edge of a planted slash pine community. A permanent, unnamed pond lies south of the area at a distance of roughly 300 meters.

All of the material came from the vicinity of several fire lanes which had been dug around the northern periphery of the pine stand. No vertical or horizontal dimensions were obtained for the site because of the very widely scattered condition of the surface sample. The soils exposed in the profiles of the fire 3
lanes were coarse, angular sands, ranging from white to yellowish tan in color.

There were no culturally diagnostic artifacts recovered from the surface; all of the material was flint chipping debris. Therefore, no positive statements about the site's size, cultural placement, or typology can be made at the present.

No recommendations are made for either the preservation or extensive excavation of the Pine Lane site. While it is doubtful that any additional archaeological data would be recovered, limited testing should be undertaken before any remaining cultural stratigraphy at the site is disturbed.

Artifact Assemblage:

lithics: 11 non-utilized waste flakes

8Ho40 West Central Knoll Site
SW¼ of SE¼ of NE¼ of Section 36, T5N, R16W

Elevated approximately 90 feet above the mean sea level, this site occupies the west slope of a low knoll along the bottomlands in the east-central part of the plant site property. A planted pine community, with a dense scrub ground cover, now lies in the immediate area of the site; mixed hydric hardwoods lie north of the site, in the vicinity of an unnamed, seasonal pond or slough. The water is 200 to 250 meters away.

The surface scatter of materials defining this site came from the intersection of two dirt roads (north-south and east-west) and several shallow fire lanes in their vicinity. The distribution of surface materials was confined to an area measuring roughly 25 meters square. 3 On the surface of the roads, as well as in the profiles of the fire lanes, exposed soils ranged from white to yellowish tan, coarse sands. No vertical dimensions were obtained.

No positive statements about the cultural placement or typology of the site can be made at the present because the recovered material is culturally undiagnostic. All of the artifacts collected from the surface are flint refuse, with one example having been retouched along its edge.

The West Central Knoll site is not recommended for preservation or extensive excavation. However, at least two or three pits should be dug in the site before it is totally destroyed. The extremely disturbed condition of the adjacent environs indicate that a thorough testing of the site is not warranted.

Artifact Assemblage:

lithics: 5 non-utilized waste flakes
1 utilized flake, with edge retouch

8Ho41 Dust Hills Site
SE¼ of SE¼ of NE¼ of Section 36, T5N, R16W

The Dust Hills site occupies the crest of a low knoll in the bottomlands along the east-central part of the survey area. It is elevated approximately 90 feet above mean sea level. Several linked unnamed ponds, surrounded by hydric hardwoods, lie northwest of the site, 75 to 100 meters distant. A secondary growth of mixed pine and scrub overlies the site area proper.

The recovered surface material came from the intersection of two dirt roads (north-south and east-west), and the area around them. The horizontal dimensions were roughly 25 meters square. No vertical dimensions were obtained for the site. However, several holes, approximately one meter deep, in the northwest quadrant of the surface scatter indicated that little, if any, cultural stratigraphy remained. The exposed soils ranged from white to yellowish tan, coarse sands. 3

There were no culturally diagnostic artifacts recovered at the site; all of the collected material was flint chipping debris. Thus, no positive statements about the cultural placement or typology of the site can be made at the present time.

Due to the highly disturbed condition of the general environs around the Dust Hills site - there having been a sawmill between the water and the site - the site is not recommended for preservation or extensive testing. However, at least two or three test pits should be dug at the site, in order to positively determine whether or not any significant, intact stratigraphy remains, before it is totally destroyed.

Artifact Assemblage:

lithics: 18 non-utilized waste flakes

8Ho42 East Island Site
NE¼ of SW¼ of NE¼ of Section 36, T5N, R16W

Elevated between 80 and 90 feet above the mean sea level, the East Island site occupies a small knoll in the wet bottomlands at the eastern edge of the Caryville Power Plant property. Unnamed, seasonal ponds or sloughs surround the rise in all directions, except to the south; none of the water sources are more than ten meters away. A community of slash pine to the north is the only large vegetation in proximity to the site; everywhere else the floral cover consists of a scrub and grass association.

The surface scatter of lithic material defining this site came from the crest of the knoll, which lies along the existing power line corridor (east-west) and several fire lanes a short distance south of it. The area measured roughly 50 meters (north-south) by 25 meters (east-west). No vertical dimensions were obtained for the site. Along the rise and in the southern fire lanes the soils were coarse grained sands, varying from white to yellowish tan in color. 3

Due to the non-recovery of any culturally significant artifacts, it is not presently possible to make any statements regarding the typology or cultural placement of the site. All of the materials recovered from the surface are undiagnostic flint chipping refuse.

The high degree of recent disturbance in the vicinity of the East Island site indicates that preservation and/or extensive excavation is not warranted. Nonetheless, several test squares should be excavated at the site, if and before it is damaged further, in order to beter understand its cultural significance. Little

additional data of archaeological importance is expected to remain below the surface. 3

Artifact Assemblage:

lithics: 6 non-utilized waste flakes

8Ho43 South Slough Site
SW¼ of SE¼ of SE¼ of Section 25, T5N, R16W

Elevated approximately 90 feet above the mean sea level, the South Slough site lies along the southern slope of a ridge. The Hathaway Mill, or Little Gum, Creek flows north of the area, at a distance of 200 to 250 meters; an unnamed, seasonal slough lies to the east, 50 meters away. A mixed hardwood-pine floral association, with a sparse, scrub ground cover, predominates in the area. A slash pine community covers the southern most extent of the surface scatter.

All of the materials recovered on the surface of the site came from an area measuring roughly 50 meters (north-south) by 25 meters (east-west). Scrutiny of the ground surface was facilitated by the recent removal of most of the surface cover, and the presence of two shallow, parallel dirt roads (north-south). One test hole placed beyond the western road revealed a possible cultural stratigraphy 30 or more centimeters deep. The soils exposed in the test hole, and on the surface of the area, ranged from white to yellowish tan, coarse sands.

3

It is not possible to date the site except post-1000 B.C., because of the small size of the recovered sample of artifacts. The three incised potsherds are unidentified for the State (Percy and Jones: personal communication), and are presently useless in assigning the site to its proper aboriginal culture. The undecorated potsherds and lithic chipping debris are not diagnostic of the site's cultural placement or typology.

The South Slough site is recommended for preservation and/or excavation. If the tentatively planned ash disposal area "B" is constructed, then the site should be excavated. The test hole suggests that at least 30 cm. of undisturbed, cultural stratigraphy remains, which would be lost by even the most superficial interference. 3

Artifact Assemblage:

ceramic: 3 unidentified, incised, sand and grit tempered potsherds

6 plain, sand and grit tempered pothserds

lithics: 33 non-utilized waste flakes and cores

shell: 1 oyster shell fragment

8Ho44 East Slough Site
SE¼ of SE¼ of SE¼ of Section 25, T5N, R16W

The East Slough site, elevated approximately 80 feet above mean sea level, lies along the north slope of a ridge line. The Hathaway Mill, or Little Gum, Creek flows north of the area, at a distance of 75 to 100 meters; an unnamed, seasonal stream or slough flows west of the site, 25 meters away. Present vegetation is a mixed association of hardwoods and pines, with limited scrub covering the few disturbed areas.

The recovered surface material came from a heavily eroded, dirt road (east-west) and adjacent areas. The size of the surface scatter area was roughly 25 meters square. No vertical dimensions were obtained for the site, although lithic debris was eroding from the profiles of the road cut, at an approximate depth of one meter. White to yellowish tan, coarse, angular sands were exposed over the entire area, and extended at least to the base of the road cut. 3

There were no culturally diagnostic artifacts recovered from the site. All of the recovered material was lithic debitage and did not allow any postive statements to be made about the cultural placement or typology of the site.

The East Slough site is recommended for preservation, or excavation if the tentatively planned ash disposal area "B" is constructed. The limited disturbance in the area, and the apparent depth of material, indicate that some archaeologically significant data remain below the surface. Additional interference in the area would destroy any remaining validity for the information still contained at the site.

Artifact Assemblage:

lithics: 80 non-utilized waste flakes and cores

8Ho45 Hathaway Quarry Site
SE¼ of SE¼ of SE¼ of Section 25, T5N, R16W

At an elevation of 90 feet, this probable prehistoric site lies on the north slope of a ridge line immediately south of the Hathaway Mill Creek. A mixed hardwood and pine association covers the adjacent areas. A heavily eroded, abandoned quarry, a source for limestone or gravel, lies between the densest area of surface scatter, which is corssed by several dirt roads (north-south and east-west), and the water. The stream flows approximately 25 meters north of the site.

All of the recovered surface material came from the dirt roads south of the quarry; no material was collected from the quarry itself, although much lithic debris had eroded into it from the area above and south of it. No vertical or horizontal 3
dimensions were obtained for the site, because of the uncertainty involved as to how much, if any, of the surface scatter was the result of modern quarrying activity. Several areas along the sides of the quarry were trowelled to reveal a possible cultural stratigraphy of white to yellowish tan, coarse sands. Clays were exposed at the base of the disturbance, approximately one to one and a half meters below the surrounding land surface.

No culturally significant artifacts were recovered on the surface of the area. The material was exclusively flint debitage and did not allow definite statements about the cultural placement of the site.

The remaining area of the Hathaway Quarry site is recommended for preservation, or excavation if it is found necessary to further disturb it. The site requires additional testing to determine

whether or not it functioned as a prehistoric, flint quarry, as there is present disagreement as to its validity as a site among Bureau personnel (Miller and Jones: personal communication). 3

Artifact Assemblage:

lithics: 185 non-utilized waste flakes

8Ho46 West Slough Site
SW¼ of SE¼ of SE¼ of Section 25, T5N, R16W

The West Slough site, at an elevation of 90 feet, lies along the upper north slope of a ridge, south of the Hathaway Mill Creek. The creek is approximately 75 to 100 meters distant, and a seasonal, unnamed stream or slough flows east of the site, 25 meters distant. The floral cover consists of a mixed pine-hardwood association, with limited scrub growth along the few recent disturbances.

The surface scatter of artifactual material came from the vicinity of two intersecting dirt roads (north-south and east-west); the area measured roughly 25 meters square. No vertical dimensions were obtained for the site. Along the two road cuts and the terrain around them, the exposed soils were coarse, angular sands, varying 3
in color from white to yellowish tan.

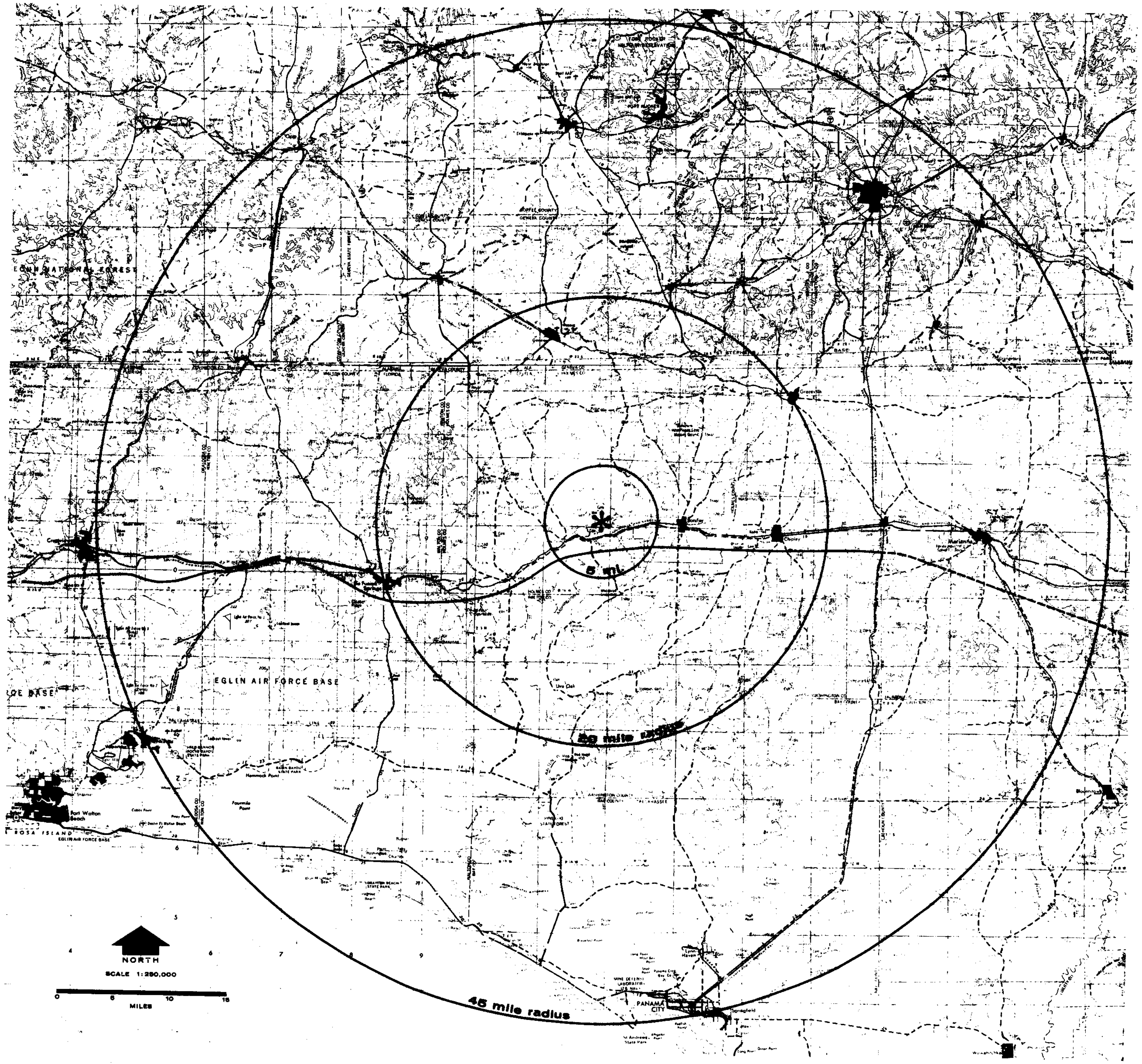
No statements regarding the correct typology or cultural placement can be made at the present time, due to the non-recovery of culturally diagnostic artifacts. All of the material collected from the surface was lithic chipping debris.

The West Slough site is recommended for preservation, or excavation if the proposed ash disposal area "B" becomes a reality. The limited extent of recent disturbance in the area suggests that additional, culturally significant data lie below the surface. The construction of the ash waste area would damage the remaining, intact stratigraphy in the immediate area.

Artifact Assemblage:

lithics: 44 non-utilized waste flakes

Image Quality
As you review the next group of images, Please note that the original documents
were of poor quality.



* PLANT SITE

MAP 6
COMMUTATION RANGES

3

Table 2-3

ESTIMATED 1970 POPULATION RESIDING WITHIN A 45-MILE RADIUS OF PLANT SITE

County	Total Population of County in 1970		Estimated Per Cent of Population Within 45-Mile Radius		Estimated Population Within 45-Mile Radius	
Covington	34,079	x	30%	=	10,224	
Coffee	34,872	x	40	=	13,949	
Dale	52,938	x	40	=	21,175	
Geneva	21,924	x	100	=	21,924	
Houston	56,574	x	80	=	45,259	
Subtotal for Alabama						112,531
Okaloosa	88,187	x	50%	=	44,094	
Walton	16,087	x	100	=	16,087	
Holmes	10,720	x	100	=	10,720	
Washington	11,453	x	100	=	11,453	
Bay	75,283	x	80	=	60,226	
Calhoun	7,624	x	40	=	3,050	
Jackson	34,434	x	70	=	24,104	
Subtotal for Florida						169,734
TOTAL						282,265

Source: U.S. Bureau of Census, Census of Population: 1970, General Population Characteristics, Final Report PC (1)-B2 Alabama, Table 16, pp. 44 and 45.

U.S. Bureau of Census, Census of Population, 1970, Number of Inhabitants, Final Report PC (1)-A11 Florida, Table 9, p. 19.

Estimates by Eric Hill Associates.

A second source of data supporting the above conclusions is state employment security information. Interviews with state employment security offices in the Florida panhandle and Tallahassee [reference (3)] provided information on the labor force, unemployment, and total employment by county. Unfortunately, all of the data available for years prior to 1974, and most of the detailed data at the county level for 1974 (the latest available year), are on a work force basis 3

(place of work) rather than a labor force concept (place of residence). The work force figures represent an estimate of jobs in the county. Jobs to which persons commute into the county are included. Also, jobholders of more than one job are counted at each place of work. Labor force statistics, on the other hand, are estimated only for those persons who live in the county. Therefore, labor force data would be more useful for supporting the contention that a reservoir of available construction skills is present within a reasonable commuting range of the plant site.

Since the only available labor force data provides the total number of persons in the civilian labor force by county for 1974, Table 2-4 was developed to provide estimates that show that the construction labor force residing in Florida within 45 miles of the site includes about 4,630 workers. If the ratio of construction workers to total population found in the seven Florida counties holds for the five Alabama counties within the 45-mile radius, the resident Alabama construction labor force would include another 1,830 workers. Therefore, within a normal commuting distance of 45 miles, the resident labor force with construction skills would include about 6,460 persons. Assuming a current unemployment 3
rate for construction workers of ten per cent,* there could be about 650 construction workers without jobs. Based on present economic conditions, it does not seem unreasonable to assume that a like number of local construction workers are presently underemployed or employed at some more distant construction job. Thus, two times 650, or about 1,300, workers would form the available reservoir of construction skills located within normal commuting range of the plant. This is greater than the 1,156 workers estimated in Table 4.1-2. Thus, employment security statistics tend to support results obtained by the interview process explained earlier.

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*According to latest Florida Employment Security statistics on unemployment rates by county (data month June, 1975), total unemployment rates for every one of the seven counties in Table 2-4 is currently greater than ten per cent, with the rates for individual counties going as high as 14.6 in Washington County. The current high figures are due partially to seasonal fluctuations, so that a more conservative ten per cent is assumed here for construction workers.

Table 2-4

ESTIMATED CIVILIAN CONSTRUCTION LABOR FORCE RESIDING IN FLORIDA COUNTIES WITHIN 45-MILE RADIUS OF PLANT SITE, 1974

County	1974 Civilian Labor Force*		Estimated Per Cent of Population Within 45-Mile Radius		Estimated Civilian Labor Force Within 45-Mile Radius		Construction Workers as a Per Cent of Civilian Labor Force**		Estimated Civilian Construction Labor Force Within 45-Mile Radius	
Okaloosa	28,120	x	50%	=	14,060	x	6.5%	=	914	
Walton	5,600	x	100	=	5,600	x	10.0	=	560	
Holmes	4,640	x	100	=	4,640	x	8.7	=	404	
Washington	4,400	x	100	=	4,400	x	7.5	=	330	
Bay	27,360	x	80	=	21,880	x	8.1	=	1,772	
Calhoun	2,840	x	40	=	1,140	x	10.0	=	114	3
Jackson	11,780	x	70	=	8,240	x	6.5	=	536	
	84,740				59,960				4,630	

Source: Eric Hill Associates calculations, based on:

*State of Florida, Department of Commerce, Division of Employment Security, Bureau of Research and Statistics, Basic Labor Market Information, March, 1974 (FDC Form RAS-33A-Revised 5/75), civilian labor force figures by county of residence.

**U.S. Bureau of Census, Census of Population: 1970 General Social and Economic Characteristics, Final Report PC(1)-C11, Florida, Table 122, pp. 493-498; figures by county for the sum of construction craftsmen, metal craftsmen (excluding mechanics), and construction laborers, as a percentage of total employed, 16 years old and over.

2.1.3 Estimates of Geographic Dispersion of In-migrating Construction Workers and Families

Of the total 1,800 peak construction labor force, it is estimated that 412 workers, or 22 per cent of the total, will relocate from areas outside the 45-mile radius. These workers will impact and be impacted by conditions within the two-county area. These workers and their families will require housing, and community facilities and services; however, they will add to the local economy.

The anticipated distribution of the in-migrating construction workers and their dependents within the 45-mile radius is given in Table 2-5. This distribution is based on analysis of the interviews and impact studies previously mentioned [references (1) and (2)], together with judgments on the degree of attraction each type of location will offer. Knowledge of various communities is based on 3
field trips to the localities as mentioned. It is assumed that of the 412 in-migrating workers, slightly less than half (45 per cent) will bring families with them.

As shown in Table 2-5, of the 845 workers and dependents who relocate to within 45 miles of the site, 65 per cent, or 550 people, are expected to settle within 20 miles of the site (see Map 6 for delineation of geographical areas within 20 and 45 miles of the site). Of these, about half (255 people) will live in four medium-size communities (Bonifay, Chipley, and DeFuniak Springs, Florida and Geneva, Alabama). None of these communities should expect more than a two to four per cent increase in their total population due to peak construction work force (see Table 2-6).

Another 295 persons who will in-migrate to within a 20-mile radius are expected to distribute widely into the rural area and 21 small communities.

Table 2-5

ESTIMATED DISTRIBUTION OF IN-MIGRATING CONSTRUCTION WORKERS, FOR PEAK CONSTRUCTION PERIOD, BY GEOGRAPHICAL AREA

Location and % of Breakdown	Total In-migrating Workers	Workers Without Families	Workers With Families	Total population at 3.25 persons per family*	
30% to medium-size communities within 20 miles of plant site:					
Bonifay, Fla.	37	20	17	75	
Chipley, Fla.	30	16	14	62	
DeFuniak Spgs., Fla.	42	22	20	87	
Geneva, Alabama	15	8	7	31	
Subtotal	124	66	58	255	3
15% to 21 small communities within 20 miles of plant site	62	33	29	127	
20% to rural areas within 20 miles of plant site (314 sq.miles)	82	44	38	168	
35% to all areas outside of 20 miles, but within 45 miles of plant site (1,254 sq. miles)	144	77	67	295	
100% TOTAL	412	220	192	845	

*Average family size factor used in similar studies for Georgia Power Company [See reference (2)].

Source: Eric Hill Associates, Inc.

Table 2-6

ESTIMATED EFFECT OF TEMPORARILY RELOCATED CONSTRUCTION WORKERS ON POPULATION OF COMMUNITIES AND AREAS WITHIN 20 MILES OF PLANT SITE

Community	1970 Population	Estimated Population Increase Due to Peak Construction Work Force	% Change
1. Bonifay, Fla.	2,068	75	3.6%
2. Chipley, Fla.	3,347	62	1.9
3. DeFuniak Springs, Fla.	4,966	87	1.8
4. Geneva, Ala.	4,398	31	0.7
5. Holmes County & Washington County (less Bonifay and Chipley)*	16,750	295	1.8
Total for 20-mile Radius	31,537	550	1.7%

*21 small communities and surrounding rural areas contain the remaining population of Holmes County and Washington County once the cities of Bonifay and Chipley are excluded. 3

Source: Eric Hill Associates, Inc.

2.1.4 Summary

The significance of Table 2-2 is that a relatively small proportion of the total peak construction work force will need to in-migrate, because most of the skilled labor required is already available within a reasonable commuting distance of the plant. The significance of Table 2-5 is that the workers who who do in-migrate will live in a widely dispersed area. The combination of these two conclusions tends to reduce the potential effect of the construction phase in the vicinity of the plant.

2.2 ECONOMICS

The six-year duration of the plant construction phase will have an impact on the economic situation in the vicinity of the site. The in-migrating workers and their families will spend money for housing, goods, services, and taxes at their new location of residence. In exchange, they will make economic demands on public and private services. That portion of the construction force that is expected to commute to the work site will likewise spend money in the area and increase the need for services, but to a different degree and in different ways than the in-migrants.

The major portion of the anticipated economic effect will be concentrated within the 20-mile radius that includes essentially all of Holmes and Washington counties, together with the neighboring communities of DeFuniak, Florida, and Geneva, Alabama. (See Map 7.) Most of the following discussion, therefore, is focussed on the two-county or 20-mile radius area. It should be noted, however, that the estimated 1,156* workers expected to commute more than 20 miles will take most of their paychecks home with them, thus spreading the economic effects of the construction over a vast area extending to Panama City and Dothan, and beyond. 3

2.2.1 Economic Effects in the Public Sector

This section explores the potential for increased demand for public services resulting from the influx of construction workers and their families, and compares additional governmental costs to provide such services with the anticipated increase in public revenues resulting from the construction phase.

Demand for Public Services. Public services of concern to this analysis include police and fire protection, education, health and welfare,

*This figure is derived from Table 4.1-2. It includes all of the 323 workers who reside outside of a 45-mile radius but will choose to commute anyway, plus 80 percent of the 1,156 workers who currently reside within a 45-mile radius.

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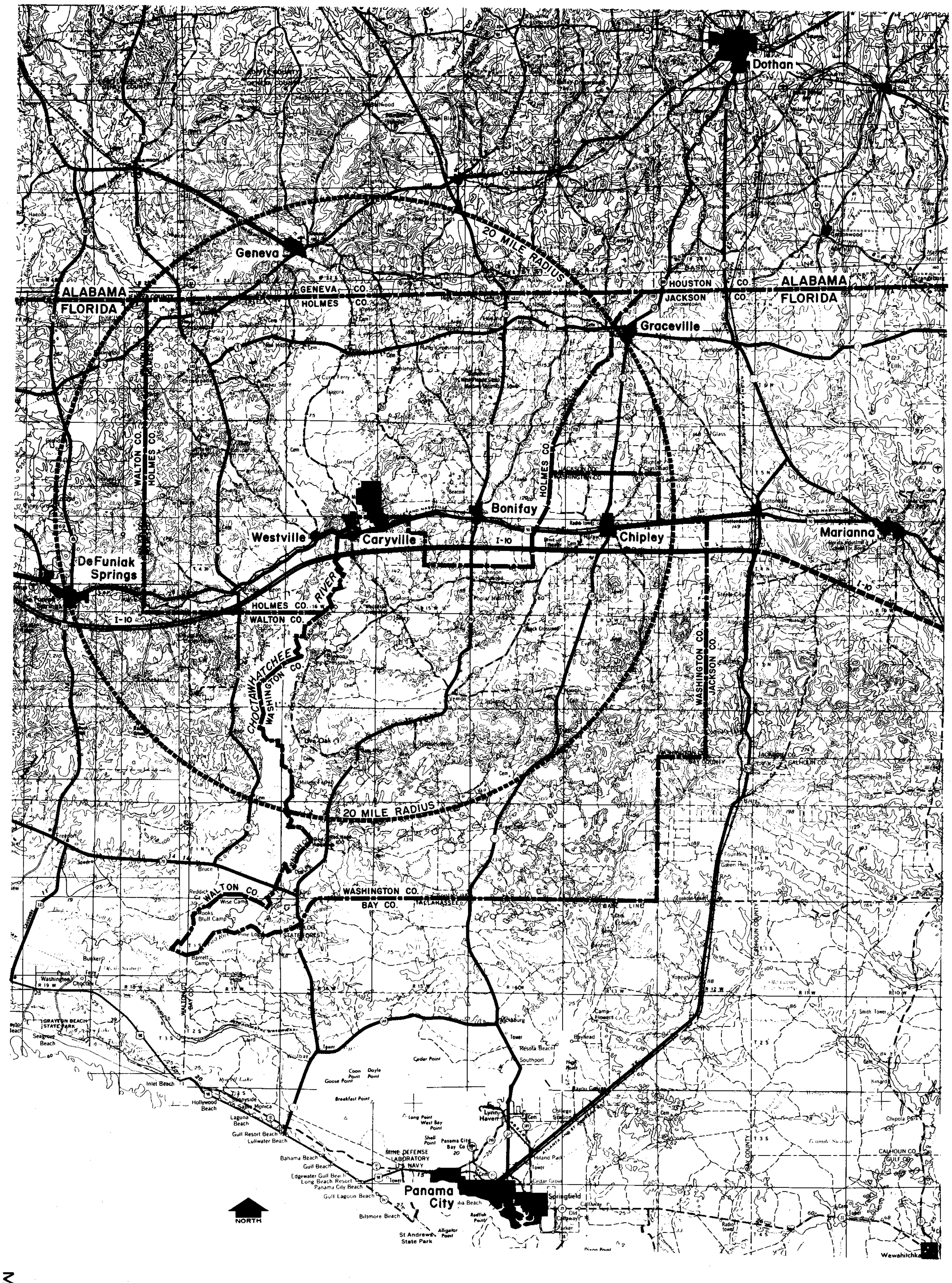

MAP 7

REGION OF PRIMARY MAN-MADE ENVIRONMENTAL EFFECTS

SCALE: 1 INCH ≈ 8 MILES

Amendment 3 9/75

solid waste disposal, water supply, sewerage, and local streets. The local facilities that currently exist in Holmes and Washington counties to provide these services have recently been studied as part of federally assisted comprehensive planning programs. The resulting "Community Facilities Plan" for each county was published in 1974 [see Chapter 3 in reference (7) and also in reference (8)]. These plans describe existing community facilities and services in relation to the needs of the existing and projected population.

Since the projected population in these studies does not anticipate the temporary influx of residents and commuters that will be caused by the construction phase, the additional need for services that may be required by such an influx is addressed in this analysis.

In Table 2-5 estimates are made for the distribution of in-migrating, peak period construction workers by geographical area. The estimates suggest that about 255 people (workers and their families) will move into four medium-size communities (Bonifay, Chipley, and DeFuniak Springs, Florida, 3
and Geneva, Alabama). Another 127 people will live in the 21 smaller communities found within the 20-mile radius. Finally, 168 people will move into rural locations (primarily fronting along highways and country roads) throughout the area within the 20-miles radius. Thus, the 20-mile radius will receive about 550 new temporary residents as a result of plant construction.

To determine the potential effects that 550 new residents would have on community services, two methods were used. First, field trips to each of the two counties and four medium-size communities were made to generally evaluate the existing level of services. Personal contacts made with local officials during these field trips are included in reference (4). Second, questionnaires were mailed to six mayors, four school superintendents, and two county administrators to ascertain whether local officials perceive any potential adverse effects from the construction influx in terms of additional community services. A list of recipients of the questionnaire and the responses received are attached as Appendix 2.1.

If a full set of codes and ordinances was adopted in each county, several new personnel would likely be required to assist the building inspectors with enforcement. Each county might require an additional $25,000 per year to fund the suggested level of enforcement. Only a portion of this additional cost could be attributed to the effect of the power plant construction, since growth would be occuring regardless, and since the State is encouraging counties to adopt a full set of codes and ordinances. Cooperation and shared responsibility arrangements worked out between cities and counties could possibly reduce the costs of thie effort for each individual government.

Potential Increase in Public Revenues for Local Governments. The plant construction phase will result in added public revenues in terms of:

- Increased real estate and personal property taxes for cities and counties as a result of improved or otherwise re-valued property arising from the influx of temporary residents.

- Increased real estate taxes accruing to Washington and Holmes counties as a result of re-evaluation of the plant site due to its new use.

- Increased sales taxes generated from local purchases by new residents and by commuters.

- Increased gasoline taxes generated from local purchases by commuters to the plant.

- Increased taxes accruing to Washington County from the added racing revenues generated by the dog race track at Ebro.

Comparison of Additional Public Costs and Revenues. The previous two sections indicate that the construction phase will likely generate more public revenues than public costs. At the county level, once the generating plant is put into operation, public revenues will vastly outweigh required public expenditures.

There should be no need for increases in local tax rates due to the effects of plant construction. It would also be unlikely that the magnitude of increased public revenues during the construction phase would allow any decreases from present local tax rates.

At the time of this writing, no responses indicate any significant effects upon public services or facilities. Two governments, the City of Caryville and Holmes County, did mention that solid waste disposal would be one area of potential concern, not so much because of the addition of construction workers and their families, but because of the current State pressures to upgrade services in this area.

The construction phase will, however, generate a need for some additional
public services associated with construction and land development controls.
New houses, motels, gas stations, mobile home parks, convenience stores, and
other private sector services may develop. If these developments are allowed
to locate in a haphazard, uncoordinated fashion, or if construction is uncon-
trolled, undesirable land use and inadequate structural conditions could be 3
generated that would adversely effect the communities and counties for a long
time after the construction phase.

At present, Washington County has adopted building, plumbing, and electrical codes, and has received recommended, though unadopted, zoning and subdivision regulations. Holmes County has adopted only the building code. Each county has employed an official to enforce the adopted codes.

<u>Potential Additional Costs to Local Governments</u>. There should be relatively little additional cost required for local governments to serve the construction influx based on the questionnaire response.

Virtually no new public facilities requiring capital expenditures are viewed as necessary because of the construction phase at any level of government. There could be minor increases in operating expenditures.

2.2.2 Economic Effects in the Private Sector

The construction phase will create more demands in the private sector than in the public sector. The greatest effect is expected to be in the area of housing. Construction employee pay scales will be high in comparison with prevailing wage rates in the area, and there will be relatively large dollar amounts spent in the area to satisfy private sector needs.

Housing Demand and Supply - The 1970 Census statistics on housing supply for Holmes and Washington counties are presented in Tables 1-12 and -13. Thev show that five years aso (the latest available data).
Holmes County had 188 vacant housing units for sale or for rent, 4.6 per cent of the total housing units. The corresponding figures for Washington County were 136 vacant units, a vacancy rate of 3.2 per cent.

If the figures are still valid and if construction workers needs and desires for housing are matched by the existing vacancies, there will presumably be 3
no housing problem. The estimated 550 people who will in-migrate to the 20-mile radius area (see Table 2-5) could easily be accommodated in 324 units. However, there are a number of indications that there are no longer that many vacant units in the two counties, and construction workers are often more interested in rental housing than in houses for sale. Virtually all the local people interviewed [reference (4)] confirmed a tight housing market, especially in terms of rental units.

Many workers, with and without families, may choose to live in mobile homes. There are some facilities for mobile homes in the area. The DeFuniak Springs vicinity is reported to have four mobile home parks that collectively have 15-20 vacant slots at the current time. Geneva, Alabama, reports three trailer parks and considerable vacant land zoned for this use. In Bonifay, there are two parks, both with city water and sewer service, one of which is being expanded. The Chipley area has about eight parks averaging 20 spaces each, but few vacancies at present.

The creation of new mobile home parks will be a likely result of the desire for this type of housing by construction workers. In addition, rented or purchased single-family lots and tracts along highways and in rural areas will probably attract a number of workers who own mobile homes.

Another type of shelter requirement will be for motels to house manufacturers' representatives and other occasional visitors to the plant site. Those workers commuting on a weekly basis without families may also choose motels or may prefer a spot to park their own camping trailer.

A likely result of the interaction of an existing short supply of housing suitable to meet the needs of construction workers, and the high wage rates paid those workers, will be inflated housing costs. In a similar situation at a power plant site in Maryland, "high wages earned at the plant pushed rentals up to two and three times their former amount, with farmers and other landlords enjoying windfall income from renting even marginal living quarters" 3
[reference (2)(d), page 3]. The construction workers, in that case, displaced former renters who were unable to spend more for housing.

Estimated Wages and Supply Costs and Their Effect - Gulf Power estimates that at the peak construction period the 1,800 workers will be earning salaries of $36 million a year. These high wage rates (an average of $20,000 for each worker's annual income) are attributed to the high prices for labor in the industry and the amount of overtime the workers are likely to spend on the job.

Workers in-migrating (estimated 268) and already residing (estimated 232*) within 20 miles of the site could be expected to earn a total of $10 million per year during the peak of construction. These workers will tend to spend their incomes in the local economy to varying degrees depending on the goods and services offered. Table 2-7 suggests the proportions of these wages that can be expected to be spent in the local economy, based on spending habits of current residents.

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*Of the 1,156 peak construction workers to be drawn from within a 45-mile radius (reference Table 2-2), 20 per cent or 232 are estimated to live within 20 miles of the plant.

Table 2-7

ESTIMATED BREAKDOWN OF LOCAL VERSUS REGIONAL SPENDING HABITS FOR CURRENT RESIDENTS OF THE PLANT VICINITY, FOR SELECTED TYPES OF PURCHASES

Type of Goods or Services Purchased	Per Cent Spent at Local Business Establishments	Per Cent Spent Outside the Area**
Food	95	5
Medical*	90	10
Appliances	80	20
Auto Purchases	60	40
Auto Maintenance	100	0
Recreation/Entertainment	30	70
Clothing	10	90

*For major surgery and obstetrics most people go outside the county.

**Primarily at urban centers like Dothan, Panama City, and Fort Walton Beach.

Source: Eric Hill Associates, based on interviews with selected local officials in business and government.

Table 2-8

TYPES OF LOCAL COMMERCIAL BUSINESSES BENEFITED BY CONSTRUCTION WORKERS RESIDING WITHIN 20-MILE RADIUS

MOST BENEFITED

Gasoline Service Stations
Eating & Drinking Places
Drug Stores & Proprietary Stores
Auto Repair, Auto Services, Garages
Food Stores

LESS SUBSTANTIALLY BENEFITED

Automotive Dealers
Furniture, Home Furnishings & Appliance Stores
Non-Store Retailers (General Merchandise)
Miscellaneous Repair Services
Miscellaneous Business Services

SUBSTANTIALLY BENEFITED

General Merchandise Group Stores
Apparel and Accessory Stores
Miscellaneous Retail Stores
Motion Pictures
Other Amusement & Recreation Services
Building Materials, Hardware, & Farm Equip.
Finance, Insurance, & Real Estate
Personal Services

Source: Eric Hill Associates based in local interviews.

Table 2-8 indicates the types of local commercial businesses that are likely to be frequented by resident construction workers and gives an ordering of the magnitude of benefit each type of establishment can expect.

The nonresident construction workers (that is, the estimated 1,300 workers who will reside outside the 20-mile radius) will drive to and from work. These commuters will spend money in the two-county area only for a limited range of goods and services, principally auto services and eating and drinking establishments. The effect of this spending will be concentrated in the immediate plant area and along U.S. 90 and Interstate 10. New establishments of the type demanded will probably develop during the construction phase to capture this market. The only existing commercial businesses within a five-mile radius of the plant are categorized in Table 2-9

Table 2-9

EXISTING COMMERCIAL BUSINESSES MOST LIKELY TO BE FREQUENTED BY COMMUTING CONSTRUCTION WORKERS, BY TYPE OF BUSINESS

Type of Business	Estimated Establishments*	
		3
MOST LIKELY TO BENEFIT		
Auto Services	7	
Eating and Drinking Places	1	
SUBSTANTIAL BENEFIT POTENTIAL		
Food Stores	4	
TOTAL	12	

*Existing establishments within a five-mile radius of the plant site.

Source: Eric Hill Associates, Inc.

Potential for Economic Decline Following Construction Phase. There will be a reduction in economic activity once the construction phase is ended. Most of the workers and families who in-migrated to the area will move elsewhere. Since they will have lived in the area for from one to six years during the construction, some of these workers and families may have grown to like the area

and may remain to find work in the general vicinity. This effect will lessen the potential for economic decline after construction. Based on discussion with labor leaders, an estimated 10 to 15 per cent of the peak construction force may be expected to remain.

The expectation for economic decline, therefore, is a result of the out-migration of approximately 468 people (workers and their families) who had temporarily relocated, (550 minus 15 per cent who remain living in the area) and the cessation of commutation of the 1,300 construction workers who traveled more than 20 miles to work. (Note: some workers are included in both of these categories.)

2.3 LAND USE

The principal land use impact of the construction phase will be the change from less intensive uses (agricultural and forestry, primarily) to residential use since the in-migrating construction work force will find a deficiency in the supply of available housing.

The largest part of this land use conversion is expected to be in the area of provision of space for mobile homes in mobile home parks and on scattered individual lots. 3

Other land use changes will be ones associated with commuting labor. The land use changes involved will primarily be within five miles of the plant at the intersections of roads. Locations which can readily be identified include the intersections of S.R. 279 with I-10 and U.S. 90, and the intersection of U.S. 90 with S.R. 179. The strip of U.S. 90 located in Caryville will also be impacted.

Neither Washington nor Holmes county nor the City of Caryville has adopted land use plans, zoning regulations, or subdivision regulations. Lack of land use controls, particularly during a growth period, can lead to uncoordinated, scattered and/or strip development which, in turn, often results in traffic congestion, visually unpleasing properties, and incompatible land use relationships. However, there is every reason to assume that the land use changes would have no significant adverse effects, because the magnitude of change will be so small relative to the large amount of undeveloped land in the vicinity's cities and counties.

2.4 TRANSPORATION

There are theree transportation facilities which will play a vital role in the movement of construction suppies/equipment and personnel to the site. Each is discussed below and the expected transportation-related impacts described.

U. S. 90, an east-west transportation artery extending the length of the northern part of Florida, forms important linkages between many small and medium-sized rural communities within the panhandle. Throughout the extreme northeastern and northwestern part of Florida, U. S. 90 serves as a parallel collector road to I-10.

It is anticipated that U. S. 90 will be a primary route used by construction workers at the Caryville plant. Many of the smaller cities and towns located along U. S. 90 will become the temporary place of residence for the construction force.

The 1974 Average Daily Traffic (ADT) for the portion of U. S. 90 within two 3
counties was 7,400, and in 1975, the count dropped to 3,400 where I-10 had been opened.

Ideally, up to 5,000 vehicles a day should use a highway like U. S. 90; however, the Department of Transportation states that overcrowding is not a problem until a level of above 15,000 vehicles a day is reached.

The other major transportation facility is I-10. This interstate is the most important east-west highway transportation facility in the northern part of Florida. At present, it is completed to Bonifay, and the entire interstate is projected to the completed by 1978. By the time it is completed, the projected ADT for the portion of I-10 between Crestview and Marianna is estimated to be approximately 12,000. (Reference (9)).

The traffic carrying capacity of a roadway like the interstate is not reached until in excess of 40,000 vehicles per day make use of it. Therefore, the total traffic volume is anticipated to be relatively small compared to traffic carrying capacity of the interstate, and the construction workers would have little effect on the total volume of I-10. 3

The third major transportation facility is the Louisville and Nashville Railroad. This railroad parallels U. S. Highway 90 on the north and passes along the southern edge of the plant site. A spur track will be constructed to service the site. Rail deliveries to the site during construction will be sporadic and are not expected to cause significant problems at railroad crossings.

2.5 References

(1) Interviews Used to Determine Availability of Labor and Potential Commutation Characteristics for Plant Construction Phase

(a) Labor Unions

Building Trades Council
Mr. Scott Alsup - Mobile, Alabama
Mr. Buck Caswell - Panama City, Florida

Operating Engineers Unions
Mr. Robert Lowe - Mobile, Alabama

Laborers International Union of North America
Mr. E.H. Booker - Pensacola, Florida

International Brotherhood of Carpenters
Mr. J.A. Ward - Panama City, Florida

International Brotherhood of Ironworkers
Mr. Scott Alsup - Mobile, Alabama
Mr. Buck Caswell - Panama City, Florida

United Association of Plumbers and Pipefitters
Mr. Harold C. Jasperson - Panama City, Florida
Mr. William R. Goubil - Mobile, Alabama 3

International Brotherhood of Electrical Workers
Mr. Clewis - Panama City, Florida

International Brotherhood of Boilermakers
Mr. J.F. Watford - Mobile, Alabama

(b) Construction Firms

Morrison-Knudson Construction Company - Boise, Idaho
Mr. Russell Martin, Assistant Chief Engineer

(c) Public Planning Agencies

Altahama Area Planning & Development Commission - Baxley, Georgia
Mr. Bill Williams, Assistant Director
(Reference: Georgia Power's Hatch Plant Construction)

Sweetwater County Planning Department - Green River, Wyoming
Mr. Steven Young, Director
(Reference: Pacific Power Jim Bigby Plant Construction)

Northwest Florida Planning and Advisory Council, Panama City, Fla.
Mr. Charles H. Shih, Planning Director
Mr. Robert N. Bates, Assistant Director of Planning
Mr. Richard J. Roche, Regional Planner
(Reference: Regional and local planning aspects of the proposed Caryville plant)

(d) Power Companies

Georgia Power Company - Atlanta, Georgia
Mr. Tom Byerly, Environmental Engineer
Mr. Bill Johnson, Construction Supervisor

Gulf Power Company - Pensacola, Florida
Mr. Ralph Bird, Construction Supervisor
Mr. George G. Layman, Manager of Power Supply

(2) Impact Studies on Other Power Plant Developments

(a) "Social and Economic Impact of a Nuclear Power Plant in Central Alabama"

For: Alabama Power Company
By: Battelle Columbus Labs
Columbus, Ohio, 1974

(b) "Impact of the Georgia Power Company Nuclear Power Plant on Community Facilities in the Toombs-Appling Bi-County Area"

For: Altamaha Area Planning and Development Commission 3
By: Graduate Students of City Planning
Georgia Institute of Technology, 1969

(c) "Impact of the Georgia Power Company Vogtle Nuclear Power Plant on the Central Savannah River Area"

For: Central Savannah River Area Planning and Development Commission
By: Graduate Students of City Planning
Georgia Institute of Technology, 1972

(d) "Socio-Economic Impact of Power Plant Construction: A Case History"

From: Maryland Department of Natural Resources, "Record of the Maryland Power Plant Siting Act", Vol. 4, No. 2, June, 1975, Annapolis, Maryland
By: John H. Baldwin of the Consulting Firm of Howard Needles Tammen and Bergendoff

(3) Florida Department of Commerce Interviews and Data Sources

(a) DeFuniak Springs Theater Office
Division of Employment Security
Florida Department of Commerce
Mr. Phillip Brial, Manager

(b) Panama City Office Area Office
Division of Employment Security
Florida Department of Commerce
Mr. Hightower, Assistant Manager

(c) Bureau of Research and Statistics
Division of Employment Security
Florida Department of Commerce
Ms. Norma Strickland, Tallahassee, Florida

(d) Industrial Development Division
Florida Department of Commerce
Mr. Jon Hardin, Panama City, Florida

(4) Resource Individuals and Agencies From Cities and Counties in the Vicinity of the Plant Site

(a) Bonifay, Florida

The Honorable Robert L. Hall, Sr., Mayor
Ms. Janie Dannelly, City Clerk
Jimmy Napier, Private Realtor
Phillip Kent, Private Realtor

(b) Caryville, Florida

The Honorable Calvit L. Walker, Mayor
Mr. John Edd French

(c) Chipley, Florida 3

The Honorable Bob Deal, Mayor
Mr. Richard Potter, Gulf Power Company

(d) DeFuniak Springs, Florida

The Honorable Harold Goodwin, Mayor
Mr. John Baldwin, City Schools Superintendent
Mrs. Harry Seymore, Private Realtor
Ms. Syble Neel, City Clerk

(e) Geneva, Alabama

The Honorable Hugh Herring, Jr., Mayor
Mr. Wynnton Melton, City Schools Superintendent
Mr. Robert Justice, City Clerk

(f) Marianna, Florida
Mr. Wayne Goble, Chamber of Commerce

(g) Westville, Florida

The Honorable W.L. Luker, Mayor

(h) Holmes County, Florida

Mr. Jack Faircloth, County Clerk
Mr. Gerald Commander, County School Superintendent
Mr. Kelley Swindle, Ex. Director, County Development Commission

(i) Washington County, Florida

Mr. Quinton Syffert, County Administrator
Mr. Kelly Brock, County School Superintendent
Mr. Allen Potter, Chairman, County Planning Commission
Mr. E.W. Carswell, Editor, Washington County News

(5) Research and Analysis: Holmes County
RMBR Planning/Design Group, June, 1974

(6) Research and Analysis: Washington County
RMBR Planning/Design Group, June, 1974

(7) Plan and Implementation: Holmes County
RMBR Planning/Design Group, June, 1974

(8) Plan and Implementation: Washington County
RMBR Planning/Design Group, June, 1974

(9) Chipley District Office
Florida Department of Transportation

Mr. Hank Miller
Mr. Royce Pitts
Mr. Charles Powell

3

APPENDIX 2.1

A questionnaire was mailed, by Eric Hill Associates, Inc., on August 12, 1975, to selected mayors, school superintendents, and county administrators within a 20-mile radius of the plant site. Purpose of the questionnaire was to determine the viewpoints of local governmental officials regarding the potential 3
adverse effects from the construction workforce influx in terms of increased demand for community facilities and services.

This appendix includes: (1) an example of the cover letter requesting the officials assistance, (2) a list of recipients of the questionnaire, and (3) all responses received by Eric Hill Associates as of August 22, 1975.

eric hill associates, inc. 33 ponce de leon avenue, n.e., atlanta, georgia 30308 404 881 6737

August 12, 1975

Re: Caryville Steam Power Plant
Environmental Assessment

Dear

The purpose of this letter is to solicit your views on the effect the construction of the Caryville coal-fired, steam generating plant will have on your community or school system. Specifically, we would like your assessment of how construction workers and families who may temporarily (from one to six years) relocate within your jurisdiction, will effect the community within which you have jurisdiction.

Our firm is assisting Gulf Power Company with its assessment of possible effects of the construction phase of the plant at Caryville, Florida. The week of July 28, 1975, we visited each of the cities, counties, and/or school systems expected to be impacted. 3

Please take a few minutes to fill out the enclosed form letter and return it to us in the self-addressed, stamped envelope. Your response, together with others we receive from neighboring governments or school systems, will be included in the environmental assessment package being prepared for the plant.

Neither you or your government will be held accountable for the preciseness of your answers. Estimates of effects will suffice. We encourage you to add your comments where you feel they are necessary.

If you have any questions, please feel free to call collect to the above telephone number. If you call, please ask for me or for Ms. Dottie Aiken. We would like to impress on you the urgency required for your response. Please return the questionnaire no later than August 20, 1975.

Thanking you in advance for your cooperation and assistance.

Sincerely,

Myles G. Smith

MGS:cj

Enclosure

Eric W. Hill • James H. Dodd AIP • Lewis L. Douglas • DeWayne H. Anderson AIP • David A. Holmes • Myles G. Smith • W. D. ...

School Superintendents

Mr. Kelly Brock, School Superintendent
Washington County School System
North Second Street
Chipley, Florida 32428

Mr. Wynnton Melton
City School Superintendent
High School Complex
Geneva, Alabama 36340

Mr. John Baldwin
City School Superintendent
Walton County Courthouse
DeFuniak Springs, Florida 32433

Mr. Gerald Commander
School Superintendent
Holmes County School System
City Hall
Bonifay, Florida 32425

County Administrators

Mr. Quinton Syffert
County Administrator
Washington County Courthouse
Highway 90 East
Chipley, Florida 32428

Mr. Jack Faircloth
County Administrator
Holmes County Courthouse
201 North Oklahoma Street
Bonifay, Florida 32425

Mayors

The Honorable Bob Deal, Mayor
City of Chipley
City Hall
505 N. Fifth Street
Chipley, Florida 32428

The Honorable Hugh Herring, Jr.
Mayor
City of Geneva
P. O. Box 37
Geneva, Alabama 35340

The Honorable Harold Goodwin
Mayor
City of DeFuniak Springs
City Hall 3
DeFuniak Springs, Florida 32433

The Honorable Robert L. Hall, Sr.
Mayor
City of Bonifay
P. O. Box 206
Bonifay, Florida 32425

The Honorable W. L. Luker, Mayor
City of Westville
P. O. Box 3
Westville, Florida 32464

The Honorable Calvit Walker
Mayor
City of Caryville
Caryville, Florida 32427

Mr. Myles G. Smith
Eric Hill Associates, Inc.
33 Ponce de Leon Avenue, NE
Atlanta, Georgia 30308

Re: Assessment of Construction Phase of Caryville Steam Power Plant

Dear Mr. Smith:

The attached questionnaire has been completed by me and may be considered to be our interpretation of the effect the construction of the proposed Caryville steam power plant will have on our (community)(~~school system~~). It is understood that the construction phase is the period in which there will be the largest impact. After 1980, construction employment will gradually decline to zero. 3

To summarize our position, we (~~feel~~)(do not feel) that the construction phase for the proposed plant will substantially effect the overall services we provide to our constituents. (add comments as necessary)

We appreciate this opportunity to express our opinion on the proposed plant.

Sincerely,

Robert L Hall, Jr.

Mayor
(title)

QUESTIONNAIRE

Caryville Steam Plant

Construction Phase Effects on Surrounding Communites and Counties

Robert L. Hall, Sr.
Name of Respondent

Mayor
Title

Bonifay, Holmes, Florida
City, County, State

August 15, 1975
Date

Eric Hill Associates has made the following estimates of the number of construction workers who will temporarily relocate to communities and counties near Caryville.

	Workers without Families	Workers with Families	Total Population @ 3.25 persons per Family*
A. Significant Towns:			
Bonifay, Florida	19	18	78
Caryville, Florida	7	7	30
Chipley, Florida	15	15	64
DeFuniak Springs, Florida	21	21	89
Geneva, Alabama	7	7	30
Westville, Florida	7	7	30
Subtotal	76	75	321
B. Counties**			
Holmes (excluding Bonifay, Westville)	29	27	115
Washington (excluding Caryville, Chipley)	31	29	126
Subtotal	60	56	241
TOTAL	136	131	562

3

* Average family size used in similar studies for Georgia Power Company.

** Total projected figures allocated to Holmes and Washington counties based on ratio of county population to total population.

Source: Eric Hill Associates, Inc. August 12, 1975

1. Would the above-allocated influx of population into your jurisdiction create an excessive demand on the following public services and facilities provided by your government? If yes, please comment and indicate percentage increase required.

	Yes	No	N/A	Comments
a. Police Protection		✓		
b. Fire Protection		✓		
c. Water Supply		✓		
d. Sanitary Sewerage		✓		
e. Health and Welfare Facilities		✓		
f. Local Street System		✓		
g. Solid Waste Disposal		✓		

Additional Comments: ______________________________

______________________________ 3

____

2. If the above estimates of population influx were wrong and twice as many people moved into your jurisdiction, would an excessive demand be created on the following public services and facilities? If yes, please comment and indicate percentage increase needed.

	Yes	No	N/A	Comments
a. Police Protection		✓		
b. Fire Protection		✓		
c. Water Supply		✓		
d. Sanitary Sewerage		✓		
e. Health and Welfare Facilities		✓		
f. Local Street System		✓		
g. Solid Waste Disposal		✓		

Additional Comments: ______________________________

____

____

3. Please provide the following information where it is readily available.

a. Number of policemen currently employed 11 full time - 1 part time

b. Number of firemen currently employed

volunteer 25

professional 6

c. Number of fire stations 1

d. Current water treatment capacity (in gallons/day) 1,440,000

e. Current water consumption (in gallons/day) ______

f. Current capacity of sanitary sewerage treatment facility (in gallons/day) 250,000

g. Current daily usage of sanitary sewerage treatment (in gallons/day) 130,000 3

Mr. Myles G. Smith
Eric Hill Associates, Inc.
33 Ponce de Leon Avenue, NE
Atlanta, Georgia 30308

Re: Assessment of Construction Phase of Caryville Steam Power Plant

Dear Mr. Smith:

The attached questionnaire has been completed by me and may be considered to be our interpretation of the effect the construction of the proposed Caryville steam power plant will have on our (community)(~~school system~~). It is understood that the con- 3
struction phase is the period in which there will be the largest impact. After 1980, construction employment will gradually decline to zero.

To summarize our position, we (~~feel~~)(do not feel) that the construction phase for the proposed plant will substantially effect the overall services we provide to our constituents. (add comments as necessary)

We appreciate this opportunity to express our opinion on the proposed plant.

Sincerely,

MAYOR
(title)

QUESTIONNAIRE

Caryville Steam Plant

Construction Phase Effects on Surrounding Communites and Counties

CALVIN L. WALKER
Name of Respondent

MAYOR
Title

CARYVILLE, WASHINGTON, FLA
City, County, State

AUG. 16 1975
Date

Eric Hill Associates has made the following estimates of the number of construction workers who will temporarily relocate to communities and counties near Caryville.

		Workers without Families	Workers with Families	Total Population @ 3.25 persons per Family*
A. Significant Towns:				
Bonifay, Florida		19	18	78
Caryville, Florida		7	7	30
Chipley, Florida		15	15	64
DeFuniak Springs, Florida		21	21	89
Geneva, Alabama		7	7	30
Westville, Florida		7	7	30
	Subtotal	76	75	321
B. Counties**				
Holmes (excluding Bonifay, Westville)		29	27	115
Washington (excluding Caryville, Chipley)		31	29	126
	Subtotal	60	56	241
	TOTAL	136	131	562

3

* Average family size used in similar studies for Georgia Power Company.

** Total projected figures allocated to Holmes and Washington counties based on ratio of county population to total population.

Source: Eric Hill Associates, Inc.

August 12, 1975

1. Would the above-allocated influx of population into your jurisdiction create an excessive demand on the following public services and facilities provided by your government? If yes, please comment and indicate percentage increase required.

	Yes	No	N/A	Comments
a. Police Protection			✓	
b. Fire Protection		✓		
c. Water Supply		✓		
d. Sanitary Sewerage		✓		
e. Health and Welfare Facilities		✓		
f. Local Street System		✓		
g. Solid Waste Disposal		✓		

Additional Comments: ____________________ 3

2. If the above estimates of population influx were wrong and twice as many people moved into your jurisdiction, would an excessive demand be created on the following public services and facilities? If yes, please comment and indicate percentage increase needed.

	Yes	No	N/A	Comments
a. Police Protection			✓	
b. Fire Protection		✓		
c. Water Supply		✓		
d. Sanitary Sewerage	(crossed out)		✓	
e. Health and Welfare Facilities			✓	
f. Local Street System		✓		
g. Solid Waste Disposal	✓			

Additional Comments: ____________________

3. Please provide the following information where it is readily available.

a. Number of policemen currently employed NONE

b. Number of firemen currently employed

volunteer 20

professional NONE

c. Number of fire stations 1

d. Current water treatment capacity (in gallons/day) 75,000

e. Current water consumption (in gallons/day) 65,000

f. Current capacity of sanitary sewerage treatment facility (in gallons/day) NA

g. Current daily usage of sanitary sewerage treatment (in gallons/day) NA 3

Mr. Myles G. Smith
Eric Hill Associates, Inc.
33 Ponce de Leon Avenue, NE
Atlanta, Georgia 30308

Re: Assessment of Construction Phase of Caryville Steam Power Plant

Dear Mr. Smith:

The attached questionnaire has been completed by me and may be considered to be our interpretation of the effect the construction of the proposed Caryville steam power plant will have on our (community)(~~school system~~). It is understood that the construction phase is the period in which there will be the largest impact. After 1980, construction employment will gradually decline to zero. 3

To summarize our position, we (~~feel~~)(do not feel) that the construction phase for the proposed plant will substantially effect the overall services we provide to our constituents. (add comments as necessary)

We appreciate this opportunity to express our opinion on the proposed plant.

Sincerely,

Hugh Herring Jr.
(title) Mayor

QUESTIONNAIRE

Caryville Steam Plant

Construction Phase Effects on Surrounding Communites and Counties

Hugh Herring, Jr.,
Name of Respondent

Mayor
Title

Geneva Geneva Alabama
City, County, State

8/14/75
Date

Eric Hill Associates has made the following estimates of the number of construction workers who will temporarily relocate to communities and counties near Caryville. 3

	Workers without Families	Workers with Families	Total Population @ 3.25 persons per Family*
A. Significant Towns:			
Bonifay, Florida	19	18	78
Caryville, Florida	7	7	30
Chipley, Florida	15	15	64
DeFuniak Springs, Florida	21	21	89
Geneva, Alabama	7	7	30
Westville, Florida	7	7	30
Subtotal	76	75	321
B. Counties**			
Holmes (excluding Bonifay, Westville)	29	27	115
Washington (excluding Caryville, Chipley)	31	29	126
Subtotal	60	56	241
TOTAL	136	131	562

* Average family size used in similar studies for Georgia Power Company.

** Total projected figures allocated to Holmes and Washington counties based on ratio of county population to total population.

Source: Eric Hill Associates, Inc. August 12, 1975

1. Would the above-allocated influx of population into your jurisdiction create an excessive demand on the following public services and facilities provided by your government? If yes, please comment and indicate percentage increase required.

	Yes	No	N/A	Comments
a. Police Protection		x		
b. Fire Protection		x		
c. Water Supply		x		
d. Sanitary Sewerage		x		
e. Health and Welfare Facilities		x		
f. Local Street System		x		
g. Solid Waste Disposal		x		

Additional Comments: *Geneva is experiencing a growth period at the present time due to our expansion of industry in Geneva and we would welcome the added influx to Geneva*

3

2. If the above estimates of population influx were wrong and twice as many people moved into your jurisdiction, would an excessive demand be created on the following public services and facilities? If yes, please comment and indicate percentage increase needed.

	Yes	No	N/A	Comments
a. Police Protection		x		
b. Fire Protection		x		
c. Water Supply		x		
d. Sanitary Sewerage		x		
e. Health and Welfare Facilities		x		
f. Local Street System		x		
g. Solid Waste Disposal		x		

Additional Comments:

3. Please provide the following information where it is readily available.

a. Number of policemen currently employed ___7___

b. Number of firemen currently employed

volunteer ___30___

professional ___2___ 3

c. Number of fire stations ___1___

d. Current water treatment capacity (in gallons/day) ___1,440,000___

e. Current water consumption (in gallons/day) ___500,000 gallons per day___

f. Current capacity of sanitary sewerage treatment facility (in gallons/day) ___1$\frac{1}{2}$ million___

g. Current daily usage of sanitary sewerage treatment (in gallons/day) ___525,000___

QUESTIONNAIRE

Caryville Steam Plant

Construction Phase Effects on Surrounding Communites and Counties

Kelley Brock
Name of Respondent

Superintendent
Title

Chipley - Washington - Fla.
City, County, State

8-14-75
Date

Eric Hill Associates has made the following estimates of the number of construction workers who will temporarily relocate to communities and counties near Caryville.

	Workers without Families	Workers with Families	Total Population @ 3.25 persons per Family*
A. Significant Towns:			
Bonifay, Florida	19	18	78
Caryville, Florida	7	7	30
Chipley, Florida	15	15	64
DeFuniak Springs, Florida	21	21	89
Geneva, Alabama	7	7	30
Westville, Florida	7	7	30
Subtotal	76	75	321
B. Counties**			
Holmes (excluding Bonifay, Westville)	29	27	115
Washington (excluding Caryville, Chipley)	31	29	126
Subtotal	60	56	241
TOTAL	136	131	562

* Average family size used in similar studies for Georgia Power Company.

** Total projected figures allocated to Holmes and Washington counties based on ratio of county population to total population.

Source: Eric Hill Associates, Inc.

August 12, 1975

1. Would the above-allocated influx of population create an excessive demand on the following aspects of your school system? If yes, please comment.

	Yes	No	N/A	Comments
a. Physical Plant Capacity		✓		
b. School Bus Requirements		✓		
c. Faculty/Staff		✓		

Additional Comments: ______

2. If the above estimates of population influx were wrong and twice as many people moved into your jurisdiction, would an overcrowding problem exist for the following:

	Yes	No	N/A	Comments
a. Physical Plant Capacity		✓		
b. School Bus Requirements		✓		
c. Faculty/Staff		✓		

Additional Comments: ______

3. Please provide the following information:

a. Number of school rooms in system:

Now in use 127

Vacant 0

Total 127

8/12/75

b. Number of teachers in system:

Elementary	85
Secondary	91
Total	176

3

c. Anticipated system-wide enrollment for the 1975-76 school year:

Elementary	1500
Secondary	1694
Total	3194

Jack Faircloth

CLERK CIRCUIT COURT AND COUNTY AUDITOR

HOLMES COUNTY

Bonifay, Florida

August 15, 1975

Mr. Myles G. Smith
Eric Hill Associates, Inc.
33 Ponde de Leon Avenue, NE
Atlanta, Georgia 30308

Dear Mr. Smith:

I am taking the liberty of using this means to answer the questionnaire sent me regarding the Caryville Steam Power Plant. I hope that this will be acceptable. Your question regarding the influx of population and the demands that would be placed on our public services will be hard to answer as posed, however, any influx of population would create greater demands upon our present facilities, but I do not feel that these demands
would be excessive. In all probability, the greatest 3
demand created would be that of solid waste disposal.

As for question No. 2, in doubling the amount of people moving in, this could create excessive demands, depending on the individual, their attitudes, public spirit, etc. Water supply and health and welfare facilities would not be over-burdened. Alluding to item No. 3, police protection, fire station, water treatment and sewage are all a part of the City's responsibility. The County does however, provide the Sheriff's Staff and a number of volunteer firemen as well as financial assistance for fire protection.

There is no money expended from County funds for items D, E, F, & G.

Hoping that this has answered your questions satisfactorily, I remain

Sincerely,

Jack Faircloth

Jack Faircloth
Clerk

JF/ea

Mr. Myles G. Smith
Eric Hill Associates, Inc.
33 Ponce de Leon Avenue, NE
Atlanta, Georgia 30308

Re: Assessment of Construction Phase of Caryville Steam Power Plant

Dear Mr. Smith:

The attached questionnaire has been completed by me and may be considered to be our interpretation of the effect the construction of the proposed Caryville steam power plant will have on our (community)(~~school system~~). It is understood that the construction phase is the period in which there will be the largest impact. After 1980, construction employment will gradually decline to zero. 3

To summarize our position, we ~~(feel)~~ (do not feel) that the construction phase for the proposed plant will substantially effect the overall services we provide to our constituents. (add comments as necessary)

We appreciate this opportunity to express our opinion on the proposed plant.

Sincerely,

[signature]
Adm. Asst. To Board
(title)
Wash. Co. Commission

QUESTIONNAIRE

Caryville Steam Plant

Construction Phase Effects on Surrounding Communites and Counties

R.L. SYFRETT
Name of Respondent

Adm. Asst to Board
Title

Chipley - Washington - Fla.
City, County, State

19 Aug 75
Date

Eric Hill Associates has made the following estimates of the number of construction workers who will temporarily relocate to communities and counties near Caryville.

	Workers without Families	Workers with Families	Total Population @ 3.25 persons per Family*
A. Significant Towns:			
Bonifay, Florida	19	18	78
Caryville, Florida	7	7	30
Chipley, Florida	15	15	64
DeFuniak Springs, Florida	21	21	89
Geneva, Alabama	7	7	30
Westville, Florida	7	7	30
Subtotal	76	75	321
B. Counties**			
Holmes (excluding Bonifay, Westville)	29	27	115
Washington (excluding Caryville, Chipley)	31	29	126
Subtotal	60	56	241
TOTAL	136	131	562

3

* Average family size used in similar studies for Georgia Power Company.

** Total projected figures allocated to Holmes and Washington counties based on ratio of county population to total population.

Source: Eric Hill Associates, Inc.

August 12, 1975

1. Would the above-allocated influx of population into your jurisdiction create an excessive demand on the following public services and facilities provided by your government? If yes, please comment and indicate percentage increase required.

	Yes	No	N/A	Comments
a. Police Protection		X		
b. Fire Protection		X		
c. Water Supply		X		
d. Sanitary Sewerage		X		
e. Health and Welfare Facilities		X		
f. Local Street System		X		
g. Solid Waste Disposal		X		

Additional Comments: ______

3

2. If the above estimates of population influx were wrong and twice as many people moved into your jurisdiction, would an excessive demand be created on the following public services and facilities? If yes, please comment and indicate percentage increase needed.

	Yes	No	N/A	Comments
a. Police Protection				
b. Fire Protection		X		
c. Water Supply		X		
d. Sanitary Sewerage		X		
e. Health and Welfare Facilities		X		
f. Local Street System		X		
g. Solid Waste Disposal		X		

Additional Comments: ______

3. Please provide the following information where it is readily available.

a. Number of policemen currently employed Chipley = 6 Caryville = none

b. Number of firemen currently employed

volunteer ✓all Volunteer Chipley = 24 Caryville = 10

professional None

c. Number of fire stations Chipley = 1 Caryville = 1

d. Current water treatment capacity (in gallons/day) Chipley 1/2 Million gallons per day Caryville N/A

e. Current water consumption (in gallons/day) Chipley = 37,000 Caryville = 10,000.

f. Current capacity of sanitary sewerage treatment facility (in gallons/day) 1/2 millions gallons per day for Chipley, Caryville = none.

g. Current daily usage of sanitary sewerage treatment (in gallons/day) Chipley = 400,000 Caryville = none

3

Mr. Myles G. Smith
Eric Hill Associates, Inc.
33 Ponce de Leon Avenue, NE
Atlanta, Georgia 30308

Re: Assessment of Construction Phase of Caryville Steam Power Plant

Dear Mr. Smith:

The attached questionnaire has been completed by me and may be considered to be our interpretation of the effect the ~~construction of~~ the proposed Caryville steam power plant will have on our (community)(school system). It is understood that the construction phase is the period in which ~~there~~ will be the largest impact. After 1980, construction employment will gradually decline to zero. 3

To summarize our position, we (feel)(do not feel) that the construction phase for the proposed plant will substantially ~~effect the~~ overall services we provide to our constituents. (add comments as necessary)

We appreciate this opportunity to express our opinion on the proposed plant.

Sincerely,

(title)

QUESTIONNAIRE

Caryville Steam Plant

Construction Phase Effects on Surrounding Communites and Counties

John Baldwin
Name of Respondent

School Superintendent
Title

De Funiak Springs, Florida
City, County, State Walton County

August 27, 1975
Date

Eric Hill Associates has made the following estimates of the number of construction workers who will temporarily relocate to communities and counties near Caryville.

	Workers without Families	Workers with Families	Total Population @ 3.25 persons per Family*
A. Significant Towns:			
Bonifay, Florida	19	18	78
Caryville, Florida	7	7	30
Chipley, Florida	15	15	64
DeFuniak Springs, Florida	21	21	89
Geneva, Alabama	7	7	30
Westville, Florida	7	7	30
Subtotal	76	75	321
B. Counties**			
Holmes (excluding Bonifay, Westville)	29	27	115
Washington (excluding Caryville, Chipley)	31	29	126
Subtotal	60	56	241
TOTAL	136	131	562

* Average family size used in similar studies for Georgia Power Company.

** Total projected figures allocated to Holmes and Washington counties based on ratio of county population to total population.

Source: Eric Hill Associates, Inc. August 12, 1975

1. Would the above-allocated influx of population create an excessive demand on the following aspects of your school system? If yes, please comment.

	Yes	No	N/A	Comments
a. Physical Plant Capacity	___	✓	___	___
b. School Bus Requirements	___	✓	___	___
c. Faculty/Staff	___	✓	___	___

Additional Comments: ______________________________

2. If the above estimates of population influx were wrong and twice as many people moved into your jurisdiction, would an overcrowding problem exist for the following:

	Yes	No	N/A	Comments
a. Physical Plant Capacity	___	✓	___	___
b. School Bus Requirements	___	✓	___	___
c. Faculty/Staff	___	✓	___	___

Additional Comments: ______________________________ 3

3. Please provide the following information:

a. Number of school rooms in system:

Now in use ________

Vacant ________

Total ________

8/12/75

b. Number of teachers in system:

Elementary ________

Secondary ________

Total 218

c. Anticipated system-wide enrollment for the 1975-76 school year: 3

Elementary ________

Secondary ________

Total 4000

3.0 EFFECTS OF PLANT OPERATION ON THE MAN-MADE ENVIRONMENT

The operation phase is expected to begin between 1980 and 1982. The plant can be expected to be in operation for 30 years or more. The anticipated effects on the man-made environment for the initial years of the operation phase is the subject of this section. The operation phase manpower requirements are so low that most effects are very minor.

3.1 DEMOGRAPHY

As presently planned, the R. F. Ellis Steam Generating plant will have 150 permanent workers, 50 of which will be moved to the area from outside the two-county region. The remaining 100 workers will be hired from the local work force. Using a factor of 3.25 persons per family, the 50 workers and their families will total 163 people moving into the two-county area and nearby communities. 3

Permanent employees of the plant are encouraged to live within a relatively short driving time of the site to be available on short notice in case of emergency. If 25 minutes is assumed as a reasonable driving time, the permanent employees will likely reside in the area from DeFuniak Springs to Bonifay and Chipley. Generally, workers will locate either east of the plant, near or in Chipley or Bonifay or locate in the town of DeFuniak Springs. Scattered housing west of the plant along U. S. 90 to DeFuniak Springs is not anticipated.

Of those familites to move into the two-county area, it is projected that there will be 65 children. As stated in Section 2.2, school officials indicate that this influx will not overburden the existing schools. In fact, sufficient vacancies now exist to care for projected increases.

3.2 ECONOMICS

The influx of plant personnel into the two counties will generate slight increases in the demand for some public and private services.

Since 50 personnel and their families are projected to locate within the two counties and given communities,* this increase is not expected to add to the levels of costs to be incurred by governments. Rather, these families will bring increased revenues to the tax base and wages which will be circulated within the local economy. Permanent employees are expected by Gulf Power to receive average annual wages of $10,000 each.

The permanent plant employees will provide a stimulus to the housing market. Vacant housing is currently in short supply within the two counties. By the year the plant begins operation, however, it is anticipated that housing for permanent personnel will be available. As noted in Section 2.0, the most severe strain on existing housing stock will occur during construction. As construction is phased out, it is anticipated that permanent workers will either absorb housing utilized by construction workers or build new structures.

The aspect of the plant operation phase that will have by far the greatest impact on the public sector will be the increase in ad valorem tax revenues generated by the plant. Estimates of the number of dollars to be paid to each county cannot be accurately determined at this time. However, this added revenue will benefit both governments. Certainly, the increased public revenues will far outweigh the need for any increased public expenditures generated by the 150 permanent plant employees. The extra revenue received may provide the stimulus needed to attract industries, increase the quantity and quality of retail services, and provide public facilities and services now ignored.

*Bonifay, Chipley, Caryville, Westville, DeFuniak Springs.

3.3 LAND USE

The impact of 150 permanent plant personnel on land use is difficult, if not impossible, to quantify. At best, positive and negative effects can be stated for each land use and the reasons for such a determination described. The following describes general effects the permanent work force will have on certain land uses.

Rural residential land use will be affected the most within the two-county area. The increased demand for housing caused by the influx of workers will, in some cases, require that presently farmed land be converted to residential use. However, because of the low density of population and housing within the two-county area and the anticipated scattering of the work force generally along U. S. 90, growth created by the work force is not anticipated to negatively affect land use patterns. As mentioned earlier, however, values of land are anticipated to change. Housing subdivisions may be begun, but not unless 3
other growth-including factors warranting such a commitment are evident.

At present, the two counties appear to be lacking in recreation facilities, and as people begin moving into the area and the tax base is increased, pressure may be put on the city and county governments to provide more amenities. Increased recreational and public facilities are anticipated and have been projected by the Northwest Florida Planning Advisory Council. The introduction of the 150 permanent plant personnel will therefore provide some incentive to provide needed recreational and public facilities.

Industrial use is not anticipated to be significantly altered because of the power plant. Certainly cities and counties may use this as one ingredient to attract new industry, but there is no evidence to indicate that the plant itself or its employees will alone attract new industry.

One type of land use that may slightly increase because of the permanent personnel is commercial, and more specifically, retail trade. Efforts may increase to capture a significant portion of the payroll to be paid to permanent plant employees.

The pace for agricultural land use has been set. It is projected that the number of farms will continue to decrease while the size of farms will continue to increase. Permanent plant personnel will have little or no effect on agricultural land use.

3.4 TRANSPORTATION

Most of the significant points regarding transportation during the operation phase have already been made in Section 2.4 relative to the construction phase.

Highways U. S. 90 and I-10 will form the principal access routes to the vicinity of the plant, and S.R. 179 and S.R. 279 will provide connecting links to the site. Each of these roadways has sufficient traffic volume-carrying capacity to accept the addition of plant operation traffic, although improvements to intersections may be necessary.

Suppliers (primarily coal shipments) to be transported to the plant on a routine basis, will mostly come by train. Gulf estimates that 90 percent of the train trips will come from the west and 10 percent will come from the east. To meet supply requirements for the initial 1000 MW plant, 4 trains per week will be needed. The trains are expected to consist of 100 hopper cars with a capacity of 100 tons each. Travelers on Highway 179 may be delayed seven-ten minutes as a train crosses. The train will not stop on the plant site but will circle the storage area dropping the coal as it moves and returns to the mainline.

8Ho47 North Quarry Road Site
NE¼ of NW¼ of SE¼ of Section 25, T5N, R16W

The North Quarry Road site lies on the crest of a ridge north of the Hathaway Mill Creek, which is 250 to 300 meters away. The site has an approximate elevation of 100 feet above mean sea level. The crest of the ridge is being used for commercial forestry and is now covered by a secondary growth of pines and a mixed hardwoods scrub floral association.

All of the surface material came from two parallel dirt roads (north-south) and the terrain between them - an area some 100 meters square. No vertical dimensions were obtained for the site. The soils exposed in the two roads and several deep disturbances
in the area between them were coarse sands, ranging in color from 3
white to yellowish tan.

None of the ceramic or lithic surface samples are specifically diagnostic in terms of the correct cultural placement of the site. The two check stamped potsherds indicate a post-1000 B.C. chronology, possibly representing the Deptford (1000 B.C. to 500 B.C.) or late Weeden Island (A.D. 1000 to 1200) culture periods. The stemmed projectile point, however, is suggestive of a late Swift Creek (A.D. 1 to 500) or early Weeden Island (A.D. 500 to 800) time span (Percy: personal communication).

The North Quarry Road site should be recommended for preservation and/or excavation. However, it lies north of all planned or tentatively planned power plant site construction activity and should suffer no additional stratigraphic disturbance. If the

Gulf Power Company alters its plans and the site is threatened, then it should be excavated.

Artifact Assemblage:

ceramic: 2 check stamped, sand and grit tempered potsherds 3

lithics: 95 non-utilized waste flakes

1 medium sized, stemmed projectile point

1 small, triangular projectile point blank

1 fragmentary, worked stone object

8Ho48 Hathaway Crossroads Site
NW¼ of SW¼ of SE¼ of Section 25, T5N, R16W

This site, with an elevation of 100 feet, lies on the north slope of a ridge to the south of Hathaway Mill, or Little Gum, Creek. The creek is approximately 75 meters north of the site. Slash pine communities cover all of the area, except the extreme northwest portion where mixed hardwoods predominate. Two infrequently used roads (north-south and east-west) intersect between the two floral communities.

All of the surface scatter of artifacts was recovered along the two dirt roads in an area measuring roughly 75 meters square. Along the road cuts the exposed soils were coarse, granular sands, varying in color from white to yellowish tan. No vertical dimensions were obtained for the site. 3

There are no culturally diagnostic artifacts recovered from the surface of the site. The lithic material is all flint chipping waste, and the two plain, sand tempered potsherds indicate only a post-1000 B.C. date. No definite statements are made for the cultural placement or typology of the site.

There are no recommendations for the preservation or extensive excavation of the Hathway Crossroads site, despite its location in the tentatively planned ash disposal area "B". However, at least one or two test squares should be excavated to beter understand the cultural significance of the site.

Artifact Assemblage:

ceramic: 2 plain, sand tempered potsherds

lithics: 46 non-utilized waste flakes

8Ho49 Hathaway Ridge Site
NE¼ of SE¼ of SW¼ of Section 25, T5N, R16W

This small site occupies an area which is elevated 100 feet along the east slope of a ridge line perpendicular to the Hathaway Mill, or Little Gum, Creek. The creek flows north of the site at an approximate distance of 300 meters. At some time in the past the vegetation was stripped from the general area and a secondary growth of mixed pines and scrub now covers it. Two dirt roads (north-south and east-west) intersect at the southwest corner of the surface scatter distribution.

Surface materials were recovered along both dirt roads and in the area northeast of their intersection; the area measured roughly 25 meters square. Soils exposed on the surface of the site and in the two road cuts ranged from white to yellowish tan, coarse sands. No vertical dimensions were obtained. 3

All of the recovered surface sample is lithic chipping debris, none of which is culturally diagnostic. Therefore, no statements about the typology or cultural placement of the site can be made at the present time.

There are no recommendations made for the excavation and/or preservation of the Hathaway Ridge site, for two reasons. First, the area is too small to warrant it; second, the apparent density of the material is too low. Nevertheless, at least one or two test squares should be excavated at the site if and before it is disturbed further.

Artifact Assemblage:

lithics: 10 non-utilized waste flakes

8Ho50 Hathaway Mill Creek 2 Site
NE¼ of SE¼ of SW¼ of Section 25, T5N, R16W

The Hathaway Mill Creek 2 site is situated on the south side of the creek, at an elevation of 100 feet. It lies on a ridge slope which is covered by mixed hardwoods. Water is obtainable from the creek, which flows no more than 75 meters north of the site.

No definite vertical or horizontal dimensions were determined for the site, primarily because of the very dense ground cover. All recovered materials came from a three meter section of an abandoned dirt road (east-west). The road was the only apparent disturbance in the area and had eroded to roughly 30 cm. below the 3
surface of the surrounding terrain.

None of the recovered surface artifacts are culturally significant. The exterior of the sole potsherd found is badly weathered and its tempering and paste are not chronologically distinctive. The remainder of the artifact assemblage is lithic debitage.

The Hathaway Mill Creek 2 site is recommended for preservation, or excavation if this is not possible. The generally intact condition of the site environs suggests that it contains culturally significant data which would be lost if the site stratigraphy were disturbed.

Artifact Assemblage:

ceramic: 1 plain, sand and grit tempered potsherd

lithics: 8 non-utilized waste flakes

8Ho51 Hathaway Mill Creek 1 Site
SW¼ of NW¼ of SW¼ of Section 25, T5N, R16W

The Hathaway Mill Creek 1 site lies along the south slope of the Hathaway Mill, or Little Gum, Creek drainage valley, at an elevation of 100 feet. Mixed hardwoods cover the slope in the vicinity of the site, and the creek flows north of the area, no more than 75 meters distant.

The small sample of lithic material recovered came from a 25 meter stretch of a new unused dirt road (east-west), which is the only visible disturbance in the area. No vertical dimensions were obtained, although material was eroding from the base of the road cut, which was at least 30 cm. below the level of the surrounding terrain. Along the road cut the exposed soils ranged from white to yellowish tan, coarse sands.

With one exception, all of the recovered material is lithic chipping debris, which is culturally non-diagnostic. The only culturally significant artifact is the basal section of a side notched projectile point; however, the point section is too small and too fragmented to be identified. No definite statements about the site's cultural significance can be made at the present time.

The Hathaway Mill Creek 1 site should be preserved and/or excavated, even though it is not immeidately threatened with destruction. Prior to any work being initiated in the tentatively proposed ash disposal area "B", further testing of the site should be undertaken because of the almost undisturbed condition of the stratigraphy.

Artifact Assemblage:

lithics: 14 non-utilized waste flakes
1 basal (hafting) portion of an unidentified, side notched projectile point

3

8Ho52 Mill Road 1 Site
SE¼ of NE¼ of SE¼ of Section 26, T5N, R16W

The first Mill Road site, with an elevation of 60 feet, occupies the lower south slope of a ridge line. A dense floral cover of mixed hardwoods and pines is found to either side of a dirt road, the single disturbance in the area. The Hathaway Mill, or Little Gum, Creek flows north of the site, at an approximate distance of 400 meters.

The small, very thin surface scatter of lithic material from this site was found along a 25 meter stretch of the dirt road (north-south). No east-west or vertical dimensions were determined. Soils exposed on the west side of the road cut, which was about 3
one meter below the surrounding terrain, ranged from white to yellowish tan, coarse sands.

Due to the small size and undiagnostic nature of the surface sample no statements about the typology or cultural placement of the site can presently be made. All of the recovered surface material is flint chipping waste.

No recommendations for the preservation or excavation can be made for the Mill Creek 1 site because it does not lie on the Gulf Power Company property. If, however, the site were on the utility company's land, it would be recommended for additional, limited testing. The small size of the surface sample indicates that a detailed examination or preservation is not warranted.

Artifact Assemblage:

lithics: 4 non-utilized waste flakes

8Ho53 Mill Road 2 Site
SE¼ of SE¼ of SE¼ of Section 26, T5N, R16W

The second Mill Road site, elevated between 60 and 70 feet above mean sea level, lies on a low knoll in the bottomlands west of the Gulf Power Company Caryville Plant property. A dense cover of mixed hydric hardwoods and scrub overlies all of the area around the surface scatter, except for two dirt roads (north-south) and east-west) which intersects on the crest of the knoll. An unnamed, permanent pond is situated east of the rise, at an approximate distance of 25 meters.

The surface scatter defining this site came from the intersection of the two roads and the exposed ground immediately adjacent to it. The soils visible on the surface were coarse, angular sands, 3
ranging from white to yellowish tan. No vertical dimensions were obtained for the site.

The artifacts recovered from the surface are not sufficiently diagnostic to allow definite statements to be made concerning the proper cultural placement or typology of the site. The ceramic materials are suggestive of a generalized Woodland tradition (1000 B.C. to A.D. 1200), which includes several separate culture periods. The lithic material is wholly undiagnostic.

No recommendations for the preservation and/or excavation of the Mill Road 2 site can be made, because it lies outside of the property of the Gulf Power Company. Otherwise, limited testing would be recommended at the site. There has been too much disturbance in the environs surrounding the knoll to imagine that there is sufficient archaeological data remaining to warrant preservation or extensive excavation.

Artifact Assemblage:

ceramic: 4 plain, sand tempered potsherds

lithics: 2 non-utilized waste flakes

1 utilized flake, with edge retough

shell: 1 oyster shell fragment

3

8Ho54 East River Line Site
NE¼ of SW¼ of SW¼ of Section 35, T5N, R16W

The East River Line site, with an approximate elevation of 50 feet, lies on a small rise in the wet, marshlike bottomlands immediately east of Cypress Slough. Adjacent vegetation consists of a mixed association of hydric hardwoods, scrubs, and grasses. Permanent water sources are found in the slough, 10 to 15 meters distant, and Wrights Creek, 200 to 250 meters west of the site.

The extremely small sample of surface material was recovered from a cleared area, measuring roughly 10 meters square, along an existing power line corridor (east-west). The visible horizontal dimensions did not accurately reflect the size of the site, since the ground cover was too dense to facilitate the viewing of the ground except along the cleared area. No vertical measurement 3
was obtained for the site. Exposed soils were the coarse, white to yellowish tan sands.

The small size of the recovered lithic sample did not permit any statements to be made about the possible cultural placement or typology of the site. Nothing but several non-utilized waste flakes were collected from the surface of the knoll.

There are no recommendations made for the preservation or extensive excavation of the East River Line site; the apparent small size of the site and the quantity of cultural material it contains do not indicate that either approach is warranted. However, limited testing, in the form of two or three test squares, is necessary in order to better evaluate whether or not significant archaeological data are present below the surface of the site.

Artifact Assemblage:

lithics: 3 non-utilized waste flakes

8Ho55 Buckhead Island Site
NW¼ of NW¼ of NW¼ of Section 3, T4N, R16W

The Buckhead Island site, approximately 1000 meters west of the Choctawhatchee River, occupies a large, irregularly shaped knoll in the Buckhead Slough. The rise, with an exception of 50 feet, is surrounded by wet, swampy terrain which periodically floods. Along the knoll the flora is a mixed association of hardwoods and pines; in the marsh below the rise is a dense cover of hydric hardwoods.

The artifacts defining the site were recovered primarily from a recently excavated borrow pit north of the existing power line corridor, along which the area is situated. Lesser quantities of cultural material were found over all of the knoll, particularly in a cleared area in the southwest quadrant of the rise. The 3
horizontal dimensions for the surface scatter distribution are roughly 50 meters (east-west) by 25 meters (north-south). There were no absolute vertical dimensions obtained; however, materials were eroding from the lower walls of the borrow pit, at least one meter below the surrounding land surface. Within the excavation, soils ranged from white to yellowish tan, coarse, angular sands.

With the exception of two unidentified, stamped potsherds, the ceramic assemblage most closely resembles that of the latter Weeden Island period (ca. A.D 1000 to 1200). This is particularly true of the check stamped sherds, which are identified as the type Wakulla Check Stamp. The remaining ceramics, as well as the small lithic sample, are culturally non-diagnostic. No statements regarding the typology of the site can be made, based on the present recovered surface sample of materials.

The remaining, intact portions of the Buckhead Island site are recommended for preservation and/or extensive excavation. Despite the amount of disturbance along the knoll, based on the available stratigraphic information, there appears to be significant quantities of archaeologically important data remaining below the surface. A more detailed examination of the site should be initiated prior to any additional construction work by the Gulf Power Company. 3

Artifact Assemblage:

ceramic: 4 check stamped, sand tempered potsherds
2 unidentified, stamped, sand tempered potsherds
2 plain, sand tempered potsherds

lithics: 4 non-utilized waste flakes

8Ho56 River Road Site
NW¼ of SW¼ of NW¼ of Section 4, T4N, R16W

The River Road site, with a general elevation of 70 feet above mean sea level, occupies a ridge crest along an existing power line corridor, immediately east of River Road. Mixed hardwoods surround the area of surface scatter. East and west of the ridge lie unnamed, seasonal sloughs or streams, both approximately 150 meters from the site.

The distribution of surface materials was restricted to a shallow, recently excavated borrow pit, on the south side of the corridor. Artifacts were recovered from an area measuring roughly 50 meters (north-south) by 25 meters (east-west). Soils exposed in the borrow pit were angular sands, varying from white to yellowish tan. No vertical dimensions were obtained for the site. 3

No statements can be made regarding the possible typology or cultural placement of the site, except that it has a post-1000 B.C. age. The ceramic assemblage is not sufficiently diagnostic to indicate a specific culture period; the lithic collection consists only of flint and/or chert waste materials.

Due to the recent, extensive alteration of the River Road site environs, no recommendations are made for the preservation or detailed examination of the site. There should, however, be limited testing undertaken in the area if it is to be subjected to any more interference as a result of power line corridor expansion.

Artifact Assemblage:

ceramic: 2 plain, sand and grit tempered potsherds
1 plain, sand tempered potsherd

lithics: 6 non-utilized waste flakes
1 non-utilized core

8Ho57 Pine Knoll Site
SW¼ of NE¼ of NW¼ of Section 31, T5N, R15W

This small site occupies a low knoll, with an approximate elevation of 100 feet, in the sloughs south of the Hathaway Mill Creek. Present vegetation in the area is hydric hardwoods (north) and planted pines (south). Grasses predominate along the crest of the rise. Water may be obtained from any one of the surrounding sloughs, none of which is more than 10 meters from the site.

The materials defining this site were recovered from the relatively unvegetated knoll, which was along an existing power line corridor (east-west). The surface scatter was confined to an area measuring roughly 25 meters (north-south) by 40 meters (east-west). No vertical dimensions were determined for the site. 3

All of the small recovered surface sample of materials is lithic chipping debris. Therefore, no statements regarding the possible typology or cultural placement of the site can be made at the present time.

The Pine Knoll site is recommended for additional investigation if it is to be damaged further. While neither preservation nor extensive excavations appear to be warranted, the superficial nature of the present disturbance indicate that archaeologically significant data may remain below the altered stratigraphy.

Artifact Assemblage:

lithics: 9 non-utilized waste flakes

8Ho58 Bay Hill Site
SE¼ of SW¼ of NE¼ of Section 23, T5N, R15W

The Bay Hill site lies on the "saddle" between two high hills at an elevation of 130 feet. To the west and east of the hills, both of which are forested with slash pine communities, lie marsh-like bays, the western one, approximately 100 meters distant, being Long Round Bay. Seasonal streams flow through the bays and are water sources.

The material defining this site came from a dirt road (north-south) and short distances into the planted pines on both sides of it. Shallow fire lanes were excavated below the trees, next to the road. Horizontal dimensions for the site were roughly 15 meters square; no vertical dimensions were obtained. Along the road and in the fire lanes the exposed soils were coarse sands, ranging from white to yellowish tan. 3

There were no culturally diagnostic artifacts recovered from the surface of the site; all collected materials were flint chipping debitage. Therefore, no statements may presently be made regarding the possible typology or cultural placement of the site.

There are no recommendations made for the preservation or detailed excavation of the Bay Hill site. However, if the Gulf Power Company purchases the land on which the site is found, then two or three test pits should be dug to better understand its cultural significance. It appears that there is little remaining, intact stratigraphy in the area.

Artifact Assemblage:

lithics: 6 non-utilized waste flakes

Amendment 3 9/75

8Ho59 Martins Bay Site
SW¼ of NW¼ of NE¼ of Section 17, T5N, R14W

The Martins Bay site, with an elevation of 140 feet, lies in the low, wet bottomlands adjacent to Martins Bay, an arm of which is approximately 15 meters from the area of surface scatter. Water may be obtained from several locations in the bay. All of the immediate area is planted with slash pines, and there is a heavy ground cover of various scrub bushes among the larger trees.

All of the recovered surface material came from the vicinity of two intersecting dirt roads (north-south and east-west); the total area of surface scatter distribution measured 15 meters square. Soils exposed along the roads varied from white to yellowish tan, coarse, angular sands. No vertical dimensions were determined for the site. 3

Due to the non-recovery of culturally diagnostic artifacts, no statements can be made concerning the cultural placement or typology of the site. The small sample of recovered surface material consists exclusively of lithic refuse.

If the Gulf Power Company purchases the land on which the Martins Bay site is located, for purposes of constructing a new power line corridor, then several test squares should be dug. The high degree of recent disturbance in the surrounding environs suggests that little intact cultural stratigraphy remains.

Artifact Assemblage:

lithics: 8 non-utilized waste flakes

8Ho60 Maize Corridor Site
SE¼ of NE¼ of NW¼ of Section 25, T6N, R14W

The Maize Corridor site, elevated 140 feet above mean sea level, lies on the north slope of a ridge, south of the Jackson Branch of Holmes Creek. The branch flows approximately 50 meters north of the site. The surrounding vegetation consists of planted pine communities on the higher elevations and hydric hardwoods at the lower elevations near the water.

The material recovered from the surface of the site came from a dirt road (north-south) and a section of existing power line corridor southeast of it. The corridor was planted with corn at the time of the survey. The visible distribution of surface scatter was confined to an area measuring roughly 25 meters (north-south) 3
by 15 meters (east-west). Soils exposed along the west profile of the road cut were coarse sands, ranging from white to yellowish tan (upper 45 cm.), underlain by various colored clays.

There were no culturally diagnostic artifacts found on the surface of the site, thus, no statements concerning the typology or cultural placement of the site can be made at the present time. Lithic chipping waste comprised the entire recovered surface sample.

The Maize Corridor site is recommended for preservation or a rather detailed examination if the proposed expansion of the existing power line corridor takes place. The quantity of recovered lithic material and possible depth of cultural stratigraphy suggest that archaeologically significant data remain below the surface.

Artifact Assemblage:

lithics: 31 non-utilized waste flakes

Amendment 3 9/75

8Ho61 Central Ridge Site
NE¼ of SW¼ of NE¼ of Section 36, T5N, R16W

The Central Ridge site, elevated 100 feet above mean sea level, occupies the south slope of a ridge line. The northeast half of the site is covered by stands of commercial slash pine and the southwest half by mixed hardwoods. An unnamed, seasonal slough lies approximately 75 meters south of the area of surface scatter.

All of the recovered material came from a 50 meter stretch of a dirt road (north-south), which separated the floral communities, and areas 25 meters wide on both sides of it. Soils exposed along the road ranged from white to tellowish tan, coarse, angular sands. No vertical dimensions were obtained for the site.

Both of the recovered potsherds have a sand and grit temper; 3
one is undecorated and the other appears to have small, circular punctations. However, the punctated specimen is quite small and not readily identifiable. All of the lithic material is chipping debitage. No definite statements about either the site's typology or cultural placement can be offered at the present.

The Central Ridge site is not recommended for preservation. However, if the tentatively proposed ash disposal area "B" is constructed then a minimum of two or three test pits should be dug at the site to determine if it has any relation to the "Cypress Knoll Site Complex" to its immediate west.

Artifact Assemblage:

ceramic: 1 plain, sand and grit tempered potsherd
1 punctated, sand and grit tempered potsherd

lithics: 23 non-utilized waste flakes

8Ho62 Feeder Site
NW¼ of SE¼ of SE¼ of Section 36, T5N, R16W

This small site lies in the bottomlands in the east-central portion of the survey area, at an elevation of 90 feet. A dense growth of hardwoods and underbrush covers almost all of the surrounding ground except for a few isolated stretches along a dirt road (north-south). The nearest source of water is an unnamed, seasonal slough, which is approximately 500 meters west of the Feeder site.

The small, thin, surface scatter of material came from an exposed stretch of the dirt road. No vertical or horizontal dimensions were obtained for the site, the former because the land had been extensively altered in the past and the latter because the surface cover was too thick to view the ground. Soils present in the immediate area of the surface scatter were coarse sands, varying in color from white to yellowish tan. 3

There was no culturally diagnostic material recovered from the surface of the site. The recovery of only a small sample of lithic debitage did not permit any statements about the cultural placement or typology of the site.

The Feeder site is recommended for only limited testing before it is destroyed. The degree of disturbance in the general vicinity of the scatter of artifactual material indicates that little, if any, archaeologically significant data remain below the present surface.

Artifact Assemblage:

lithics: 6 non-utilized waste flakes

8Ws24 Evans Road II Site
NW¼ of NE¼ of NE¼ of Section 1, T4N, R16W

The Evans Road II site, opposite the first Evans Road site, is situated on the west slope of a low ridge, at an elevation of approximately 80 feet. Evans Road bisects the site in a general east-west direction; a secondary growth of mixed hardwoods, pines, and scrub bushes cover the terrain to both sides of the road. A seasonal stream, the same as associated with the Evans Road I site, flows at a distance of 25 meters to the west.

Artifacts were recovered from a 50 meter long section of the road and for a distance of rougly 25 meters into the wooded area on both sides of the road. The soils exposed along the surface of the road and the embankments to either side ranged from white to 3 yellowish tan, coarse, angular sands. Clays appeared to underlie the sands at a general depth of one meter, as viewed in the deep road cut.

None of the recovered lithic material is culturally diagnostic. Therefore, no statements can be made about the site's typology, cultural or temporal placement.

There are no recommendations made for the preservation and/or extensive excavation of the Evans Road II site. The site has been disturbed by both the road itself and the removal of its original vegetation. However, limited testing should be carried out at the site before any remaining cultural stratigraphy is destroyed.

Artifact Assemblage:

lithics: 32 non-utilized waste flakes
1 projectile point blade fragment (possible)
1 unifacial tool (thumb-nail scraper?)

Amendment 3 9/75

8Ws25 Evans Road I Site
NE¼ of NW¼ of NE¼ of Section 1, T4N, R16W

This small site is located on the eastern slope of a low ridge, at an elevation of 80 feet. A dirt road (east-west) bisects the site, which is covered by planted pine communities both north and south of the road. A small seasonal stream, ten meters distant, flows east of the site.

Materials were recovered from a 50 meter long section of the road and for a distance of 25 meters to either side of it, in the slash pine stands where surface cover was absent. Soils exposed by the road cut and those visible in the pine communities 3
ranged from white to yellowish tan, coarse, granular sands.

No culturally diagnostic artifacts were recovered from the surface of the site. Neither the site typology nor its cultural placement could be determined.

The small size of the site, its apparent partial destruction and the non-diagnostic nature of its surface remains indicate that only limited additional testing is warranted. No recommendations, therefore, are made for its preservation or detailed excavation.

Artifact Assemblage:

lithics: 9 non-utilized waste flakes
1 utilized flake

8Ws26 Evans Ridge Site
SE¼ of NW¼ of NE¼ of Section 1, T4N, R16W

The Evans Ridge site, elevated approximately 100 feet above the mean sea level, is located on a ridge crest. The southern portion of the site lies in a slash pine community and the northern portion in a cattle pasture. The same seasonal stream which flows between the Evans Road I and II sites flows to the north of this site an an approximate distance of 250 meters; a permanent pond lies 100 meters to the south.

The limited material recovered at this site came from a single fire lane along the south edge of the slash pine, north of the pasture's north fence. Access was not obtained to the pasture to test for possible cultural stratigraphy, and three test holes placed in the area of the pines produced no sub-surface artifacts. 3
The test holes revealed at least 50 cm. of possible cultural stratigraphy, as indicated by the yellowish tan, coarse sands.

The single potsherd recovered from the site is an undecorated, sand tempered specimen. It is culturally undiagnostic, as are the non-utilized flint waste flakes.

No recommendations are made for either the preservation or extensive excavation of the Evans Ridge site, primarily because of the non-recovery of material during test holing. However, if the site is destined for any further disturbance, at least one or two test pits should be excavated in order to better understand its cultural significance.

Artifact Assemblage:

ceramic: 1 plain, sand tempered potsherd

lithics: 2 non-utilized waste flakes

Amendment 3 9/75

8Ws27 Pine Tent Site
NE¼ of NW¼ of NW¼ of Section 6, T4N, R15W

The Pine Tent site occupies the north slope of a ridge, at an elevation of 100 feet above the mean sea level. Recent extensive logging activities have removed almost all of the surface vegetation in the area, with the exception of an isolated small slash pine or scrub oak. A small, seasonal slough lies approximately 150 meters north of the site.

Surface materials were recovered from a section of the cleared area measuring roughly 50 meters by 50 meters. Artifacts were also recovered at the bottom of several areas, within the 50 meter square site, which had recently been graded to an approximate 3
depth of 30 cm. Soils exposed on the surface of the clearing and in the profiles of the grader cuts ranged from white to yellowish tan, coarse, angular sands. No definite vertical dimensions were obtained.

There were no culturally significant artifacts recovered at 8Ws27. Surface materials were limited to flint chipping debris; no ceramics were noted.

Extensive testing and/or preservation are not recommended for the Pine Tent site. While it is doubtful that archaeological excavation would produce any new data, several test squares should be excavated before any remaining cultural stratigraphy is disturbed.

Artifact Assemblage

lithics: 7 non-utilized waste flakes

8Ws28 Horse Marsh Site
SE¼ of SE¼ of NW¼ of Section 6, T4N, R15W

This site, elevated 90 feet above mean sea level, lies in the wet bottomlands at the north base of a ridge. Recent clearing activities have stripped almost all of the previous plant cover from the area, with the exception of scattered, second growth, scrub bushes. Hydric hardwoods, fringing a small stream 25 meters distant, border the site on the north. Periodically flooded, marshy areas lie to the immediate west and southwest.

Surface materials were recovered from a portion of the cleared area measuring approximately 50 meters (north-south) by 100 meters (east-west). Materials were also found in the bottom of several shallow fire lanes which crossed the northern limits of the surface scatter. Soils exposed in the profiles of the fire lanes, as 3
well as on the surface of the clearing, were coarse sands, varying in color from white to yellowish tan. No vertical dimensions were obtained for the site.

None of the recovered surface artifacts are culturally diagnostic. The projectile point fragment is from the extreme end of the blade section and could be indicative of any one of several culture periods. The remaining artifacts are lithic debris, one example showing evidence of having been used as a tool.

The disturbed condition of the general area of the Horse Marsh site and its relatively small size, as determined by the limits of its surface scatter, suggest that detailed archaeological testing is not warranted. Therefore, only limited testing is recommended for the site if and before it is damaged further.

Artifact Assemblage:

lithics: 7 non-utilized waste flakes

1 utilized flake

1 distal (blade) end of a projectile point 3

8Ws29 Holmes Creek South Site
SW¼ of NE¼ of SE¼ of Section 2, T2N, R16W

This site, elevated 30 to 40 feet above mean sea level, lies in the wet bottomlands immediately south of Holmes Creek. The water flows less than 25 meters north of the site. South of the area from which materials were collected, the vegetation is planted pine; north, along the edge of the creek, hydric hardwoods occur.

All of the cultural material was recovered from a cleared plot, crossed by several dirt roads, between the two floral communities. The area measured approximately 25 meters square. Within the clearing, exposed soils were coarse sands, ranging from yellowish tan to light gray. No vertical dimensions were obtained for the site.

The recovered ceramic assemblage is too small and homogeneous 3
to allow very definite statements to be made about the typology or cultural placement of the site. The sand tempering of all of the potsherds, and identified check stamping of four examples, indicate a post-1000 B.C. date for the occupation of the area. The lithic assemblage is culturally undiagnostic flint chipping waste.

The Holmes Creek South site is recommended for preservation and/or detailed excavation, if and when the Gulf Power Company purchases the property to construct a new power line corridor. Despite the recent disturbance in the area, it appears as though there are significant amounts of intact, cultural stratigraphy at the site. This is particularly true in the hardwoods bordering the south side of the creek.

Artifact Assemblage:

ceramic: 7 unidentified, decorated(?), sand tempered potsherds
4 check stamped, sand tempered potsherds
lithics: 7 non-utilized waste flakes

8Ws30 Chapel Branch Site
NW¼ of SE¼ of NW¼ of Section 36, T3N, R16W

This site lies in the bottomlands, at an elevation between 20 and 30 feet above mean sea level, between the Chapel Branch of Holmes Creek and its sole northern tributary. The tributary creek is roughly 100 meters west of the visible surface scatter. There are no trees in the immediate area, as the lands south of the site are grass covered pasture and those north of it are combined pasture and agricultural plots.

The distribution of surface materials was limited to a 15 to 20 meter stretch of right-of-way along either side of a paved road (east-west). No dimensions were obtained for the north-south or 3
vertical components of the site, because access could not be gained to the privately-owned lands on both sides of the road. The soils exposed along the shoulders of the road were coarse sands, ranging from white to medium gray.

The recovered ceramic artifacts are insufficiently diagnostic to date the site any more accurately than post-1000 B.C. The sole lithic example is an insignificant flint waste flake. For this reason, no statements regarding the proper typology or cultural placement of the site can be made at the present.

The Chapel Branch site is recommended for preservation and/or extensive excavation, if the site area is purchased for the construction of a new power line corridor. The greater part of the present disturbance to the environs appears quite superficial, suggesting that significant archaeological data remain below the pastures and fields.

Artifact Assemblage:

ceramic: 12 plain, sand tempered potsherds

5 unidentified, decorated, sand tempered potsherds 3

1 check stamped, sand tempered potsherd

lithics: 1 non-utilized waste flake

8Ws31 Brink Hill Site
SE¼ of NW¼ of NE¼ of Section 11, T2N, R16W

Elevated approximately 40 feet above mean sea level, the Brink Hill site occupies the crest of a low hill, which is planted with slash pine. The rise is located between the Reedy Branch of Holmes Creek and its last southern tributary stream before it flows into the larger creek. Both of the available water sources are roughly 150 to 200 meters from the area of surface scatter.

The small sample of cultural materials was recovered from a dirt road (east-west) which crosses Brink Hill. A north-south measurement was not obtained because the dense surface cover among the planted pines made viewing the ground impossible. Soils exposed 3
along both sides of the road were light gray to yellowish tan, coarse sands; they extended to a general depth of 30 cm. below ground level.

Due to the small size and non-diagnostic nature of the recovered surface scatter no statements can be made regarding the possible cultural placement or typology of the site. The artifact assemblage consists of small quantities of lithic waste material and one fragment of oyster shell.

No recommendations are made for the preservation or extensive excavation of the Brink Hill site. However, if the utilities company purchases the land, one or two test pits should be dug in order to determine whether or not any intact, cultural stratigraphy remains in the area. The present condition of the immediate environs suggests that little, if any, cultural data remain in place beneath the commercial pine communities.

Artifact Assemblage:

lithics: 4 non-utilized waste flakes 3

shell: 1 oyster shell fragment

8Ws32 Holmes Bluff Site
SW¼ of NW¼ of NE¼ of Section 27, T2N, R16W

The Holmes Bluff site, with an elevation of 140 feet, occupies the upper slope of a ridge line east of Holmes Creek. North and south of the ridge are unnamed, tributary streams of the larger creek, both between 100 and 125 meters distant from the site. Present vegetation in the immediate area is planted pine, with a dense scrub underbrush.

The materials defining this site came from a 25 meter stretch along a dirt road (east-west) on the crest of the ridge line. The area of surface scatter was approximately 25 meters wide (north-south). There were no vertical dimensions determined for the site. Soils, exposed along the surface of the road and the embankments 3
to its sides, were white to yellowish tan, coarse, angular sands.

No statements concerning the possible typology or cultural placement of the site can be made at the present because of the lack of culturally diagnostic artifacts from the surface. All of the material collected from the surface is lithic chipping debris.

There are no recommendations made for the preservation or extensive excavation of the Holmes Bluff site, even if the Gulf Power Company expands the already existing power line corridor the site is situated on. However, very limited testing should be undertaken before any additional damage is done to the area, to determine the cultural significance of the site.

Artifact Assemblage:

lithics: 9 non-utilized waste flakes

8Ws33 Mill Lake Site
NW¼ of NE¼ of SE¼ of Section 4, T1N, R16W

This site, with an elevation of 60 feet, lies on the crest of a low hill which is situated equidistant from Mill Lake (west) and Long Pond (east). An unnamed, permanent pond is between 50 and 75 meters from the hill top. Presently, the vegetation is limited to communities of slash pine and heavy scrub vegetation.

The small sample of recovered artifacts defining this site came from a 50 meter stretch of dirt road (north-south) along an existing power line corridor; its other visible horizontal dimension (east-west) was approximately 25 meters. There were no vertical dimensions obtained for the site. Coarse, angular sands, ranging from white to medium gray in color, were the only soil types exposed along the road. 3

Due to the undiagnostic nature of the present surface collection of artifacts, no definitive statements may be made concerning the typology or specific cultural placement of the site. In general, the ceramic assemblage indicates a post-1000 B.C. date for the site's occupation. The flint chipping waste is temporally insignificant.

The Mill Lake site is not recommended for extensive excavation and/or preservation, because both the size of the surface sample and condition of the surrounding terrain dicate that neither approach is warranted. Nonetheless, if the power company decides to expand their existing power line corridor in its vicinity, then several test squares should be excavated at the site in order to better understand its significance.

Artifact Assemblage:

ceramic: 2 plain, sand and grit tempered potsherds 3

1 plain, sand tempered potsherd

lithics: 2 non-utilized waste flakes

8Ws34 Mill Branch Site
SW¼ of SE¼ of SE¼ of Section 4, T1N, R16W

This site, at an approximate elevation of 30 feet above the mean sea level, is located in the bottomlands roughly 100 meters south of the Mill Lake site (8Ws33). An unnamed, tributary spring, of the Mill Branch of Holmes Creek, lies about 200 meters due west of the surface scatter distribution. Vegetation in the surrounding areas is slash pine with dense scrub among the larger trees.

The visible dimensions of the area of surface scatter were roughly 50 meters square. No vertical dimensions were determined. All of the cultural material came from a dirt road (north-south) on an existing power line corridor, along which were exposed sandy soils, ranging in color from white to medium gray. 3

The relatively large collection of potsherds, representing several distinct ceramic types, indicates that the site was occupied during the latter half of the Weeden Island period, ca. A.D. 800 to 1000 (Percy 1974:6). However, no statements are presently possible concerning the site's typology. The lithic material is an insignificant part of the total artifactual assemblage.

Due primarily to the relatively large size of the recovered ceramic assemblage, the remaining areas of the Mill Branch site are recommended for extensive testing and/or preservation. There appears to be significant archaeological data left at the site which would be destroyed if, as planned, the Gulf Power Company expands their existing power line corridor in the vicinity of the site.

Artifact Assemblage:

ceramic: 26 plain, sand tempered potsherds

15 plain, sand and grit tempered potsherds

2 brush marked (?), sand tempered potsherds

2 (Keith) incised, sand and grit tempered potsherds 3

2 unidentified, decorated, sand and grit tempered potsherds

1 (Wakulla) check stamped, sand and grit tempered potsherd

lithics: 1 non-utilized waste flakes

8Ws35 Pine Chair Site
SW¼ of NE¼ of NE¼ of Section 1, T4N, R16W

This site lies along the east slope of a north-south oriented ridge, at an approximate elevation of 90 feet. Planted pines lie to the north and east of the recovered surface scatter and assorted hydric hardwoods to the south and west. An unnamed stream flows south and east of the site, at a distance of 50 meters.

The very thin scatter of surface materials came from a recently cleared section at the southwest corner of the slash pine community. No horizontal dimensions were obtained for the site becuase of the dense ground cover under the pines and hardwoods; no vertical dimensions were obtained. Soils exposed on the surface of the clearing and in several deep holes ranged from white to yellowish tan coarse sands. 3

None of the recovered artifacts are culturally diagnostic. Nothing, therefore, can be stated with certainty about the site's typology or cultural affiliation.

There are no recommendations made for the excavation or preservation of the Pine Chair site. The site appears both too small and too disturbed to yield additional data to a more thorough testing.

Artifact Assemblage:

lithics: 2 non-utilized waste flakes

1 utilized flake, with edge retouch

8By72 Pine Log Forest Site
NE¼ of NE¼ of SE¼ of Section 24, T1S, R17W

This site, in the Pine Log State Forest, lies on a low rise in the bottomlands east of an unnamed, tributary stream of Pine Log Creek. The site is elevated approximately 60 feet above the mean sea level and lies about 50 meters from the water. Vegetation in the surrounding environs is pine, with a dense growth of underbrush.

All of the materials from the surface of this site came from a dirt road (north-south) along an existing power line corridor, and several deep fire lanes at the edge of the pines to either side of the road. The area of surface scatter distribution measured roughly 25 meters square. Exposed soils were coarse sands, varying from white to medium gray in color. There were no vertical dimensions obtained for the site. 3

No statements, other than that its occupation was later than 1000 B.C., may presently be made regarding the possible typology or cultural placement of the site, because of the non-diagnostic nature of the surface sample. The only type of material recovered is ceramic refuse. The plain, sand or sand and grit tempered potsherds are not culturally diagnostic.

If the power line corridor on which this site is located is expanded by the Gulf Power Company, then limited testing should be done at the Pine Log Forest site, before it is damaged further. The small size of the recovered surface sample and generally disturbed condition of the immediate area indicate that extensive excavation and/or preservation of the site is not warranted.

Artifact Assemblage:

ceramic: 4 plain, sand and grit tempered potsherds 3

2 plain, sand tempered potsherds

Acknowledgements

Several individuals with the Division of Archives, History and Records Management deserve mention for having contributed to the production of this report. Mr. George W. Percy, Administrator of the Archaeological Research Section, provided a comprehensive bibliography for the archaeology of Northwest Florida, which in part appears in this report. Mr. James J. Miller, Historic Sites Specialist with the A.R.S., performed the computations which appear in the section of environment. Both men acted as general editors for the report. 3

Mary K. Jones and Marsha Penman prepared the finished site forms which appear at the conclusion of this report, and Mr. Steve Henson typed the final copy. Finally, Mr. R. Bruce Council deserves credit for having served as the second survey archaeologist during the field portion of the project.

Bibliographic Note

Many of the references in the following bibliography are not cited in the body of the report. However, they are included in the bibliography because they are pertinent to the archaeology of Northwest Florida and provide a partial list of the available source material for those individuals interested in a more detailed study of the general area. 3

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SECTION 2 OF APPENDIX D

The following pages contain detailed ecological data relative to the proposed power plant's water intake structure, water discharge structure, and river access corridor. This data is arranged into five main subject areas followed by a comprehensive bibliography. 3

SITE SELECTION:

WATER INTAKE, WATER DISCHARGE, AND RIVER ACCESS CORRIDOR

FOR THE

R. F. ELLIS, JR. ELECTRIC GENERATING PLANT

GULF POWER COMPANY, CARYVILLE, FLORIDA

3

August 1975

WATER AND AIR RESEARCH, INC.

GAINESVILLE, FLORIDA

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I

EXECUTIVE SUMMARY

In accordance with requirements of the Federal Water Pollution Control Act Section 316(b) and 404, as well as other Federal and State regulations, a study was conducted to determine the optimum location and alternatives for the operation of cooling water intake and treated wastewater discharge facilities on the Choctawhatchee River as part of the R. F. Ellis Electric Generating Station. Consideration was given to river dynamics, water intake alternatives, disposal of cooling tower blowdown, water quality, and the ecology of the river and associated wetlands. A site (site 1) was chosen and predictions of the effects of plant operation made. The results showed the water withdrawal and treated wastewater discharge can be accomplished with minimal adverse effects on the indigenous natural resources. 3

River Dynamics

The Choctawhatchee River is a meandering stream with a wide floodplain. Under average flow conditions (5320 cfs) the river has an average velocity of about 2-3 fps along the straight reaches and about 1.25 fps in the bend near intake site 1. During flood flow in April, 1975, the river velocities were 3.8 fps in the straight reach and 1.7 fps in the bend. The suspended solids concentrations were about 45 mg/l.

In the vicinity of the plant the river is about 300 ft wide at normal flow. The floodplains are wide -- approximately 3500 ft on the east bank adjacent to the plant site and 9500 ft on the west bank. At the plant site the river flows for about 0.5 miles in a straight reach in a wide unpredictable channel. However, a stable bend occurs at intake site 1 where the bank migration is slow; the river velocity is

low; the cross-sectional area is large; and the flow is deep. Secondary flow deepens the channel on the outside bend; the river thalweg always occurs on the outside bend.

Water Intake Alternatives

Three alternative sites for water intake were considered. The best site for the water intake is in the outside bend at intake site 1 where the river dynamics are most favorable. The river and bank are stable with no migration. The thalweg of the river is adjacent with a deep bottom at 22 ft MSL. The currents are slow both in normal flow, 1.25 fps, and flood flow, 1.7 fps. The secondary currents bring the low suspended solids from the surface to the bottom -- <40 mg/1 at average flow. Clean water flows at <1 fps from the floodplain during floods. The intake structure will have no adverse effects on the river flow or erosion patterns.

The alternative locations, site 2 and 3, are in a wide straight 3
reach of the river where the channel is unstable and unpredictable. The river dynamics are not as favorable as at site 1.

The proposed water intake configuration is a cost-effective, submerged intake particularly designed to minimize the impingement and entrainment of fish and planktonic fish eggs. The structure will be placed in the river thalweg. This allows the water intakes to be placed near the bottom of the river, completely submerged at all times, and still withdraw water with minimum suspended solids. The river currents are spiralling at site 1; the force of the river flow is downward past the screens and not into the screens. This minimizes impingement and sweeps fish, materials, etc. past the intake. The screens are designed

so that the intake flow is less than 0.5 fps, allowing fish to escape impingement.

This intake configuration is analogous to a bridge pier in a channel. The configuration is a simple cost-effective structure, causes mimimun disruption to river flow, allows efficient high speed pumping, and provides maximum safeguards to the environment.

In the selection process the conventional traveling screen intake and a slotted pipe intake configuration were also considered. However, it was believed that these were less acceptable in achieving cost-effective engineering and environmental safeguards.

Effluent Water Discharge

Three alternatives were considered for the disposal of the heated water effluents from the plant. These were disposal into Little Dram Branch, the rim swamp and the Choctawhatchee River.

The alternatives of disposing of the heated effluents into either 3
Little Dram Branch or the rim swamp were both unsatisfactory. Disposal in Little Dram Branch will not allow cooling of the thermal discharge and could create an adverse ecological impact. Disposal into the rim swamp would effectively dissipate the heat, but the long term ecological impact could be severe. The rate and extent of possible damage to these areas are unknown; therefore, the risk is unwarranted where a more completely understood and available alternative exists. The functions of the wetlands in retaining nutrients and in the food web are extremely valuable. The forest system of the branch and swamp, if lost, might require decades to recover. The dynamic river system is unlikely to be affected by chronic stresses from the effluent water discharge, and

could recover in a short term -- perhaps days -- from an acute stress.

Dissipating the heated effluent into the Choctawhatchee River is the best alternative. The discharge site should be located in the river approximately 100 ft downstream from the water intake structure. Little ecological impact should result to the river system.

Water Quality

The Choctawhatchee River is naturally turbid and carries sufficient suspended solids to limit primary production of aquatic plants and algae. The dissolved solids are low. The discharge effluents from the plant will not degrade the water quality of the Choctawhatchee River. There will be no significant changes in temperature, total dissolved solids, or ionic balance. Outside of a small mixing zone, the thermal impact on the river will be negligible. Low dissolved oxygen concentrations in the discharge will not alter the oxygen balance in the river. 3

The total dissolved solids in the Choctawhatchee River under the most adverse conditions (3000 MW - autumn) will increase from 54.2 mg/1 to 65.8 mg/1 (21.5 percent), and under average conditions (3000 MW - autumn) from 54.2 mg/1 to 55.9 mg/1 (3.2 percent). Natural sulfate concentrations in the river are extremely low and variable. The sulfate will increase from 1.55 to 5.15 mg/1 (230 percent) under adverse conditions, and from 1.55 to 2.20 (42 percent) under average conditions. No harmful effects are expected from this increase in sulfate or increase in total dissolved solids.

Biologic Characteristics of the River

Sufficient information has been developed on the aquatic ecology to predict the impact of the power plant on these aquatic communities.

The primary aquatic production in the Choctawhatchee River is severely limited by natural forces. The food web for fish is based on detritus from the drainage area, rather than on the biologic components of the river.

The planktonic and periphyton primary producers are mostly diatoms. They are sparse, with low biomass. The Shannon-Weaver Diversity Indices of each are about 3, indicating a fairly diverse population; the evenness coefficient values are about 0.8, indicating uniformity; Morisita's Indices indicate similar populations throughout the river.

The plankton community will be affected by entrainment and thermal shock from the discharge plume. The typical plankton loss under average operating conditions (3000 MW - winter) could total about 3 percent of the population -- 1.3 percent by entrainment and 1.8 percent from thermal shock. This is negligible. Under the worst case conditions (3000 MW - winter), this total plankton loss could be about 23 percent -- 11.5 3
percent by entrainment and 11.6 percent from thermal shock. However, the probability of this occurrence is extremely low. The plankton community will not be affected by the change in water chemistry, the increase in total dissolved solids, or the chlorine residuals.

The periphyton community will not be affected by plant operation. The whole river increases in temperature (<2°F), dissolved solids, and chlorine residuals will have no effect on the periphyton community.

The benthic macroinvertebrates are sparse and under severe natural stress. The community is predominantly chironomids, oligochaetes, and bivalve molluscs. The less abundant groups indicate this is an unpolluted area. The Asiatic clam, Corbicula, is present but not

abundant. The diversity indices are about 1, indicating low diversity-high stress; the evenness values are about 0.7, indicating fair uniformity, and a cluster analysis for Morisita's Indices indicate two dissimilar populations -- one in the thalweg and one at the river's edge.

The benthic macroinvertebrates on the river bottom will not be affected by plant operation. Thermal tolerances will not be exceeded on the bottom. Hatches of benthic organisms will be affected in the same manner as plankton. The increases in total dissolved solids and chlorine residuals in the whole river are not sufficient to affect the benthic community structure. The water intake and discharge structures in the river will create a new habitat for benthic macroinvertebrates which require stable substrate.

The commercially important or game fish that are of particular interest are Striped bass and shad (Alosa) because of their planktonic eggs. Fish will be only slightly affected by plant operation. The impingement and entrainment of fish by the water intake will be minimized by the configuration of the intake structure. Fish will avoid the discharge plume, minimizing the effects of thermal shock and low dissolved oxygen. There should be no effect from increased dissolved solids or chlorine residual. Planktonic fish eggs will be affected in the same manner as plankton. However, the impact of entrainment and thermal shock are reduced because the Striped bass and shad (Alosa) spawn only in the spring. The portion of the plankton and eggs affected will be reduced during this season because of the high river flow.

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The construction and operation of the proposed plant should have no adverse effects on the aquatic ecology of the Choctawhatchee

River. The river should continue to support its present levels of plankton, periphyton, benthic macroinvertebrates and fish.

Ecology of the Access Corridor

Three alternative routes were considered for the intake-discharge corridor from the river to the plant site. Corridor 1 was selected as the best alternative. It is the shortest route, approximately 5000 ft long; it affects the fewest acres of floodplain and upland forests. The corridor will be 100 ft wide with a maintenance road at approximate elevation of 60 ft (MSL) across the floodplain. A causeway will be required across the low areas with appropriately placed culverts and/or 3
trestles to facilitate the movement of water. There are no unique vegetative associations and there are no rare or endangered plants or animals in the area.

The causeway across the floodplain will block approximately 12 percent of the flood flow in the east bank floodplain for a flood at elevation 60 ft (MSL). This will cause an additional backwater of only 2 inches in the whole river and a velocity increase of only 0.25 fps. Localized velocities near the end of the causeway may reach 5-6 fps.

This corridor and causeway will have minimal effects on the ecology of the river, the floodplain, and the uplands.

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II

INTRODUCTION

The Gulf Power Company, anticipating the need for additional electric power in northwest Florida, proposes to build the R. F. Ellis Electric Generating Plant, which will go into operation in 1980 with an initial capacity of 500 megawatts (MW). This capacity will increase to 1000 MW by 1981 and ultimately reach 3000 MW. This fossil fuel plant will be located on a 1934 acre site along the east bank of the Choctawhatchee River near Caryville, Florida.

The Choctawhatchee River drains 3499 square miles of northwestern Florida and southern Alabama and empties into the Gulf of Mexico through the Choctawhatchee Bay. Most of the Choctawhatchee watershed is undeveloped. The plant site is in an area of sand hills with low topographic relief about a mile east of the river. The area between the river and the plant is a well-developed floodplain, rim swamp and upland forest. 3

A number of regulations and laws -- both at the Federal and State level -- are applicable to the siting of power plants, the disposal of effluents, the maintenance of water quality standards, and regulation of activities in navigable waters and wetlands. In Florida, the Electric Power Plant Siting Act 403.5 regulates the siting of power plants, and Chapter 17-3 (FAC) establishes the water quality criteria. The Federal Water Pollution Control Act 92-500 section 316(b) stipulates best available technology to minimize the adverse effects of cooling water and section 404 regulates activities to minimize the impact on wetlands. Federal Regulation 40 CFR 423 prescribes the

standards of performance regarding point source effluents from steam electric power plants and the new regulation from the Corps of Engineers Title 33 part 209 section 10 pertains to permits for activities in navigable waters. The Gulf Power Company is cognizant of these various regulations and is exerting every effort to conscientiously comply with these requirements.

The purpose of this investigation is to select a site for the water intake, for the effluent water discharge and for an access corridor between the river and the power plant. In selection of these various sites, the considerations of environmental protection, best technology, engineering feasibility, and cost-effectiveness were all important. Not only were alternative locations for these sites considered but alternative methods and configurations for water intake and water disposal were also considered. 3

At 3000 MW capacity a maximum of 37,500 gpm water will be removed from the river to meet the requirements of plant operation. Three alternative water intake sites at various locations on the Gulf Power property along the river bank were considered. River dynamics of the Choctawhatchee River were determined within this reach of the river to locate the best site. Information was obtained from field studies, from the Gulf Power Company and from published literature. The various configurations for a site specific water intake were evaluated. These evaluations were to achieve a design that would be cost-effective, represent best available technology, and provide the best possible protection of the various indigenous environmental systems.

A cooling tower blowdown of 9000 gpm must be discharged from the plant along with other effluent waters. Three systems were

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considered for the disposal of this heated effluent water from the plant -- disposal into: 1) the Little Dram Branch, 2) a nearby rim swamp and 3) into the Choctawhatchee River. Calculations were made to determine the dissipation of the heat in each of these systems. Again the environmental considerations were paramount in the selection of the best system and site.

The selection of an access corridor from the river to the plant depends first on the selection of the water intake, then on the selection of the shortest route that would cause the least environmental alteration to the terrestrial system.

The environmental factors were identified so that the effects of plant construction and operation could be assessed on each of them. The objective was to establish information and guidance for the planning and management function of this project to protect and preserve the 3 environmental resources yet contribute to the design, engineering, and decision-making process in a meaningful, cost-effective manner.

Both aquatic and terrestrial ecologies were studied. A survey of the biological community of the Choctawhatchee River was conducted in the spring of 1975. Spring was selected as the period of maximum ecological sensitivity, highest natural stress, and therefore, the optimum season to study the biological components of the river. A terrestrial study was conducted through the floodplain, rim swamp, and upland forests between the river and plant site. Information was obtained from these field studies, from the Gulf Power Company, from various governmental agencies, and from the published literature. The data base developed on the aquatic and terrestrial ecology was sufficient to predict the impact of the power plant on these various communities.

III

CHOCTAWHATCHEE RIVER: PHYSICAL AND CHEMICAL CHARACTERISTICS

River Dynamics

Introduction

To select the optimum water intake site and to select the optimum intake configuration, it is necessary to understand and evaluate the river dynamics in the vicinity of the proposed plant site. It is necessary to know the characteristics of flow, the velocity, the nature of the currents, the profiles in the river bottom, the thalweg of the river, the stability of the channel and banks, and the suspended sediment load, the nature of the sediment, the history of flooding, the characteristics of the floodplain, etc. It is the purpose of this section to describe the river dynamics of the Choctawhatchee River in the vicinity of the Gulf Power plant site near Caryville, Florida. 3

Methods

Samples were taken and measurements were made on the Choctawhatchee River in the vicinity of the proposed plant in April and May, 1975. These measurements, along with other data and records from the U.S. Geological Survey (USGS), Gulf Power Company, and others, were used to define the river dynamics. Standard methods of evaluating the hydraulics in open channel flow and sediment transport were employed.

Results

The optimum location for a water intake is on the east bank of the Choctawhatchee River in the vicinity of site 1. The bank is stable, the river is deep and the water is clear. The optimum location for water discharge is into the Choctawhatchee River at a site approximately 100 ft downstream from the water intake. Currents will dissipate the discharge rapidly.

General Description of the River. The Choctawhatchee River is a meandering stream with a wide floodplain. Under average flow conditions, about 5320 cfs, the river has an average velocity of about 2 to 3 fps and a suspended solids concentration of about 45 mg/l. The velocity across the river varies as a function of river position; the velocity is higher in straight reaches than in bends. In addition to the suspended sediment, relatively large volumes of sand and silt are transported just above the river bed. 3

Compared to other rivers in the United States, the Choctawhatchee River has a low concentration of suspended sediment. However, compared to other rivers in Florida, the river has a high sediment burden (Vernon, 1942). Sediment transported in a river is dependent on the characteristics of the drainage basin, the soil type, vegetative cover and climatic conditions. If cultivation in this drainage basin increases, the sediment load of the Choctawhatchee River can be expected to increase. In predominantly agricultural areas the reservoir sedimentation rates can be as high as 1.3 acre-feet per square mile of drainage area per year (Water Resource Council, 1970).

The Choctawhatchee River near Caryville, Florida is shown on the general vicinity map, Figure III-1. At the Gulf Power Co. plant site it flows for about 0.5 miles in a straight reach then bends sharply to the

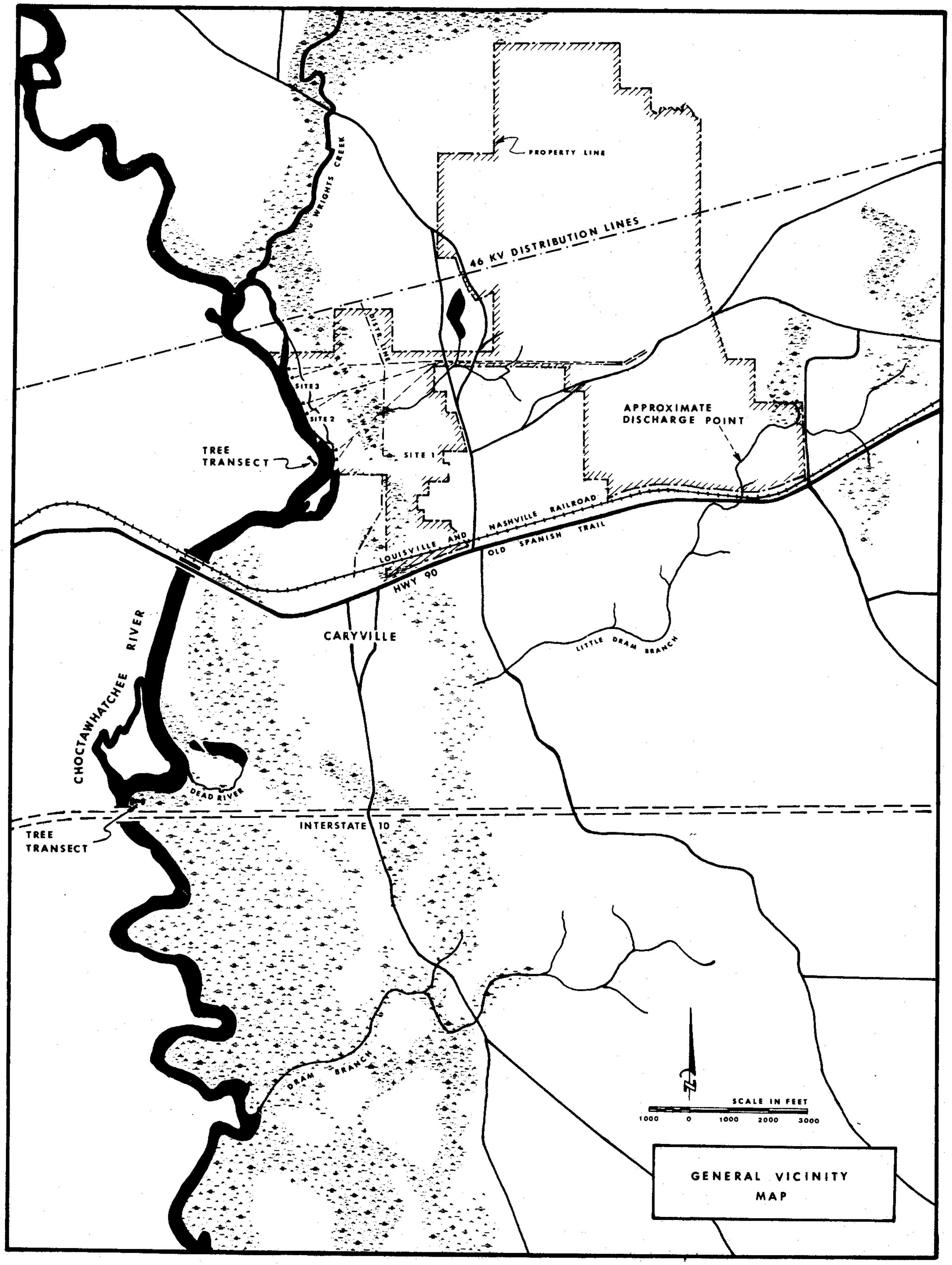

FIGURE III-1. CHOCTAWHATCHEE RIVER IN THE VICINITY OF THE PROPOSED R. F. ELLIS, JR. STEAM ELECTRIC GENERATING STATION, CARYVILLE CARYVILLE, FLORIDA

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southwest. Approximately 0.6 miles downstream from the site the river flows under a railroad bridge and highway US 90, and further downstream under highway I-10.

In the vicinity of the plant site the river is about 300 ft wide at normal flow at elevation 46 ft MSL, and about 400 ft wide at bank full flow at elevation 50 ft MSL. The floodplains are wide -- approximately 3500 ft on the east bank adjacent to the plant site and 9500 ft on the west bank. A USGS gauging station is located at the US 90 bridge. The flood of record is 66.1 ft MSL.

The reach of the river along the plant site and the locations of three alternative water intake sites are shown in Figure III-2. A wide unpredictable channel is found along the straight reach between alternative sites 1 and 3. An unstable area is found between site 1 and 2 where erosion is occurring along the west bank and aggradation along the east bank. Another unstable area is found downstream from site 1, where erosion is occurring along the east bank and aggradation along the west bank. A stable bend is found at site 1. The thalweg of the river, the deepest portion of the stream, is shown in Figure III-2. 3

<u>River Currents</u>. The current velocities measured along this portion of the Choctawhatchee River during normal flows in May, 1975, were about 2-3 fps along the straight reaches in the vicinity of site 2 and about 1.25 fps in the bend near site 1. During flood flow in April, 1975, the river velocities were 3.8 fps in the straight reach and 1.7 fps in the bend.

These measurements are consistent with calculations using Manning's

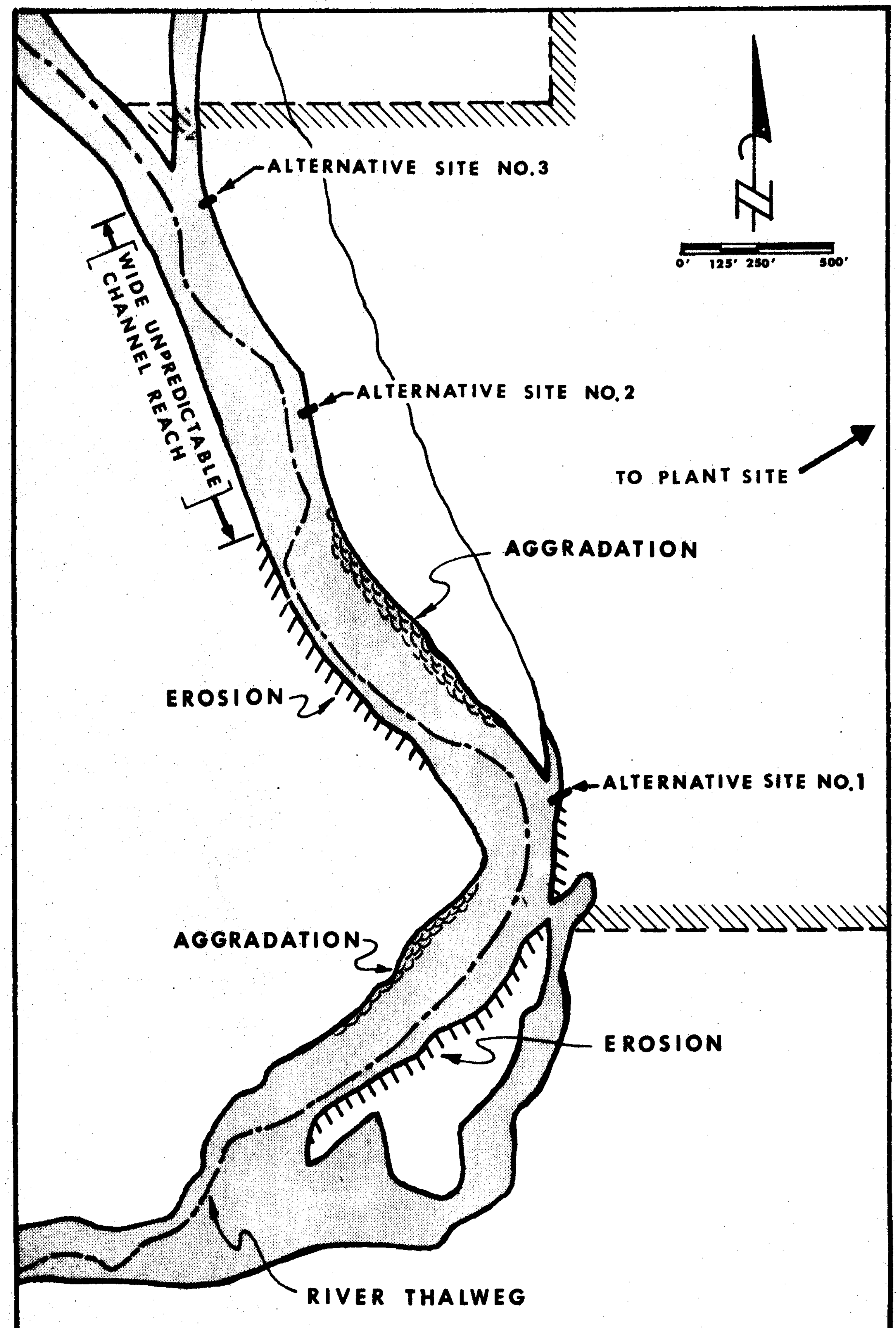

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FIGURE III-2. CHOCTAWHATCHEE RIVER THALWEG, EXISTING EROSION, AND SEDIMENT DEPOSITION AREA IN THE VICINITY OF THE THREE ALTERNATIVE WATER INTAKE SITES.

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equation:

$$V_m = \frac{1.49}{n} (R)^{2/3} (S)^{1/2}$$

Where:

V_m = velocity

n = Manning's coefficient

R = Hydraulic radius

S = Slope of the channel

In the straight reach of the river near site 2, in normal flow the width is about 280 ft , the depth is about 8 ft , thus the hydraulic radius is approximately 8 ft. From the USGS quadrangle maps the slope of the channel is estimated to be about 1.82×10^{-4}. Manning's coefficient 3
can be assumed to be 0.035.

Then $$V_m = \frac{1.49}{0.035} (8)^2 (1.82 \times 10^{-4})^{1/2}$$

$$V_m = 2.30 \text{ fps}$$

The normal flow can be calculated:

$$Q = V_m A$$

Where:

V_m = the average velocity, and

A = the cross-section

Then $Q = (2.30)(8)(280) = 5{,}150$ cfs.

This compares well with the USGS reported value of 5320 cfs normal flow.

The current velocities in the bend of the river near site 1 are lower than the velocities in the straight reach both during normal and flood flow. Although there is a complex interaction of forces that effect velocities in a river, a simplistic hydraulic explanation can be made for the lower velocities on the outside of a river bend. The hydraulic energy of any open channel is both potential energy -- static head of elevation, and kinetic energy -- velocity head, $V^2/2g$. Thus:

$$\text{Hydraulic Energy} = h + V^2/2g$$

Centrifugal force causes the water to mound on the outside of a bend -- a "super-elevation"; while on the inside, water loses elevation. This increase in height, or potential energy, on the outside is offset by a compensating decrease in velocity head to maintain a constant hydraulic energy level (Fox, 1974; Ananyan, 1957). The "super-elevation" 3
in the bend in the vicinity of site 1 is estimated to be 0.75 in. This is the major factor effecting the velocity in the river near site 1. A "super-elevation" of 0.75 in. will reduce the velocity by 2 fps. This compares well with the observed velocities both during normal and flood flow.

Continuity and secondary flow also contribute to the velocity in a bend. Continuity of flow is simply the statement that flow moving down a river at one point must equal flow at another point if there are no inputs or discharges. Average velocity can then be expressed as the flow divided by the cross-sectional area,

$$V = Q/A$$

Since erosion is prevalent in river bends, the cross-sectional area at bends is normally larger than the cross-section in straight reaches

and thus the average velocity is lower in the bend to maintain continuity.

$$V_a A_a \simeq V_b A_b$$

Secondary flow is the spiralling motion of the water caused by the resultant forces of gravity and centrifugal force. Centrifugal force near the surface drives surface water to the outside of the bend; pressure forces at the bottom push bottom water away from the deeper side.

Typical currents in a river bend are illustrated in Figure III-3. A secondary flow develops with a velocity component that is a small fraction of the river velocity and is perpendicular to the river flow. This introduces a spiralling motion which moves relatively clear water from the surface to the outside of the bend, and relatively turbid water from the bottom to the inside of the bend. Secondary flow deepens the channel on the outside bend and deposits sand downstream on the inside bend. 3
This is illustrated for the bend at site 1 in Figure III-3. The river thalweg, the deepest portion of the river, always occurs on the outside bend as illustrated in Figure III-2.

It was observed during the flood in April, 1975, that water on the east bank floodplain flowed at velocities less than 1 fps and re-entered the river at the bend near site 1. During flood flow a relatively clean, slow moving water is provided at site 1 from the floodplain, as well as from the river.

The bend of a river is referred to as a "pool" reach of the river. In such areas the river velocity is low; the river cross-sectional area is relatively large; and the depth of flow is usually deeper than in a straight reach. These are ideal conditions at site 1 for the location of the water intake and water discharge structures. The spiralling flow brings the cleanest water to a submerged water intake, while the spiralling turbulence offers rapid dissipation of a discharge plume.

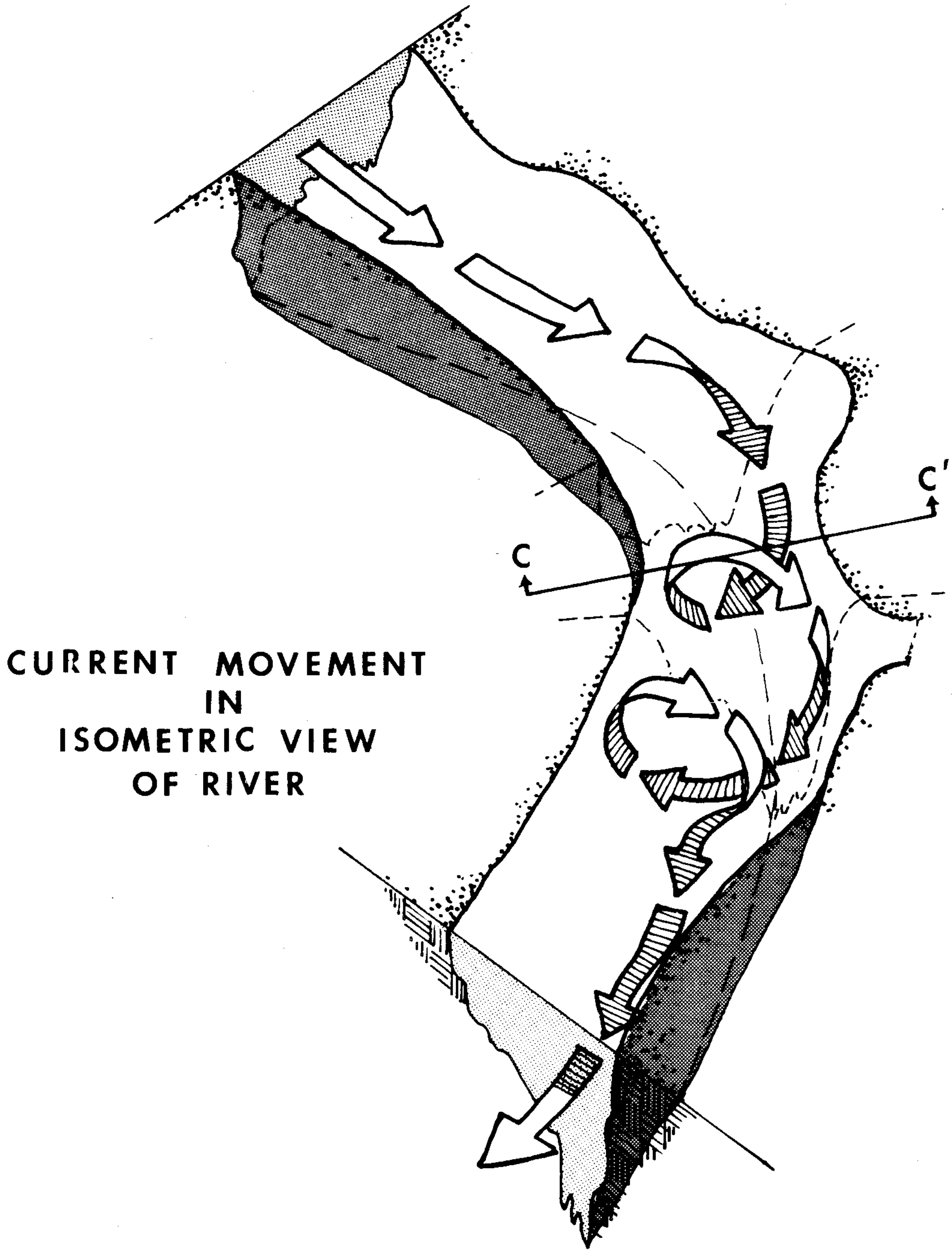

FIGURE III-3a. AN ILLUSTRATION OF THE PRIMARY AND SECONDARY CURRENTS IN THE RIVER BEND NEAR WATER INTAKE SITE 1.

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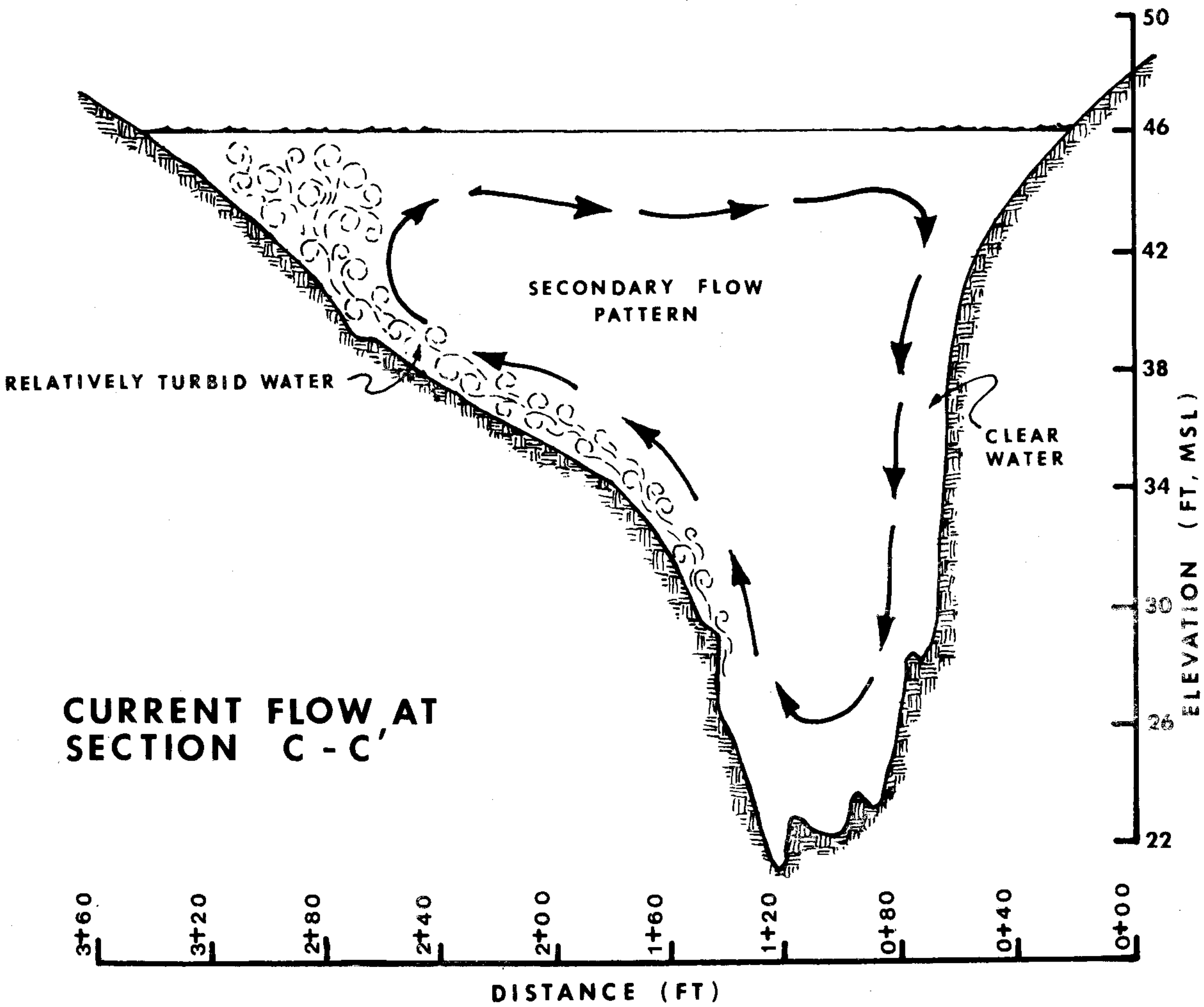

FIGURE III-3b. AN ILLUSTRATION OF THE PRIMARY AND SECONDARY CURRENTS IN THE RIVER BEND NEAR WATER INTAKE SITE 1.

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Erosion and Sedimentation Patterns

The geometry and location of the channel in the Choctawhatchee River are continually changing as portions of the channel erode while other portions aggrade. The thalweg of the river -- the deepest portion -- is shown for this reach of the river in Figure III-2. The areas undergoing erosion and aggradation are also shown. In general, downstream portions of river bends are the most active areas. Erosion takes place on the outside bends, while deposition occurs on the inside of the bends. In straight, wide channel reaches, shifts in the river bed are unpredictable; there is a tendency for the river to form a braided channel network, then return back to its normal width. This can be seen along the river in the vicinity of site 2.

Tree transects were studied at two inside bends of the river to estimate the lateral migration of the river near the proposed site. These transects are shown on Figure III-1. One transect, is located on the inside bend, across the river, immediately downstream of site 1. A second transect is located downstream of the plant site. The latter transect is in a bend downstream of an unusually active area -- a river cutoff where an oxbow lake has recently formed. 3

Core borings were taken from various trees -- water locust, river birch, sycamore, and Florida elm -- at breast height (4.5 ft.) with a standard 10.5" increment border. The cores were sliced in thin sections, the length of the core, and the annual rings were counted with a microscope to establish the age. The ages of the trees were determined as a function of distance from the river. This relationship is shown in Figure III-4A and B.

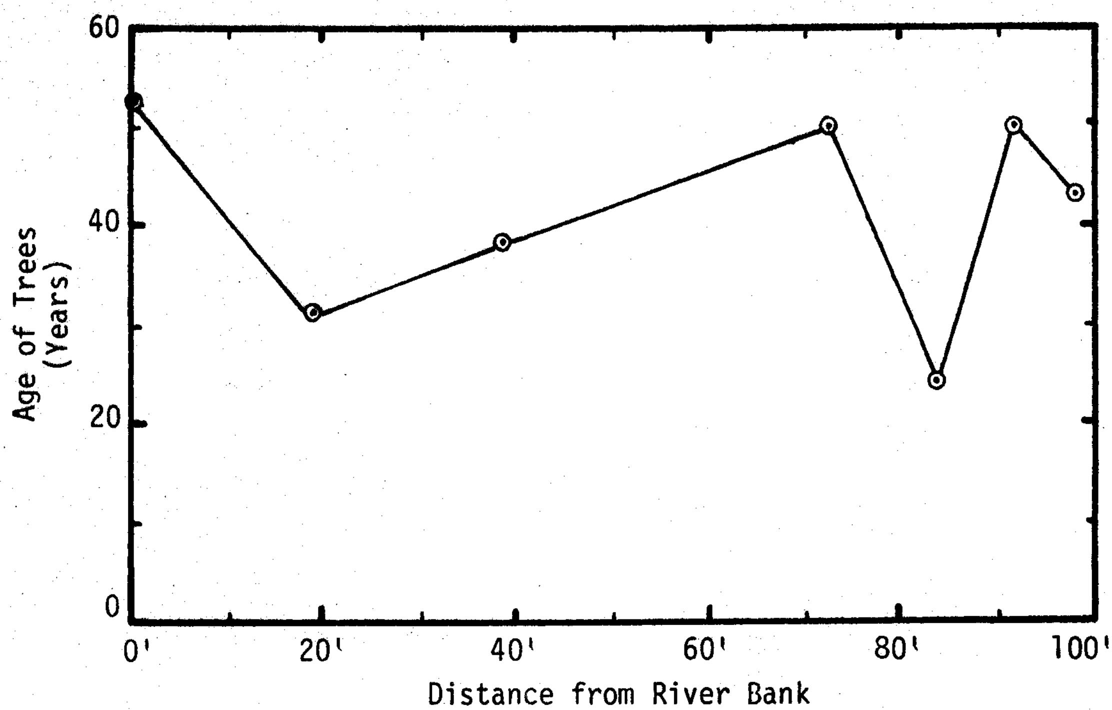

FIGURE III-4A TREE TRANSECT LOCATED IN BEND AT ALTERNATIVE WATER INTAKE SITE 1.

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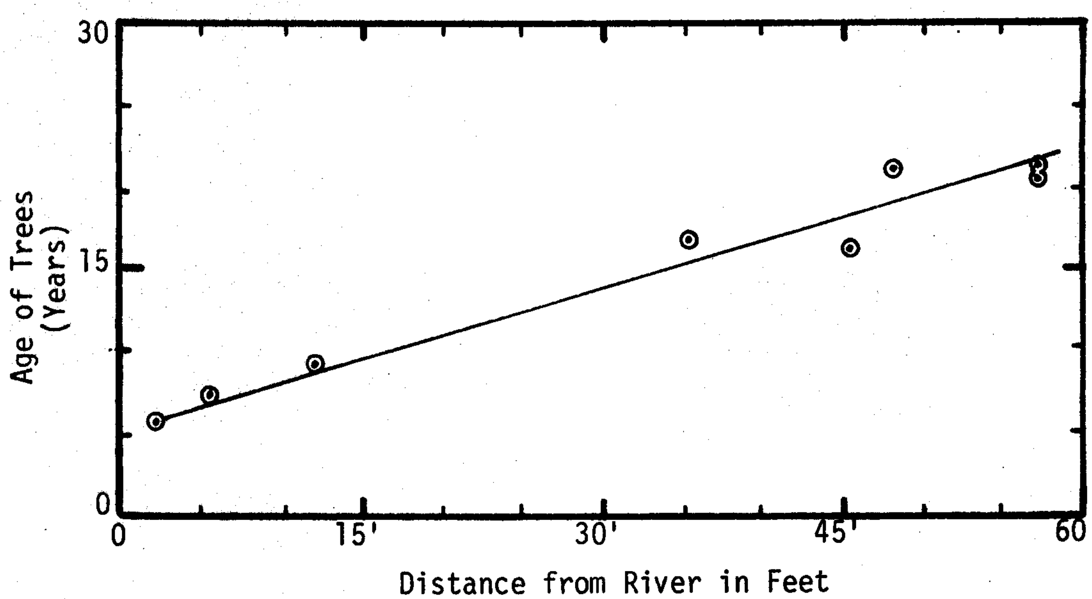

FIGURE III-4B. TREE TRANSECT LOCATED IN BEND OF AN UNUSUALLY ACTIVE RIVER REACH

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The study indicates that the bend migration is practically non-existent in the bend at site 1. The ages of the trees were about 40 years all along the transect. The lateral migration rate in the active bend downstream from the plant site is about 3 feet per year. Analysis of river currents, tree transects in the bends, and visual inspection along the banks concludes that the river migration at site 1 is very slow and should be no problem during the expected life of the generating plant.

Suspended Sediment

Water quality with respect to suspended solids varies as a function of location in the river. The best water quality in this reach of the river is found near the intake site 1.

In straight reaches, the concentrations of suspended sediment in
a river vary greatly from the surface to the bottom. Water near the 3
bottom carries considerably more suspended material than at the surface. This is particularly true during flood flow when the river carries increased amounts of sand and silt in suspension. Variations in sediment concentrations across the river laterally are usually not significant. However, in a river bend, as at site 1, the lateral, rather than the vertical changes in water quality are appreciable.

The Choctawhatchee River enters the bend near site 1 in a spiralling flow as shown in Figure III-3. The high velocity clear water near the surface moves to the outside of the bend, and rolls to the bottom while the sediment laden water near bottom moves to the inside of the bend. This is illustrated in Figure III-3. Also, during flood flow, relatively clear water re-enters the river from the east bank

floodplain near the bend. Both of these factors bring water with the least sediment directly into site 1.

Water samples were taken during the flood flow, April 12 - 13, 1975. The concentration of suspended sediments in the Choctawhatchee River at various distances from the bottom are shown in Figure III-5. Along with measured data, a plot is shown of suspended sediments vs. distance from the river bottom calculated from conventional sediment transport theory. The sediment concentration as function of depth can be expressed as:

$$\frac{C_y}{C_a} = \left[\left(\frac{d-y}{y}\right) \times \left(\frac{a}{d-a}\right)\right]^z \qquad \text{(Eq. III-1)}$$

where:

C_y = sediment concentration of a certain sediment size at a distance y above the stream bed; 3

C_a = measured sediment concentration of the same size at a distance "a" above the stream bed;

d = flow depth; and

z = empirical constant depending mainly on sediment fall velocity, and shear stress on the river bottom.

The measured and calculated results show that (1) the variation in sediment concentration with depth is much larger in the straight reach of the river than in the bend at site 1. This means that the location of intakes with respect to the river bottom is less critical at site 1 than in the straight reach. Nevertheless, the intakes should be placed well above the river bottom to minimize the intake of sediments transported along the river bed. And (2) the average sediment concentration on the outside of the bend at intake site 1

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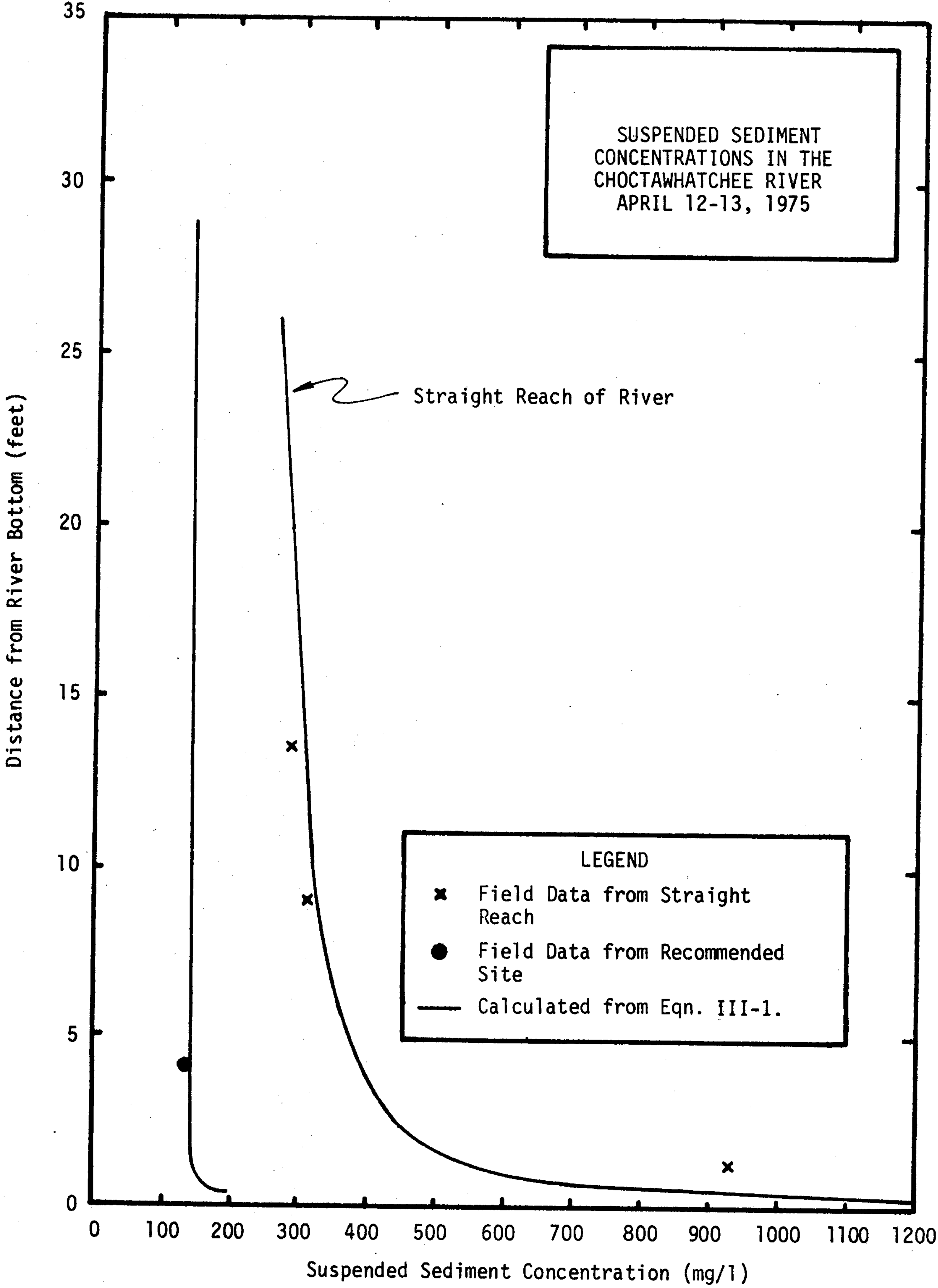

FIGURE III-5. SUSPENDED SEDIMENT CONCENTRATIONS IN THE CHOCTAWHATCHEE RIVER APRIL 12-13, 1975.

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is much less than in a typical straight channel reach. The measured data for flood flow conditions taken on April 12 to 13, 1975 indicate that about one-half of the amount of sediment will enter a water intake located at site 1 as would enter an intake located on a straight reach of the river.

The data from this study are combined with additional data on suspended solids from Gulf Power Company and the USGS to estimate suspended solids concentrations in the river at various flow rates. This is shown in Figure III-6. The maximum concentration of suspended solids for flow at the flood of record (206,000cfs) is estimated at 360 mg/l. The sediment concentration at the average annual flow (5320 cfs) is estimated at 40 mg/l. The suspended solids in the water entering an intake on site 1 would be less than this because of the improved water quality in the bend compared to the straight reach of the river. 3

Bottom sediments in this reach of the Choctawhatchee River are predominantly sand. The particle size distribution of a typical sample from the river bend is shown in Figure III-7. The river bed is well graded sands with a median size of 0.33 mm (medium sand).

During floods the river carries sediments into the floodplain. The banks and floodplain are thus composed of the fine material deposited during various flood stages. The particle size analysis of typical bank material near site 1 is shown in Figure III-8. The bank is 92 percent sand with a median size of 0.18 mm.

The bottom sediment load in the river at site 1 is the lowest along this reach of the river. The secondary flow pattern reduces the bottom sediment transport. The velocity is relatively low even during floods -- i.e. 1.7 fps. And during floods large volumes of relatively

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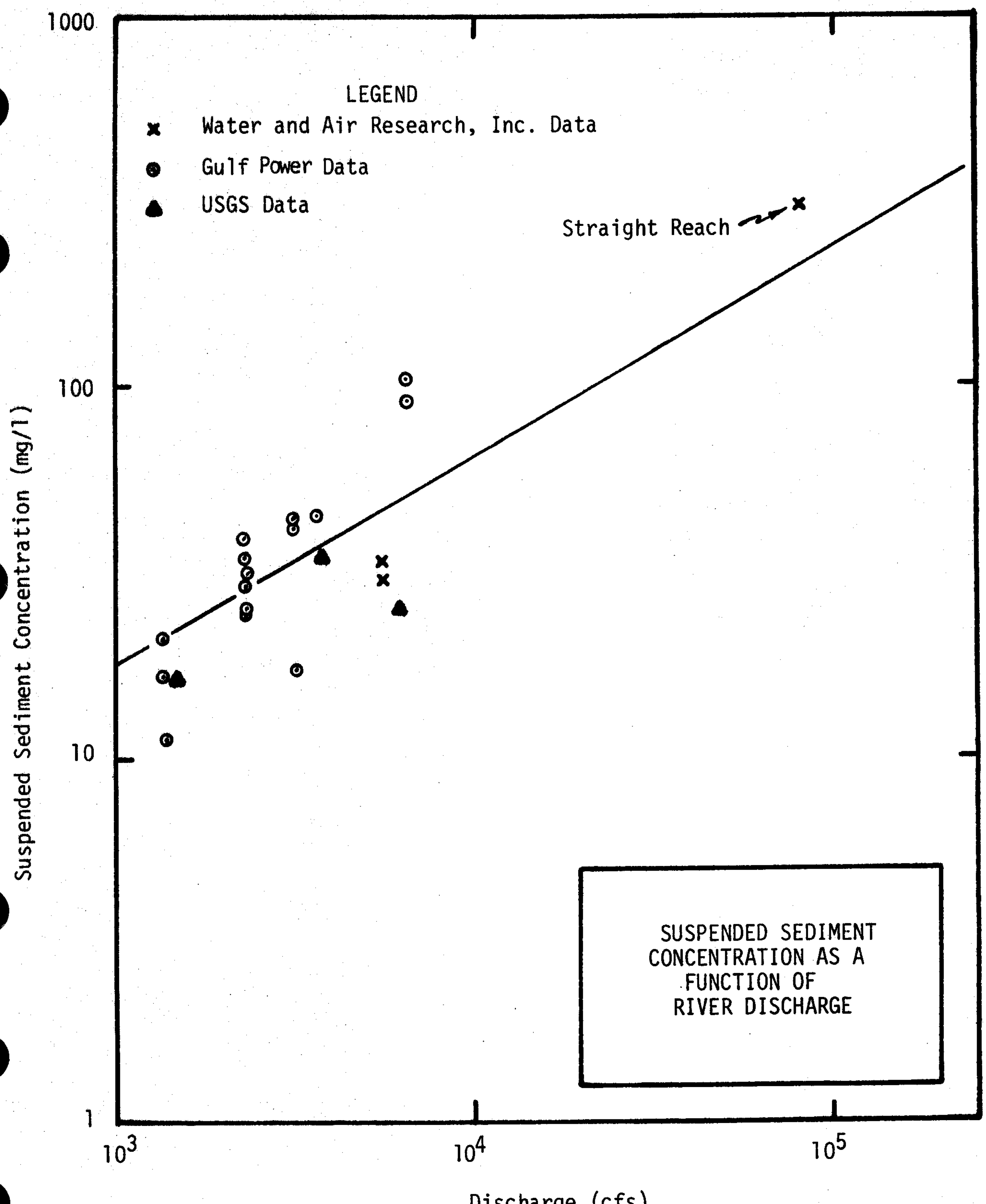

FIGURE III-6. SUSPENDED SEDIMENT CONCENTRATION AS A FUNCTION OF RIVER DISCHARGE.

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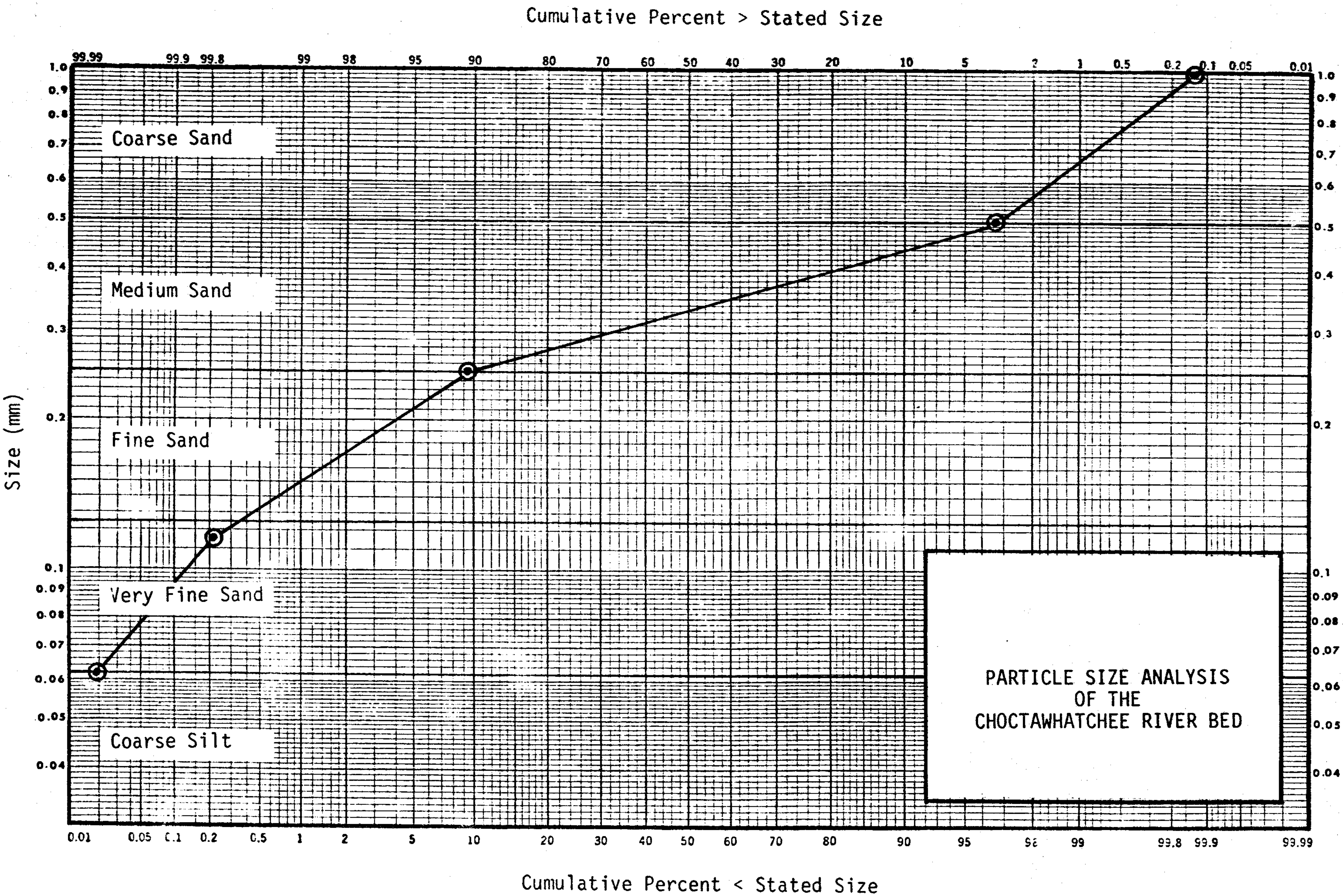

FIGURE III-7. PARTICLE SIZE ANALYSIS OF THE CHOCTAWHATCHEE RIVER BED.

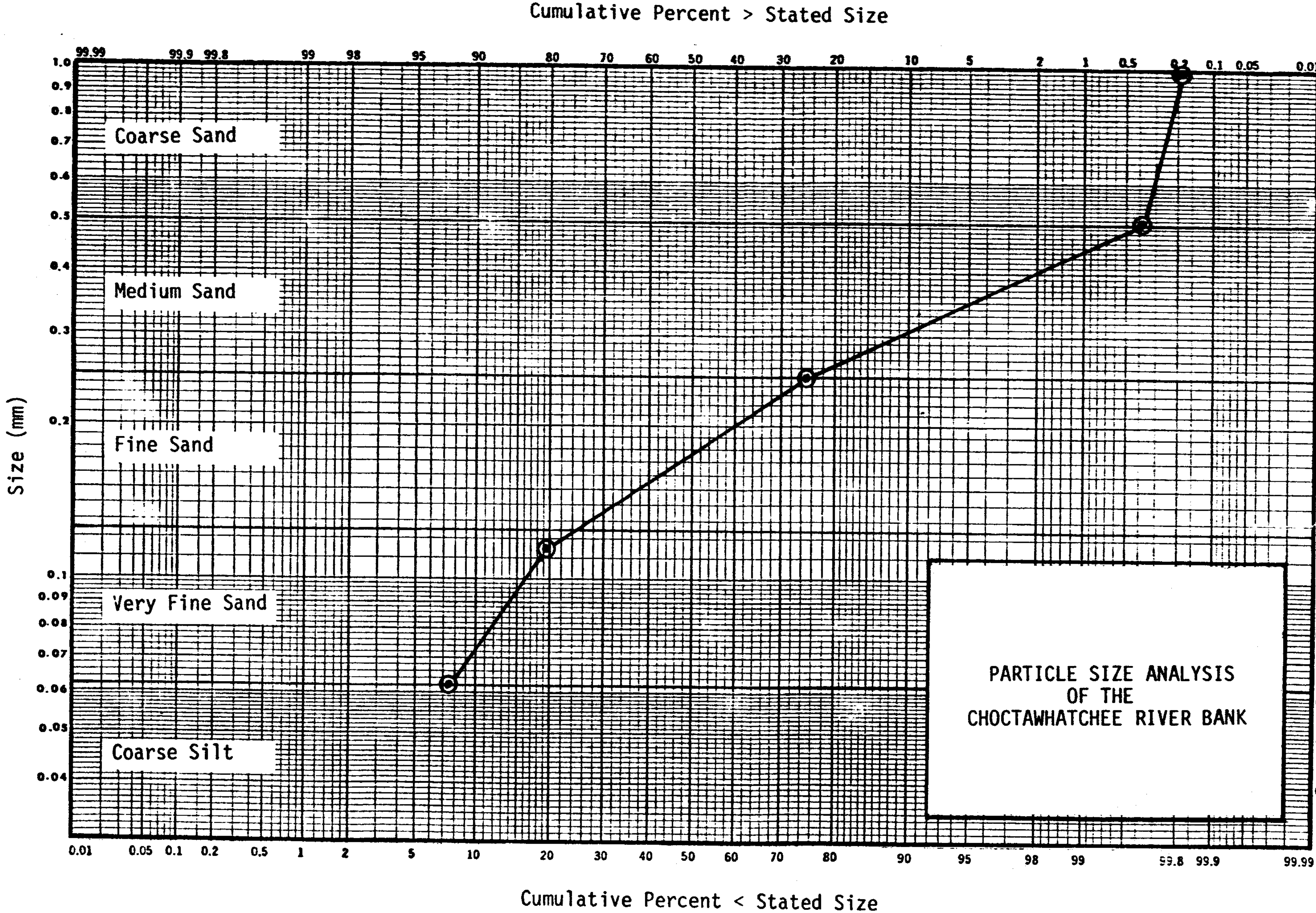

FIGURE III-8. PARTICLE SIZE ANALYSIS OF THE CHOCTAWHATCHEE RIVER BANK.

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clear, slow moving waters re-enter the river from the east bank floodplain.

Hydraulic Effect in the River of an Intake Structure and An Access Corridor - The degree of disturbance created by hydraulic structures in channels and floodplains is dependent on the size of the structure in relation to the size of the remaining area of flow. The installation of an intake structure in the Choctawhatchee River with an associated access corridor across the east bank floodplain will produce only minor obstruction to the river flow -- even under worst case flood conditions.

The size of the intake structure is negligible in relation to the total channel flow area. The surrounding flow conditions will be similar to that of a bridge pier in a river channel. Water velocities and turbulence levels will increase locally and riprapping will be required around the intake structure. Aggradation will occur downstream in the wake of the 3
structure, where velocities slow and turbulence subsides. Minor changes in erosion and sediment deposition will occur immediately after construction until a new equilibrium is established in the river bed. No continuous or long-term erosion and sediment deposition will occur.

The blockage of flood flow by an access corridor will be small in comparison to the blockage already experienced in this area by the causeways at highway U.S. 90 and the railroad bridges some 0.6 miles downstream of the plant site. The backwater effect currently experienced from the highway and railroad causeways is 2 to 3 feet, depending on the flood state.

The blockage effects of an access corridor across the east bank floodplain with a causeway of elevation 60 ft MSL can be evaluated for a flood of elevation 60 ft MSL by comparing the flood flow that the east

bank floodplain conveys to the flood flow conveyed by the main channel and west bank floodplain. These respective flood flows are calculated in a conventional manner by comparing the respective conveyance values (Chow, 1959) for the channel and the two floodplains. The Manning n values for these computations are estimated at .04 for the channel and .15 for each of the floodplains.

At a flood of elevation 60 feet MSL, the flood flow across the east overbank is only 12 percent of the total flow; the channel carries 34 percent and the west floodplain carries 54 percent of the flood flow. This 3
situation is depicted in Figure III-9. An access corridor with a causeway at 60 ft MSL will obstruct a maximum of 12 percent of the total flow at a flood of elevation 60 feet MSL. A smaller percentage of the flow will be obstructed for floods at lower elevations, and a smaller percent of the flow will also be obstructed for floods at higher elevations where the water will pass over the causeway. These estimates are conservative because the flows that will be passing through openings provided through the causeway, i.e. culverts and trestles, have been neglected. This flood blockage is relatively small and will not cause erosion and sedimentation problems.

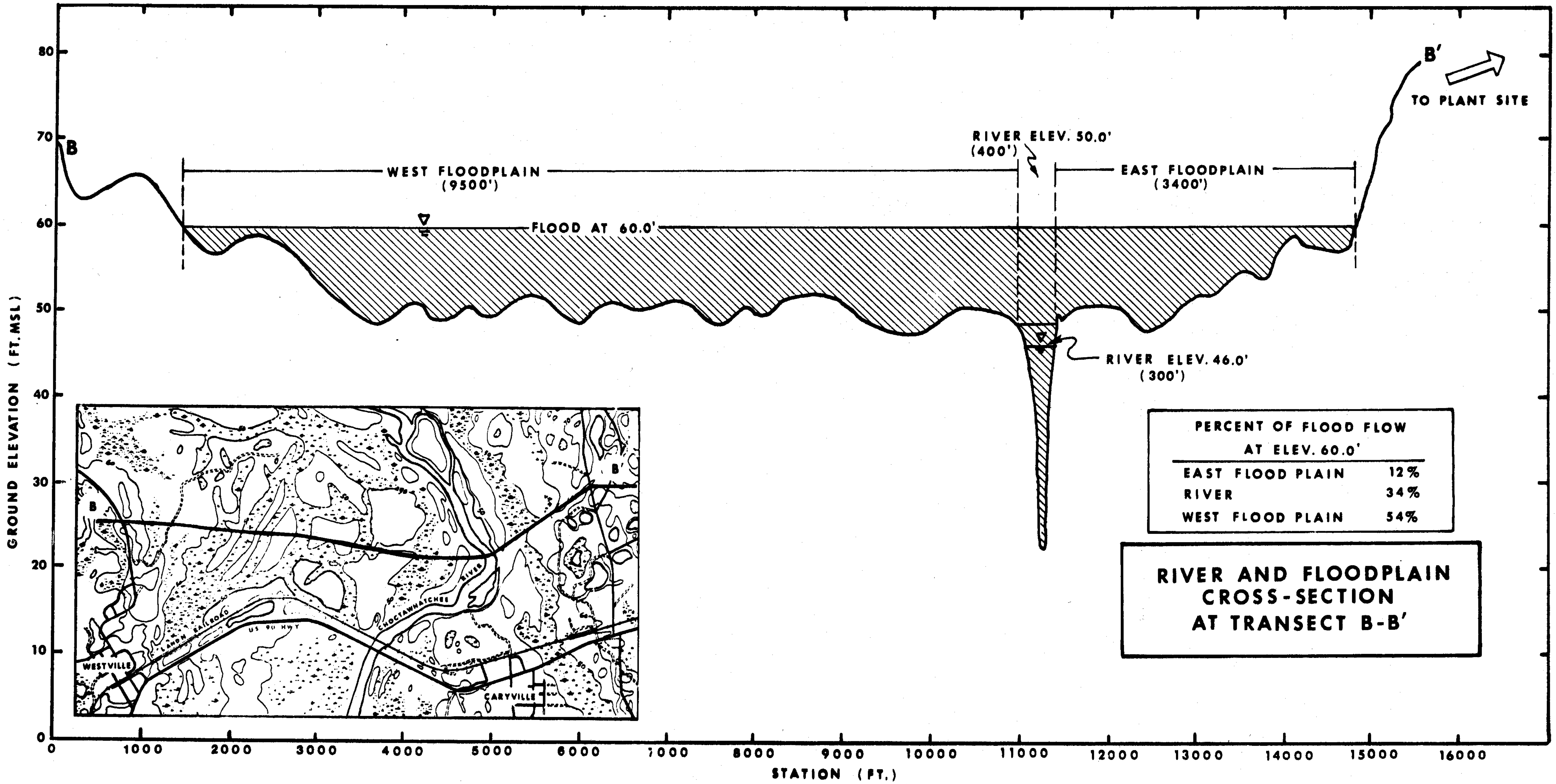

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FIGURE III-9. TYPICAL RIVER AND FLOODPLAIN CROSS SECTION AT THE RECOMMENDED (SITE 1) LOCATION OF THE INTAKE/OUTFALL STRUCTURE AND ALONG THE RECOMMENDED CORRIDOR 1 TO THE PLANT SITE SHOWING FLOOD AT ELEVATION 60.0' MSL.

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Detailed backwater computations show that the maximum backwater created by a causeway in the corridor across the floodplain to the plant at elevation 60 feet (MSL) will be about 2.0 inches for a flood at elevation 60 feet (MSL). The analysis follows the currently accepted practice developed by the Federal Highway Administration (U.S. DOT, 1970)

An outline of the procedure and the assumptions used are given below:

(1) the energy coefficient α_1 of the approaching river and floodplain flow is computed to be:

$$\alpha_1 = \frac{\Sigma\, K_i^3/A_i^2}{\frac{(\Sigma K_i)^3}{(\Sigma A_i)^2}} = 5.75$$

Where K_i = conveyance of the i th river subsection. 3

the flow was subdivided into three subsections: east overbank, channel, and west overbank.

A_i = Area of the i th river subsection

(2) Assume that complete obstruction of flow occurs in the east overbank. This results in 12 percent of the total flow being diverted into the channel and west overbank area.

(3) Also a conservative assumption is made that 12 percent of the existing flow in the west overbank area is blocked for computational purposes. This assumption will yield a backwater greater than actually experienced at the site. Since blockage will exist only in the east bank floodplain,

the backwater will be a maximum at the east overbank and decrease to zero at the west end of the west bank floodplain area.

The existing cross-sectional area of the west overbank is 89,400 ft^2. the assumption that 12 percent of the flow is also blocked in the west overbank. area results in an opening area of (1 - .12) 89,400 = 78,700 ft^2.

(4) The open area, assumed for computational purposes, is therefore equal to the channel area plus the remaining west overbank area, or,

$$A_{n_2} = 78,700 + 10,280 = 88,700 \text{ ft}^2$$

(5) The discharge at elevation 60 ft MSL is estimated at 106,000 cfs. Therefore, the average velocity through the opening area is: 3

$$V_{n_2} = \frac{Q}{A_{n_2}} = \frac{106,000}{88,700} = 1.35 \text{ fps}$$

(6) The flow area downstream of the construction is conservatively assumed to be equal to the area of the opening, or

$$A_4 = A_{n_2} = 88,700 \text{ ft}^2$$

(7) Assume that the energy coefficient α_2 through the conservatively assumed opening is equal to the energy coefficient upstream of the construction, or

$$\alpha_2 = \alpha_1 = 5.75$$

(8) Assuming 12 percent of the flow is obstructed on each floodplain, the bridge opening ratio is:

$$M = \frac{1 - (2)(0.12)}{1} = 0.76$$

(9) For M = 0.76, the backwater coefficient from Figure 6, of the reference (U.S. DOT, 1970) is

$$K_b = 0.45$$

(10) The total backwater coefficient,

$$K^* = K_b = 0.45$$

since (a) no piers are present, (b) no skew effects are present, and (c) no eccentricity effects are present with the assumed blockage of 12 percent in the west overbank area.

(11) The total area of flow upstream of the constriction, A_1 is shown in Figure III-9, and is equal to 120,000 ft^2. 3

(12) The total backwater, or rise above the existing stage is conservatively estimated from:

$$h_1^* = \left\{K^* \alpha_2 + \alpha_1 \left[\left(\frac{A_{n2}}{A_4}\right)^2 - \left(\frac{A_{n2}}{A_1}\right)^2\right]\right\} \frac{V_{n2}^2}{2g}$$

$$= \left\{0.45 \times 5.75 + 5.75 \left[\left(\frac{78,700}{78,700}\right)^2 - \left(\frac{78,700}{120,000}\right)^2\right]\right\} \frac{1.35^2}{64.4}$$

$$= 1.66 \text{ ft.}$$

$$= 1.99 \text{ inches, say } \underline{2.0 \text{ inches}}$$

The average increase in velocity through the constriction is inversely proportional to the area of flow. Therefore, the maximum average increase in velocity would be only about 12 percent above the velocity

that would exist without any constriction. Thus the increase in velocity in the whole river might be 0.2 fps. However, localized increases in velocity near the intake structure will be much higher. The maximum velocity will occur at the end of the causeway near the intake structure. At this point, the localized water level is conservatively estimated to be 0.5 feet below the upstream levels. The maximum velocity in this immediate vicinity is estimated at 6 feet per second, as computed below: 3

$$V_{max} = (2 g \Delta h)^{1/2}$$

$$= (64.4 \times 0.5)^{1/2}$$

$$= 5.7 \text{ fps, say } 6.0 \text{ fps.}$$

This velocity decreases rapidly with distance from the end of the causeway constriction. The regions where high velocities are expected will be adequately protected with riprap.

Water Intake Alternatives

Introduction

Considerable process water is required for steam electric generating plants. Most of the water is used as make up in the circulating cooling towers -- some is evaporated to the atmosphere, however, a portion is discharged back to the river. Water is also used to sluice fly-ash and bottom ash to the disposal ponds. These various water requirements are detailed in section 3.3 of the Site Certification Application. All of the intake water is filtered. An installed pump capacity of 45,000 gpm is proposed to meet the maximum water requirements of 37,500 gpm for 3,000 MW generating capacity. As detailed in the Site Certification Application, an adequate supply of water is available in the Choctawhatchee River (average normal flow 5,320 cfs) to meet these water requirements. 3

The purpose here is to consider alternative intake sites and select the best site for a water intake structure along the Choctawhatchee River. Alternative configurations for a water intake structure are also considered and the best configuration is recommended.

Methods

The best intake site and configuration are selected by optimizing the best features of river dynamics -- slow current, stable bank, deep flow, clean water, etc. -- with minimum change or disruption to the environment. The factors of river dynamics are discussed in Chapter III; aquatic ecology in Chapter IV; and terrestrial ecology of an access corridor in Chapter V.

Results

Alternative Intake Sites. The locations of three alternative sites for water intake on the Choctawhatchee River are shown in Figure III-2.

Site 1. The best site for the water intake is in the vicinity of site 1 in the river bend as shown in Figure III-2. It is found that the river dynamics are most favorable at site 1. The river and bank are stable with no migration. The thalweg of the river is adjacent with a deep bottom at 22 ft MSL. The currents are slow both in normal flow, 1.25 fps, and flood flow, 1.7 fps. The secondary currents bring the low suspended solids from the surface to the bottom -- <40 mg/l at average flow. Clean water flows at <1 fps from the floodplain during floods. The intake structure will have no adverse effects on the river flow or erosion patterns. An access corridor to site 1 will cause little damage to the floodplain (Ch. V). A causeway at elevation 60 ft 3
MSL will block a maximum of 12 percent of any flood flow, cause a maximum added backwater of 2 inches to a flood, and increase the whole river velocity a maximum of 0.2 fps during floods with localized velocities reaching 6 fps.

Site 2 is located in a wide straight reach of the river where the channel is unstable and unpredictable. The river dynamics are not as favorable as at site 1.

Site 3 is also located in a wide straight reach of the river where the channel is unstable and unpredictable. Wrights Creek causes additional instability by introducing an additional flow. The river dynamics are not as favorable as site 1.

Alternative Intake Configurations. The best configuration for the water intake is illustrated in Figure III-10, III-11, and III-12.

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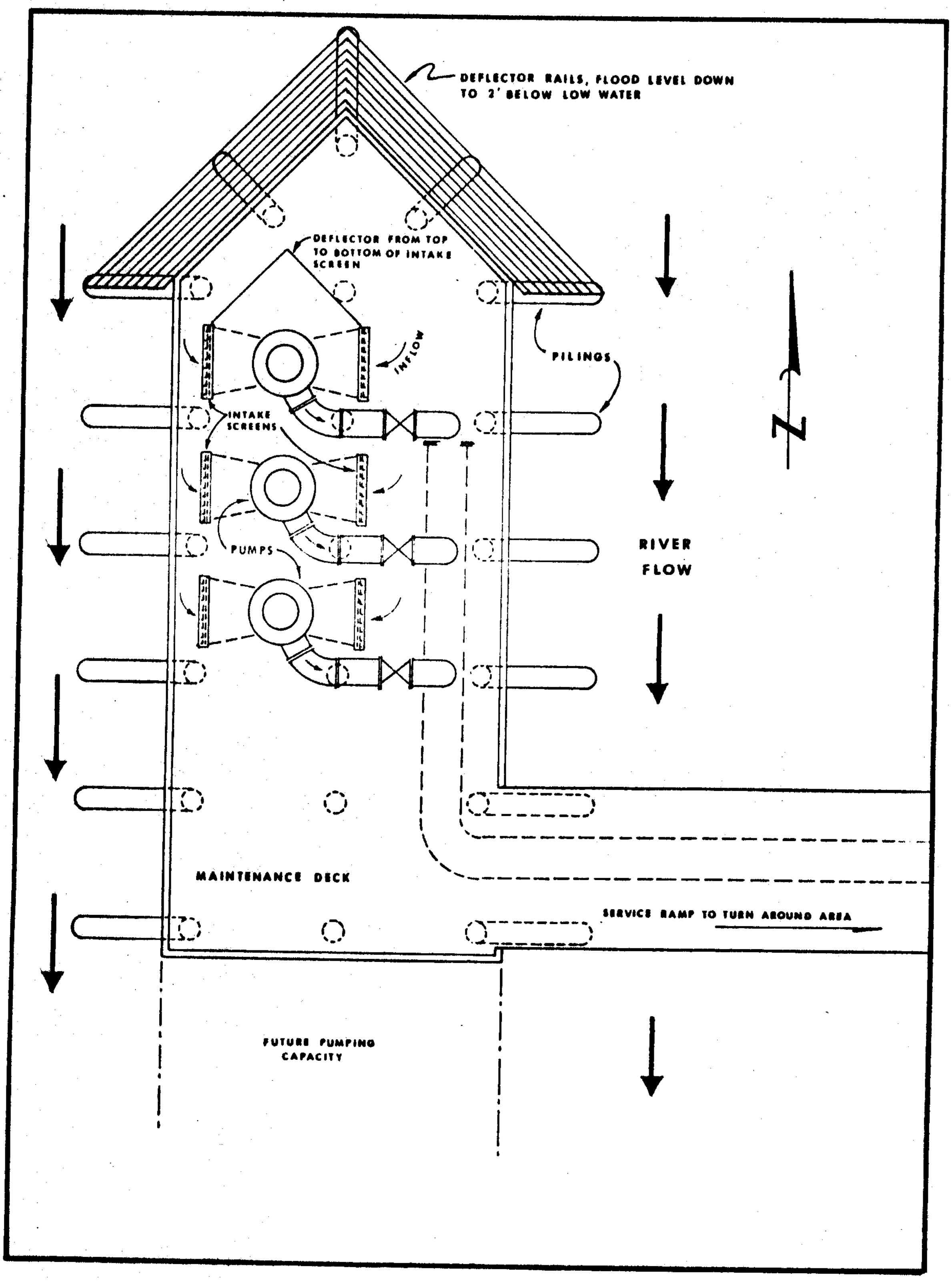

FIGURE III-10. HYPOTHETICAL WATER INTAKE CONFIGURATION.

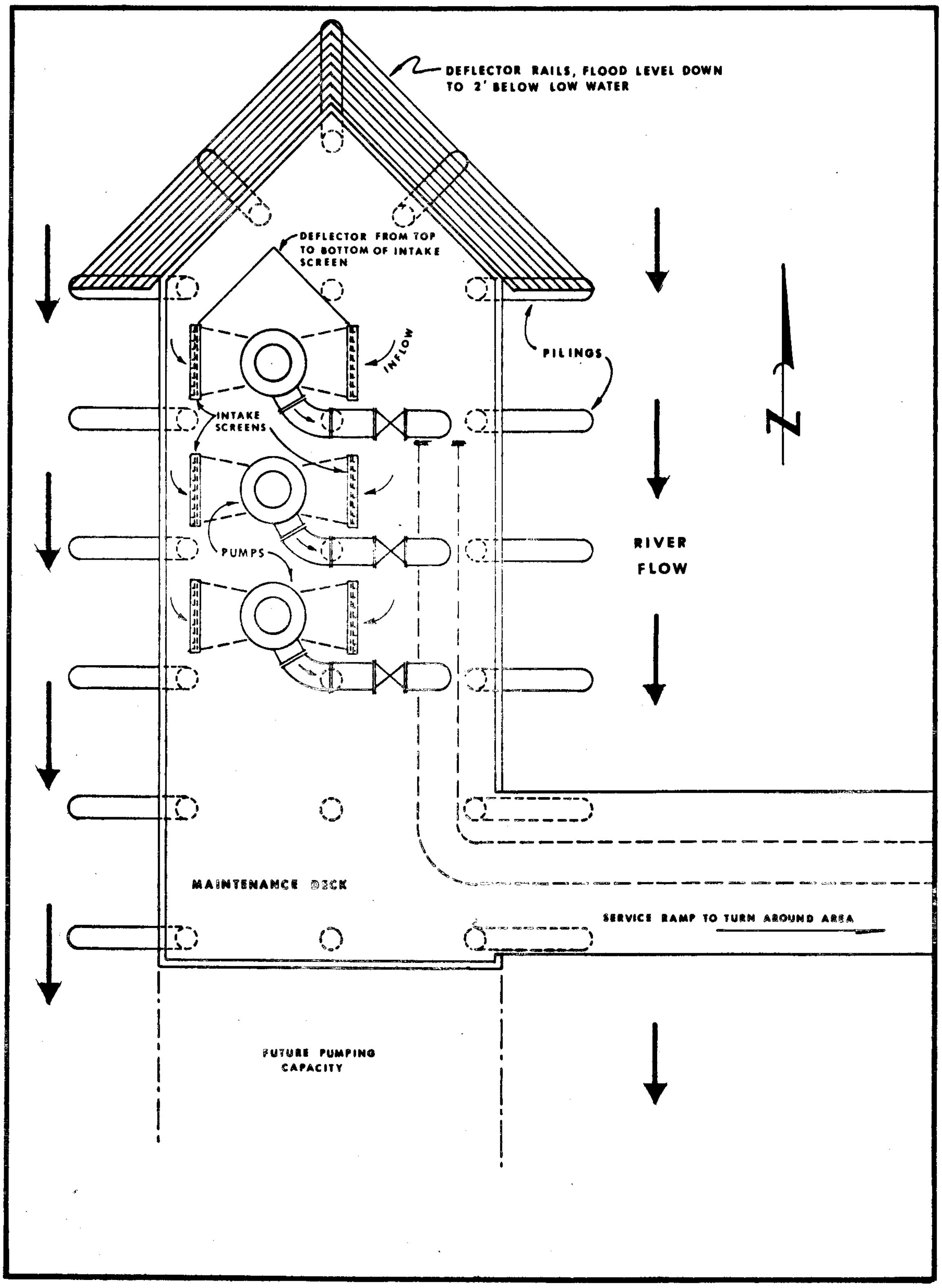

FIGURE III-10. HYPOTHETICAL WATER INTAKE CONFIGURATION.

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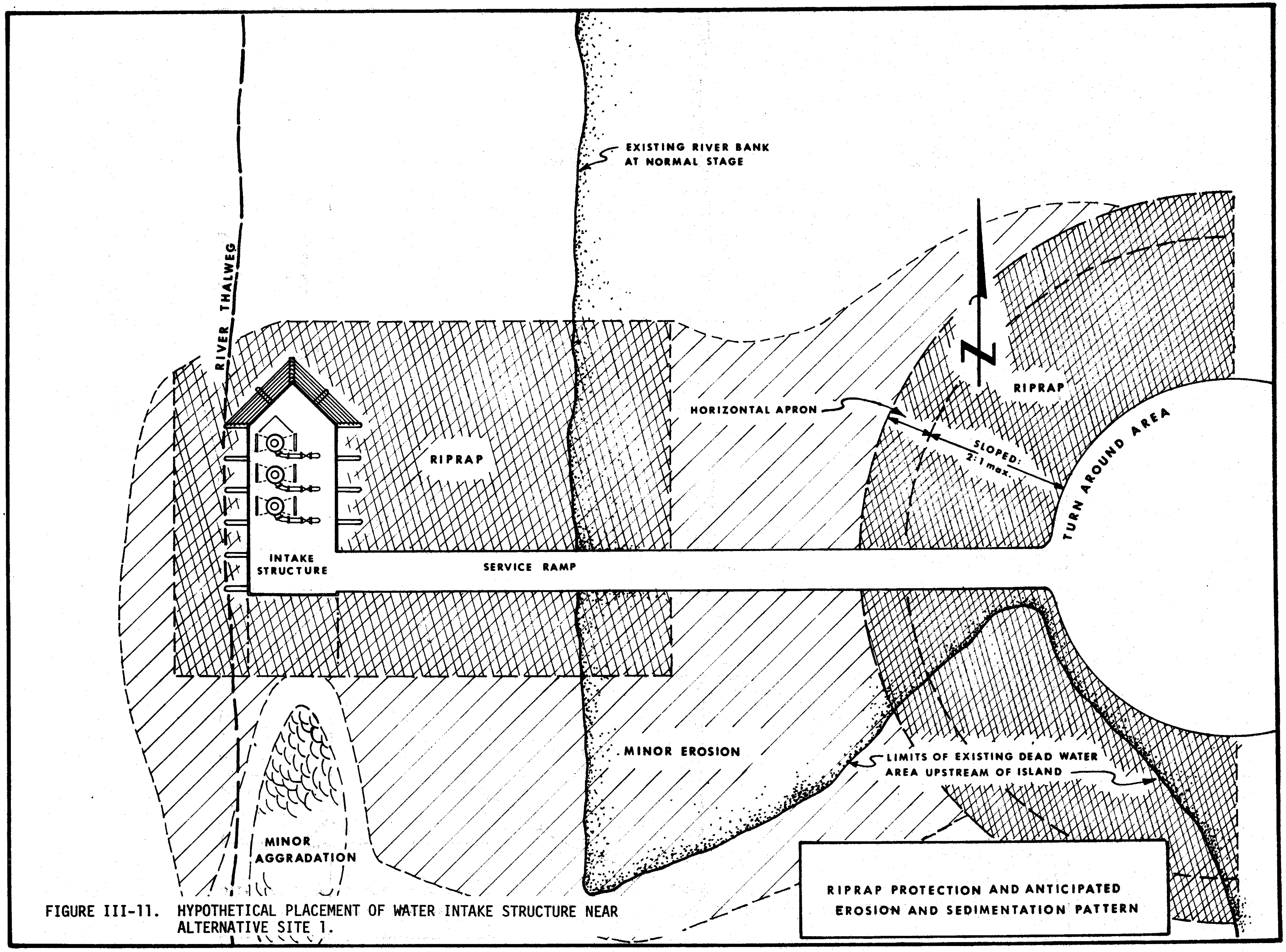

FIGURE III-11. HYPOTHETICAL PLACEMENT OF WATER INTAKE STRUCTURE NEAR ALTERNATIVE SITE 1.

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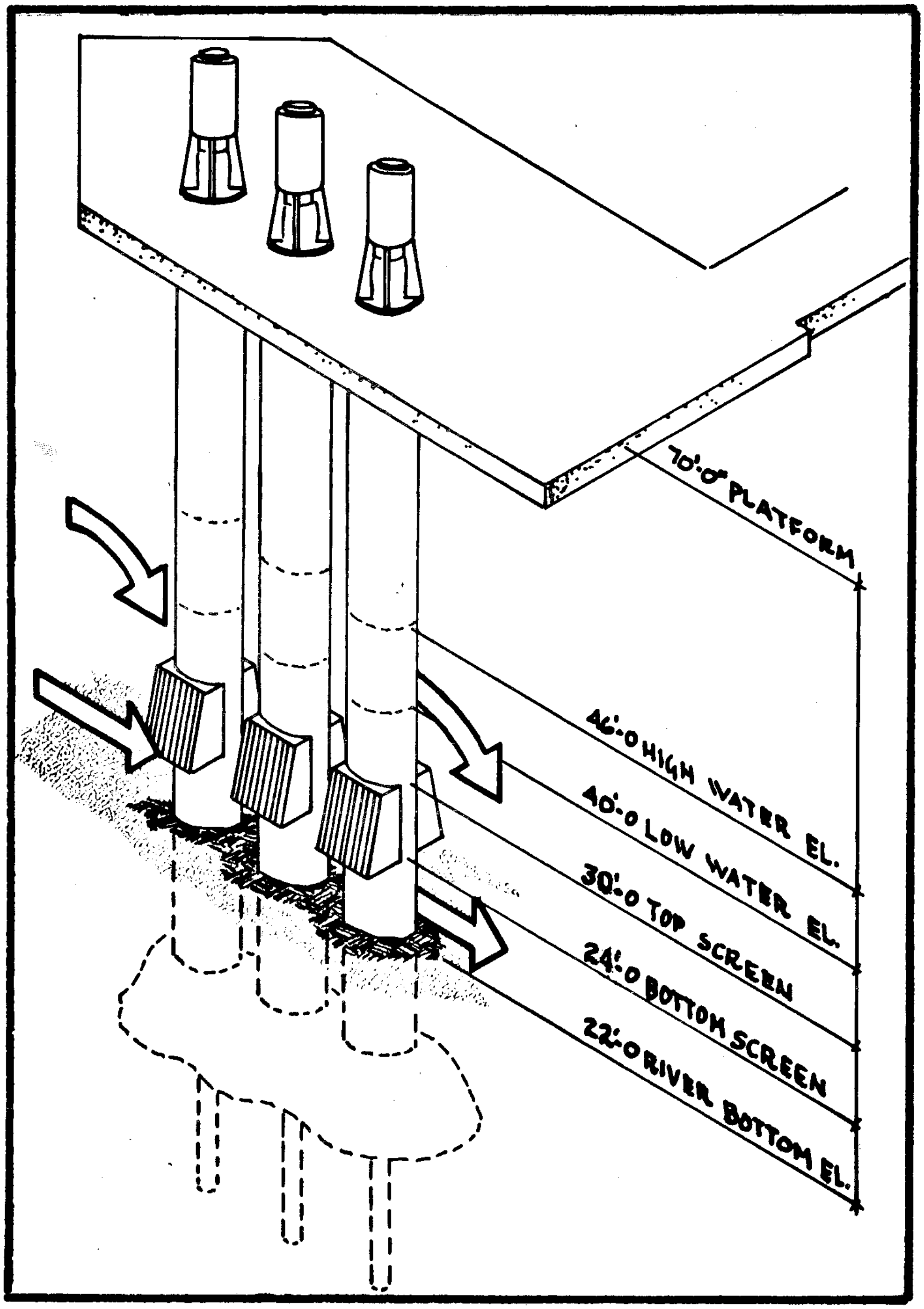

FIGURE III-12. AN ISOMETRIC ILLUSTRATION OF THE HYPOTHETICAL WATER INTAKE CONFIGURATION.

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This proposed water intake configuration is not a conventional traveling screen intake structure, but rather is a cost-effective, submerged intake particularly designed to minimize the impingement and entrainment of fish and planktonic fish eggs.

As indicated in Figure III-10, the intake pumps and pipes are on a simple "dock" platform on pilings in the river. This minimum structure is not only cost-effective but it will cause minimum disruption to river flow, erosion patterns, and the river environment (Chapter III and Chapter IV). As shown in Figure III-11, the structure should be placed immediately adjacent and parallel to the river thalweg. Some riprap will be required around the turn-around area to minimize erosion. During floods, the causeway will block flow through the floodplain and deflect flood water back into the river. Around the end of the causeway, flood waters could 3
reach localized velocities of 5-6 fps. This is not an unusual flow, but will require training structures to minimize erosion. The turn-around area should be placed at least 200 feet from the intake structure to minimize the effect of the corridor on the intake structure.

Excavation and fill of the river banks will be minimized, particularly adjacent to the main channel, as such actions tend to destabilize the river. The riprapped slopes will not be steeper than 2.0 horizontal to 1.0 vertical and will be feathered out along the river bank to streamline river flow and minimize erosion caused by channel irregularities. The river channel cross section will not be altered significantly.

Because of secondary currents, clean water with low suspended solids can be obtained near the bottom of the river (Figure III-3). This will allow the water intakes to be placed near the bottom of the river and be completely submerged at all times. This has engineering advantages as well as environmental advantages to the river.

As shown in Figures III-10 and III-12, the intake screens in this configuration are placed near the bottom and parallel to the river flow. However, the intakes should be sufficiently above the bottom to minimize the entrainment of the sand that is transported along the bottom. The river currents are spiralling at this site and the flow is both down and past the screens (Figure III-12). The force of the river flow is past the screens and not into the screens. This will minimize impingement and sweep fish, materials, etc. past the intake. The screens are designed so that the intake flow is less than 0.5 fps. This will allow fish to escape entrainment. Removable screens will allow maintenance and minimize blinding by the Corbicula (Asiatic) clam.

This intake configuration provides water entrance to each pump from two directions. This will minimize the disturbance in the river flow as it passes by the intakes and minimize air entrainment from vortex action. The pumps will be submerged below the intakes; this also prevents air entrainment, as well as allows the use of smaller higher-speed pumps without cavitation. 3

This intake configuration is analogous to a bridge pier in a channel with respect to flow obstruction. No particular maintenance problems will develop from the placement of such a structure in the river.

This intake configuration is a simple, cost-effective structure, causes minimum disruption to river flow, allows efficient high speed pumping, and provides maximum safeguards to the environment.

In the selection process of an appropriate intake configuration, a conventional traveling screen intake and a slotted pipe intake configuration were considered. The conventional traveling screen structure as shown in Figure III-13 is quite large and costly. Construction of

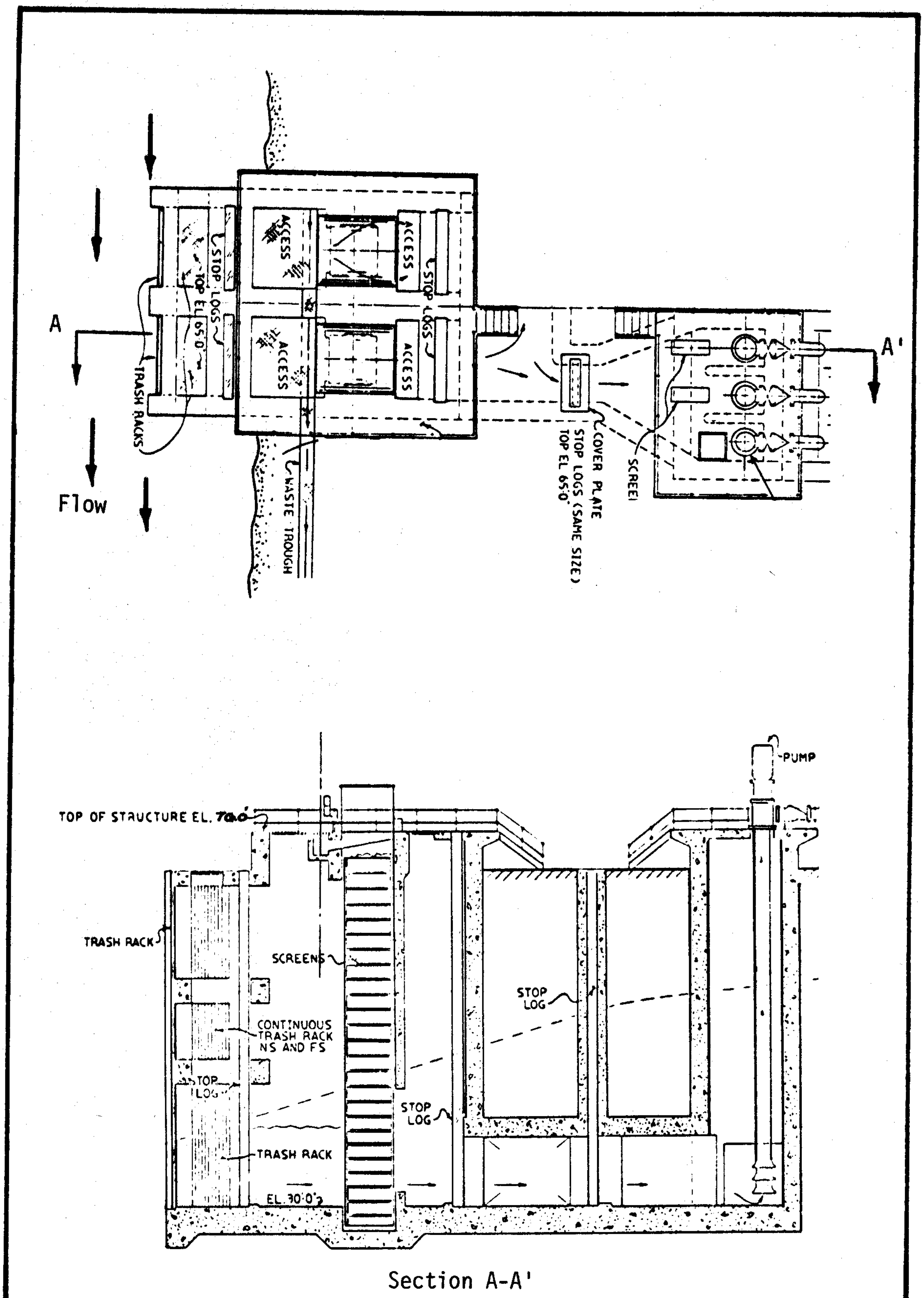

FIGURE III-13. ILLUSTRATION OF AN ALTERNATIVE WATER INTAKE CONFIGURATION -- CONVENTIONAL TRAVELING SCREEN INTAKE

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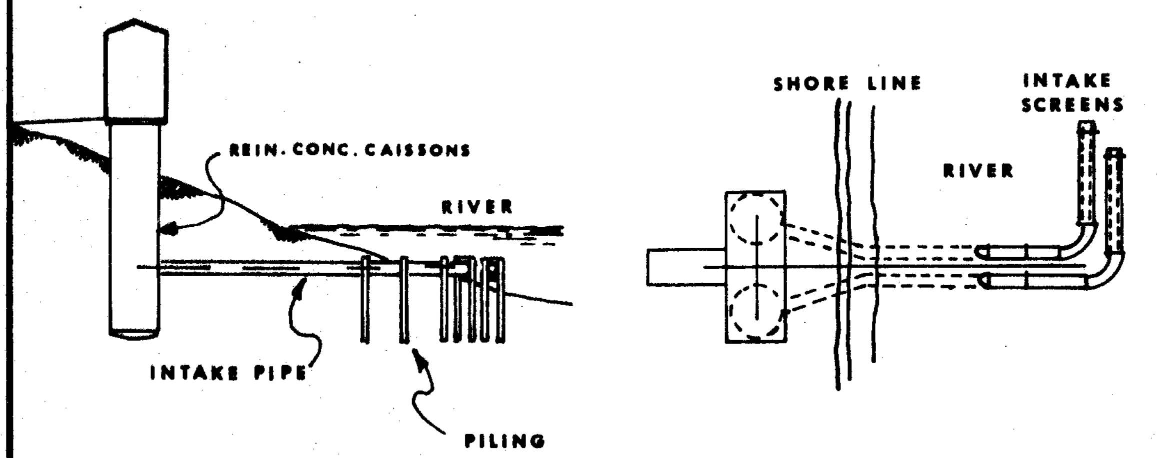

Slotted Pipe in River

FIGURE 13a. ILLUSTRATION OF AN ALTERNATE WATER INTAKE CONFIGURATION -- SLOTTED PIPE CONFIGURATION IN THE RIVER. 3

such a structure requires considerable disturbance to the surrounding areas and river bottom. It was believed that improvements could be achieved in costs, engineering, and safeguards to the environment.

A slotted pipe configuration as shown in Figure III-13a was also considered. This is a simple, cost-effective configuration that provides adequate safeguards to the environment, causes minimum interference with river flow and can be constructed with minimum disruption to the surrounding areas. However, because of the Corbicula (Asiatic) clams which are prevalent in the area, considerable difficulty could be experienced in operation. Technology is not available to assure that the slots would not be clogged by the clam. Removeable screens are probably the best technology to cope with the Corbicula (Asiatic) clam. 3

The intake configuration in Figures III-10, III-11, and III-12 is believed to be the best available technology and is selected as the best alternative for placement in the Choctawhatchee River for the proposed electric generating facility.

EFFLUENT WATER DISCHARGE ALTERNATIVES

Introduction

Three alternative methods of heated water disposal are considered and the most effective way to dissipate the heat from cooling tower blowdown is recommended. These methods are: disposal directly into the Choctawhatchee River; disposal into Little Dram Branch, a small creek originating near the site; or disposal as sheet flow in the rim swamp.

The water intake site for the plant is located at Site 1 on the Choctawhatchee River. This is shown on the vicinity map, Figure III-1 and more specifically located on Figure III-2. The discharge of effluent water into the Choctawhatchee River would be located approximately 100 ft downstream from the intake.

Little Dram Branch is shown on the vicinity map, Figure III-1. It runs across the southeast portion of the Gulf Power Company property, crosses under Highway 90 and drains into the rim swamp east of the city of Caryville. The rim swamp is also shown on the vicinity map, Figure III-1. It runs north-south from Wrights Creek between the plant site and the river. It extends southward, east of the city of Caryville, intercepts Little Dram Branch, continues southward past I-10 until it intercepts Little Dram Branch, through which it drains back to the Choctawhatchee River.

Dissipation of the heated effluent in the river is considered in detail in Section 5.1 of the Site Certification Application. Little needs to be added to that analysis, which shows a very limited range of influence on the river from cooling tower blowdown. Details of the environmental impact of river disposal on water quality and on the aquatic ecology of the Choctawhatchee River are described in a subsequent section of Chapter III and Chapter IV. This section predicts the percent of the river flow that is needed to be entrained with the thermal discharge to bring the plume within $5^{o}F$ of the ambient river temperature.

This section also predicts the temperature reduction in the water discharged into the Little Dram Branch and the rim swamp. The effects of the heated water on the environment of the branch and swamp are discussed.

The best alternative is selected for the discharge of this effluent water.

Methods

Discharge in the Choctawhatchee River. Because of the three-dimensional nature of the buoyant (heated) discharge jet, the Hirst Analytical Model is used to predict temperatures in the river. The dissipation of heat from the cooling tower discharge into the Choctawhatchee River is considered and presented in detail in Section 5.1 of the Site Certification Application. The portion of the river flow needed to be entrained in the discharge to bring the plume within 5^{o}F of the ambient river temperature is discussed subsequently in this section with the results.

Discharge into Little Dram Branch and the Rim Swamp. The Hirst analysis cannot be used when the discharge is into the swamp or creek areas. 3
In these latter cases the effluent spreads in a shallow flow that will be well mixed, both vertically and laterally. Instead of turbulent mixing, the predominant consideration is heat exchange with the atmosphere, as the effluent moves longitudinally and eventually enters the Choctawhatchee River.

The dissipation of heat to the atmosphere from water surfaces has been studied by many investigators, notably Edinger and Geyer (1965) and the Federal Water Pollution Control Administration, now EPA (FWPCA, 1968).

The basic equation for heat exchange is presented in equation 1; However, this equation must be modified for use in creek and swamp areas. Details of the theory, data sources, and calculations are shown. The results of these computations for Little Dram Branch Creek and the rim swamp are subsequently presented.

The method involves a linearized heat exchanged equation of the form:

$$\rho \, c_p \, \frac{A}{Q} \, \frac{dT}{dx} = -K \, (T-E) \qquad (1)$$

where: ρ = water density, 62.4 lb/ft^3,

c_p = water specific heat, 1 BTU/lb -°F,

A = surface area of swamp, ft^2,

Q = flow rate of heat effluent, 20 cfs,

T = effluent temperature °F, as a function of distance, x, ft,

K = heat exchange coefficient, BTU/ft^2-sec-°F,

E = equilibrium temperature of swamp, °F.

The equilibrium temperature, E, is the theoretical steady state temperature that would exist if heat inputs to the water just equalled 3
the outputs. Both K and E are functions of local meteorological conditions.

In order to understand the nature of terms involved in equation (1), it is necessary to understand the total heat balance. Heat is added to water by discharges such as the tower blowdown. But, the natural sources of heat that are relevant to the analysis are net short wave (solar) radiation and net long wave (atmospheric) radiation. Heat is lost by long wave radiation from the water surface, by evaporation, and by conduction-convection.

The natural processes determine K and E as described by Edinger and Geyer (1965). In fact, the analysis has been performed by Thackston (1974) for both average and adverse heat dissipation conditions for several geographical areas around the country, and his values for

Mobile may be safely applied to the plant location at Caryville.

Most studies of heat dissipation are for open water, e.g., large rivers, lakes, bays, etc. However, the Little Dram Branch and the rim swamp both have extensive forest canopies that can affect heat transfer in at least four ways:

1. Short wave (solar) radiation is reduced by the shading effect. This tends to cool the water.
2. Long wave (atmospheric) radiation is increased because the canopy tends to radiate as a black body at the prevailing air temperature, whereas the atmosphere radiates only as a gray body, with an emissivity in the range 0.80 - 0.97. This tends to warm the water.
3. Wind speed is greatly reduced, probably to near zero, thus reducing evaporative and conductive losses. This tends to warm the water. 3
4. Due to reduced circulation, the air between the water surface and the canopy tends to be at a higher relative humidity than the surrounding atmosphere. Moreover, transpiration from the canopy adds an additional amount of vapor to this volume of air. These effects reduce the vapor pressure gradient and hence evaporation. This tends to warm the water.

These effects must be quantified. This is done below through modifications of the heat exchange coefficient, K, and equilibrium temperature, E.

The first need is to quantify the amount of cover. This can be defined as the fraction of ground (or water) surface area that would be shaded if the sun were directly overhead, and is termed the fraction canopy, F. Thus F = 1.0 indicates complete canopy cover and low light

penetration. Based on the type of forest cover found in the two locations, the following estimated values of F are used in the analysis.

Fraction Canopy, F, at Caryville Plant Site

	Little Dram Branch	Rim Swamp
Summer	1.0	0.7
Winter	1.0	0.1
Fall	1.0	0.7

The primary effect of the canopy on the short-wave radiation budget is to diminish incident radiation at the surface in accordance with an extinction coefficient k_t, thus

$$I'_{sg} = k_t \; I'_s \qquad (2)$$

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where: I'_{sg} = incident short-wave radiation after passing through canopy, BTU/ft^2-day,

k_t = canopy extinction coefficient,

I'_s = short-wave radiation from cloudy (average) sky, BTU/ft^2-day.

The canopy extinction, k_t, is given as a function of fraction canopy, F, by Eagleson (1970), p. 36.

Total incident short-wave radiation may then be apportioned according to the amount of canopy, thus:

$$I'_{sa} = F \, I'_{sg} + (1-F) \, I'_s \qquad (3)$$

where: I'_{sa} = average incident short-wave radiation over total area with and without canopy, BTU/ft^2-day.

Finally, the net short-wave radiation absorbed by the water is

$$I'_{sn} = (1-r)\ I'_{sa} = (1-r)\ [F\ I'_{sg} + (1-F)\ I'_{s}] \qquad (4)$$

where: I'_{sn} = absorbed short-wave radiation, BTU/ft^2-day,

r = albedo or reflection coefficient.

Since $k_t < 1$, it is clear that I'_{sn} decreases as F increases, cooling the water.

The long wave radiation exchange with the forest canopy is:

$$R_f = \sigma\ (T_a^{\ 4} - E_w T^4) \qquad (5)$$

where: R_f = net exchange with forest canopy (positive when water is warmed), BTU/ft^2-day,

σ = Stefan-Boltzman constant = 4.11 x10^{-8} BTU/ft^2-day -°R^4,

T_a = atmospheric temperature, °R,

T = water temperature, °R,

E_w = emissivity of water = 0.97. 3

In equation (5) it is assumed that the canopy radiates as a blackbody (emissivity = 1.0) at the air temperature, T_a.

Net exchange with the open atmosphere can be described similarly,

$$R_c = (1 - r_e)\ \sigma\ E_a\ T_a^{\ 4} - \sigma\ E_w T^4 \qquad (6)$$

where: R_c = net exchange with open atmosphere, BTU/ft^2-day,

r_e = long wave albedo - 0.03,

E_a = atmospheric emissivity.

In light of subsequent approximations, the terms $1-r_e$ and E_w are taken as 1.0 in following equations. The overall net long-wave exchange, R_e, can be derived as before by apportioning on the basis of canopy cover, thus,

$$R_e = F R_f + (1-F) R_c \qquad (7)$$

$$= \sigma T_a^4 [F + (1-F) E_a] - \sigma T^4$$

where: R_e = overall net long-wave exchange, BTU/ft^2-day.

In this case, since E_a <1, R_e increases as F increases, further warming the water.

Evaporation and conduction losses are the most difficult terms to evaluate in the heat budget since they are functions of turbulence, humidity gradients, and temperature gradients, most of which are very difficult to measure. However, the effects are described functionally in numerous formulas, all of which are accurate only for the exact conditions for which they were derived. However, it is necessary to choose one for subsequent analysis. The Meyer (1942) equation is used for two reasons: 3

1) It is used by Edinger and Geyer (1965) in their work leading to equation (1).

2) It has the desirable characteristic of separating the effects of turbulence due to wind from those present in "still" air. Thus, parameters for the Meyer equation will be used below.

The canopy effect is incorporated by reducing the wind speed in direct proportion to the amount of canopy. The effect of increased vapor pressure is not included because of no methods to determine the increase. The equation for evaporative - conductive heat losses including the

canopy effect is thus,

$$\phi_{ec} = [a + (1-F)\ b\ u]\ [K_1\ (e_s - e) + K_2\ (T-T_a)] \qquad (8)$$

where: ϕ_{ec} = heat flux due to evaporation and conduction-convection, (positive for cooling), BTU/ft^2-day,

a = empirical coefficient = 73 BTU/ft^2-day - mm Hg in Meyer formula,

b = empirical coefficient = 7.3 BTU/ft^2-day-mm Hg-mph in Meyer formula,

u = wind speed, miles/hr.,

K_1 = conversion constant = 1.0 in Meyer formula,

e_s = saturation vapor pressure at water surface temperature, mm Hg,

e = vapor pressure of ambient atmosphere, mm Hg,

K_2 = conversion constant = 0.26 mm Hg/°F in Meyer formula,

T = water temperature, °F, 3

T_a = air temperature, °F.

It can be seen that ϕ_{ec} decreases as F increases.

The net flux of heat into the water from the atmosphere is now

$$\mathcal{H}_n\ (F) = I'_{sn} + R_e - \phi_{ec} \qquad (9)$$

where $\mathcal{H}_n(F)$ is the net heat flux into the water (BTU/ft^2-day) and is a function of fraction canopy, F. In the general, non-linearized case, $\mathcal{H}_n$ may be used to replace the right hand side of equation (1). When linearized, the terms that multiply the water temperature serve to define the heat exchange coefficient, K, and the constant terms (i.e., not functions of water temperature) define the equilibrium temperature, E.

In order to isolate the effect of the canopy, equation (9) may be

separated into terms involving F and terms independent of fraction canopy. Thus

$$\mathcal{F}_n (F) = \mathcal{F}_n (0) - (1-r)\ I_s' \ (1-k_t)\ F \qquad (10)$$

$$+ \sigma\ T_a^{\ 4}\ (1-E_a)\ F$$

$$+ b\bar{u}\ \ [K_1\ (e_s - e) + K_2\ (T-T_a)]\ F$$

where $\mathcal{F}_n$ (0) is the heat flux with no canopy present and substitutions have been made for I_{sn}', R_e and ϕ_{ec} from earlier equations. Note that $\mathcal{F}_n$ (0) = 0, T = E, that is, the equilibrium temperature is defined by setting the net heat flux equal to zero. When $\mathcal{F}_n$ (F) is set equal to zero, a modified equilibrium temperature (and heat exchange coefficient) are defined that include the canopy effect.

The heat flux with no canopy is already defined by Thackston (1974) 3
for the Caryville area, as discussed previously. Thus,

$$\mathcal{F}_n\ (0) = -K\ (T-E) \qquad (11)$$

where K and E are taken from Thackston (1974). The additional terms in equation (10) serve to modify this K and E. Since no fourth-power radiation terms involving water temperature are included, and since vapor pressure may be treated as linearly proportional to temperature over specified temperature ranges, the additional terms in equation (10) may be readily linearized to the form:

$$-f_{sw} + f_{lw} + f_{ec} \ \equiv\ K'\ (T-E') \qquad (12)$$

where f_{sw}, f_{lw}, and f_{ec} are the short-wave factor, long wave factor and evaporation - conduction faction, respectively, on the right hand

side of equation (10). Equation (12) defines the primed heat exchange coefficient and equilibrium temperature.

Then the modified heat exchange coefficient, K_m, and equilibrium temperature, E_m, are defined by

$$K_m\ (T-E_m) = K\ (T-E) - K'\ (T-E') \qquad (13a)$$

where: $$K_m = K-K' \qquad (13b)$$

and $$E_m = \frac{KE - K'E'}{K-K'} \qquad (13c)$$

In order to evaluate the term f_{ec}, the saturation vapor pressure must be given as a function of temperature. Two equations are required to reflect seasonal changes in temperature ranges.

For winter conditions, assuming 25 <T <55°F,

$$e_s = 0.254\ T - 3.56 \qquad (14)$$ 3

where: e_s = saturation vapor pressure over the water surface, mm Hg,

T = water temperature, °F,

For summer and autumn conditions, assuming 65 <T <92°F,

$$e_s = 0.787\ T - 36.2. \qquad (15)$$

If temperature ranges for equations (14) and (15) are exceeded, only a small error will result.

The evaporation - conduction factor thus becomes:

<u>Summer-Autumn</u>

$$f_{ec} = 7.[illegible]\ u\ (1.047\ T - 36.2 - e - 0.26\ T_a)F \qquad (16)$$

Winter

$$f_{ec} = 7.3\ u\ (0.514\ T - 3.56 - e - 0.26\ T_a)\ F \qquad (17)$$

The factors of equation (12) were evaluated for the Carryville site as shown in Table III-1. As indicated in the footnotes, meteorological data were assembled from U.S. Weather Service "Climatological Data" summaries for Florida. In all cases the weather stations nearest Caryville (Chipley 3E, Apalachicola, Tallahassee) at which relevant parameters were measured were used to obtain data. Calculations utilized appropriate equations presented earlier. Atmospheric vapor pressure was found from air temperature and relative humidity readings. Cloudiness was used to calculate atmospheric emissivity.

Heat exchange coefficients and equilibrium temperatures used in 3
the study are shown in Table III-la. Thackston's (1974) results for nearby Mobile, Alabama are used for average and extreme (adverse) conditions for open water. Thackston defines extreme conditions as the 10 percent value of the weather variable (the monthly average exceeded, on the average, once in 10 years). The 10 percent high value of temperature and relative humidity used in conjunction with the 10 percent low value of wind speed and cloud cover were used to derive conditions conductive to maximum heating. With K calculated, based on four extremes occurring simultaneously, the estimate is quite conservative.

"Values Corrected for Canopy" in Table III-la are computed from equation (13) utilizing K' and E' from Table III-1 and the open-water E as indicated. These values are thus the K_m and E_m parameters required for subsequent evaluation of equation (1).

Finally, for appropriate values of K and E, equation (1) may be

TABLE III-1. SUMMARY OF METEOROLOGICAL PARAMETERS AND CALCULATIONS

(Refer to Text for Equations Used)

	Average Summer[a]	Adverse Summer[a]	Average Winter[a]	Adverse Winter[a]	Average Autumn[a]	Adverse Autumn[a]
<u>Little Dram Branch</u>						
A. Short-wave (solar) radiation factor						
1. Daily totals[b], I'_s, ly/day	550	600	250	300	350	400
2. Albedo[c], r	0.10	0.10	0.10	0.10	0.10	0.10
3. Fraction of canopy[d], F	1.0	1.0	1.0	1.0	1.0	1.0
4. Canopy extinction[e], k_t	0.1	0.1	0.1	0.1	0.1	0.1
5. Net short-wave factor, f_{sw}, BTU/ft^2-day	121	132	55	66	77	88
B. Long wave radiation factor						
1. Air temp[f], T_a, °F	82	90	49	61	72	84
2. Relative humidity[g], RH, %	82	90	70	80	74	80
3. Atm. vapor pressure, e, in Hg	0.904	1.080	0.244	0.432	0.585	0.940
4. Fraction cloudiness[h]	0.6	0.6	0.4	0.4	0.4	0.4
5. Atm. emissivity[i], E_a	0.95	0.97	0.82	0.84	0.87	0.92
6. Net long wave factor, f_{lw}, BTU/ft^2-day	284	113	497	485	428	288

3

Table III-1. (cont.)

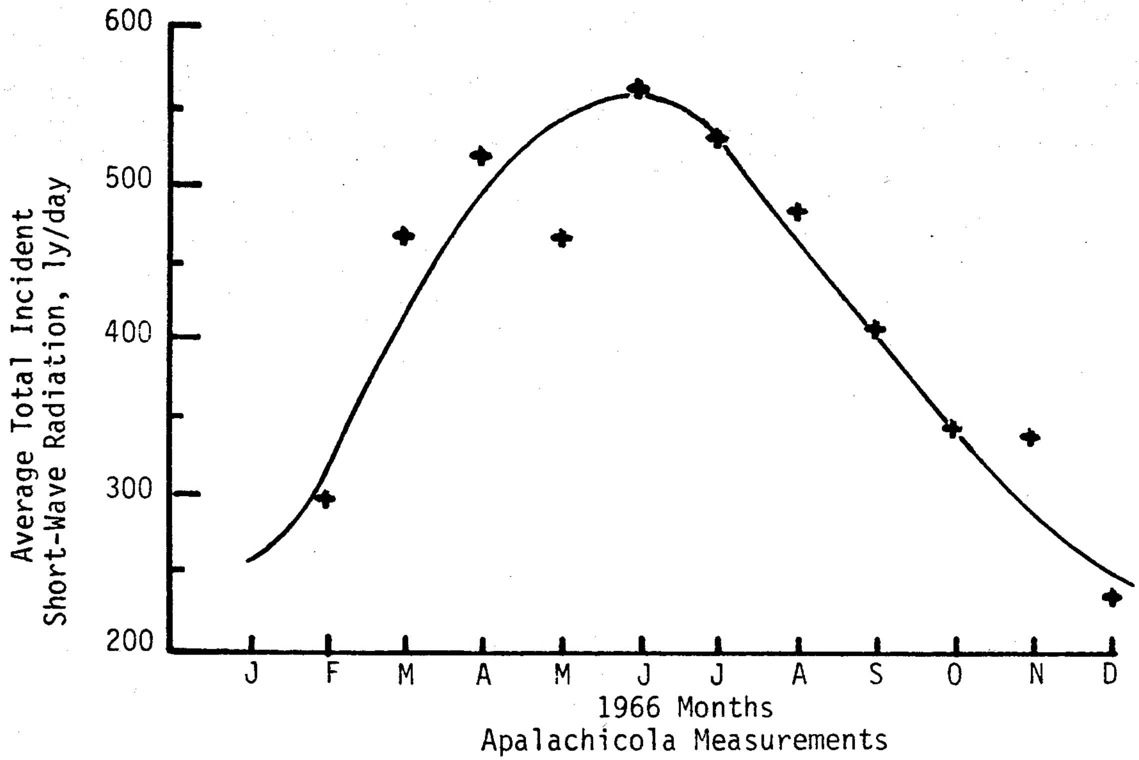
	Average Summer[a]	Adverse Summer[a]	Average Winter[a]	Adverse Winter[a]	Average Winter[a]	Adverse Winter[a]
C. Evaporation-conduction factor						
1. Wind speed[j], $\bar{u}$, mph	5.7	6.3	7.8	8.5	6.1	6.7
2. Atm. vapor pressure, e, mm Hg	22.96	32.51	6.20	10.97	19.86	23.88
3. Net evap. - cond. factor, ϕ_{ec}, BTU/ft^2-day (T is water temp. in °F)	43.57T-3349	48.15T-4236	29.27T-1281	31.89T-1886	46.62T-3107	51.21T-4007
D. Total factor (C.3 + B.6 - A.5), K'(T-E') BTU/ft^2-day	43.57x (T-73.1)	48.15x (T-87.7)	29.27x (T-28.7)	31.89x (T-46.0)	46.62x (T-59.1)	51.21x (T-74.3)
Rim Swamp[k]						
A.3 Fraction of canopy[d], F	0.7	0.7	0.1	0.1	0.7	0.7
A.4 Canopy extinction[e], k_t	0.1	0.1	0.6	0.6	0.1	0.1
A.5 Net short-wave factor, BTU/ft^2-day	85	92	2.4	2.9	54	62
B.6 Net long wave factor, BTU/ft^2-day	199	79	50	48	300	202
C.3 Net evap. - cond. factor, BTU/ft^2-day	30.50T-2344	33.71T-2965	2.93T-128	3.19T-189	32.63T-2175	35.85T-2805
D Total factor (C.3 + B.6 - A.5) BTU/ft^2-day	30.50x (T-73.1)	33.71x (T-88.3)	2.93x (T-27.2)	3.19x (T-45.9)	32.63x (T-69.1)	35.63x (T-74.3)

3

[a]Seasonal parameters are taken from Weather Service Climatological Data for locations indicated in subsequent notes. February 1973 is used for winter, July 1973 for summer and October 1973 for autumn.

Table III-1. (cont.)

[b]Incident daily short-wave (solar) total based on plot of 1966 Apalachicola measurements:



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[c]Albedo (short-wave reflection coefficient) based on Table 3-4 and Figure 3-10 from Eagleson (1970), for average cloud cover, solar altitude and combination of forest and water.

[d]Fraction of canopy cover are estimates based on type of vegetation found in Little Dram Branch and the rim swamp.

Table III-1. (cont.)

[e]Canopy extinction factor taken Eagleson (1970), Figure 3-9. This figure is for coniferous forests and used in lieu of more appropriate data.

[f]Air temperatures (averages and maxima used for average and adverse conditions, respectively) are for Florida station Chipley 3E. 3

[g]Relative humidity data are for Tallahassee. Adverse value is arbitrarily chosen.

[h]Fraction cloudiness data are for Tallahassee.

[i]Atmospheric emissivity taken from Eagleson (1970), Figure 3-16.

[j]Wind speed data are for Tallahassee. Adverse value is arbitrarily taken as 10% greater than average.

[k]Items not listed are the same as for Little Dram Branch.

TABLE III- 1a

HEAT EXCHANGE COEFFICIENTS, K, AND EQUILIBRIUM TEMPERATURES, E

	Open Water			Values Corrected For Canopy					
				Little Dram Branch			Rim Swamp		
	K^a BTU/ft²-day-°F	E^a °F	E_R[b] °F	K_L BTU/ft²-day-°F	E_L[c] °F	E_{RL}[d] °F	K_{RS} BTU/ft²-day-°F	E_{RS}[c] °F	E_{RRS}[d] °F
Average Summer	165	90	79.6	121	96.4	82.2	134	94.2	81.4
Adverse Summer	130	94	71.0	82	97.1	60.7	96	96.3	65.1
Average Winter	130	57	52.0	101	65.1	58.6	127	57.7	52.6
Adverse Winter	100	60	39.0	68	66.7	35.8	97	60.4	38.7
Average Autumn	150	75	75.3	103	82.5	82.9	117	79.7	80.1
Adverse Autumn	110	80	68.0	59	89.6	62.3	74	82.9	65.1

[a]From Thackston (1974) for Mobile, Alabama.

[b]River temperature used in plume study, from Site Certification Application, Table 5.1.

[c]Computed from equation (13) using Thackston E

[d]Computed from equation (13) using river temperature for E

3

solved for T_x, the temperature at any downstream location, x:

$$T_x = (T_o - E)e^{\frac{-KA}{\rho c_p Q}} + E \qquad (18)$$

Equation (18) is used subsequently to predict effluent temperatures from Little Dram Branch and the rim swamp. Computations are performed separately for summer, winter, and autumn and for average and "worst case" conditions, in order to correspond to calculations done for the river discharge in the Site Certification Application. 3

The reduction of temperature in the water effluent discharged into Little Dram Branch and the rim swamp are discussed in the following section of results.

Results

Heat Dissipation in the Choctawhatchee River. The discharge of heated water effluent directly into the Choctawhatchee River will cause less thermal stress and have fewer adverse effects than discharge into the alternative land sites.

The dissipation of heat from the cooling tower discharge into the Choctawhatchee River is considered and presented in detail in section 5.1 of the Site Certification Application.

Regulations of the State of Florida allow cooling tower blowdown to raise the temperature of receiving waters a maximum of 5°F above the ambient river temperature, measured at the boundary of the mixing zone (Chapter 17-3.05 FAC, as amended). Therefore, the cooling requirements discussed here consider the quantity of river flow entrained in the heated discharge plume required to cool this discharge to within 5°F of the
ambient river condition. 3

The predicted thermal plumes are described in section 5.1 of the Site Certification Application for 500, 1000, and 3000 MW generating capacities under adverse winter conditions and for 3000 MW capacity under average winter conditions. These plumes are based on the Hirst (1972) model for a three-dimensional submerged jet. The model presumes a Gaussian excess temperature profile perpendicular to the centerline of the plume with isotherms symmetrical to the centerline. The portion of the river flow that must be entrained to cool the discharge can be determined from the ratio of the cross-section of the plume to the cross sectional area of the river. This analysis visualizes the river as a series of planar cross-sections perpendicular to river flow. Each cross-section passes the discharge structure at the linear velocity of the river and receives an injection of heated effluent perpendicular to the axis of river flow. The discharge momentum propels heated effluent across the

moving cross-section until turbulent entrainment dissipates the temperature to within 5°F of the ambient river temperature at some point downstream of the discharge structure.

The temperature distribution curves of section 5.1 may be considered a plan view of the effluent trajectory seen from time $t = 0$, when the moving cross-section passes the discharge structure, to time $t = t^* = x^*/v$ -- where t^* and x^* are the time and downstream distance required to cool the discharge to less than 5°F above ambient river temperature and v is the linear velocity of the river. The most conservative cross-sectional area of the plume can be developed by rotating the plan view of the 5°F isotherm about the center line of trajectory and projecting the resulting distorted ellipsoid back to the $t = 0$ cross-section. This is illustrated in Figure III-14.

The fraction of the river flow required to quench the heated discharge to within 5°F of ambient temperature is the ratio: 3

$$\frac{(\text{Maximum } \Delta 5°\text{F plume cross-section}) - (\text{discharge water cross-section})}{\text{river cross-section}}$$

Where the 5°F plume area is projected back to the 0 time frame.

Then: Percent river flow required $= (100)\,\frac{(Ap - Ad)}{Ar}$

Where: Ap = the projected area of the 5°F isotherm on the 0 time frame (f^2)

Ad = the portion of projection Ap that is caused by heated discharge (f^2); this can be calculated from

$$Ad = \frac{Q\text{ effluent (cfs)}}{\text{river velocity (ft/sec)}}$$

which gives the maximum area of the heated effluent.

Ar = cross-sectional area of the river (ft^2)

which can be calculated from:

$$Ar = \frac{Q\text{ river (cfs)}}{\text{river velocity (ft/sec)}}$$

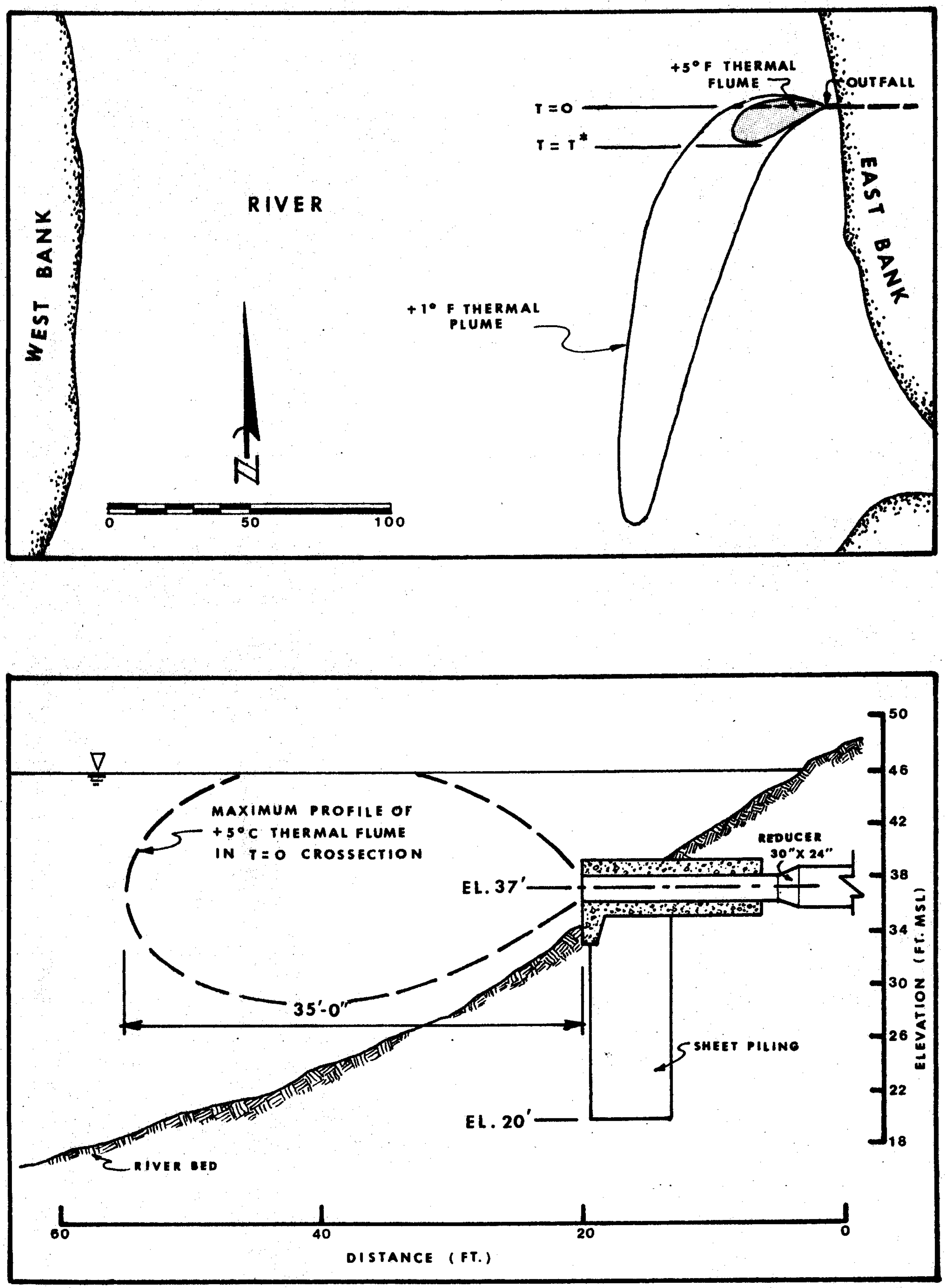

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FIGURE III-14. ILLUSTRATION OF THE THERMAL DISCHARGE PLUME UNDER ADVERSE WINTER OPERATING CONDITIONS FOR 3000 MW GENERATING CAPACITY.

TABLE III-2.

CALCULATION OF RIVER WATER REQUIRED TO BRING THERMAL PLUME TO WITHIN 5°F OF AMBIENT RIVER TEMPERATURE (1)

Generating Capacity & Condition	River Flow		Thermal Discharge (cfs)	Cross Sections (ft^2)			(%) Percent Required
	Volume (cfs)	Velocity (fps)		Plume Ap	Discharge Ad	River Ar	
500 MW							
Adverse (3)	870	0.55	3.34	22	1.35	1582	1.0
Average (2)	6413	2.49	3.34	5.5 (4)	6.07	2576	0.2
1000 MW							
Adverse	870	0.55	6.68	56.5	12.14	1582	2.8
Average	6413	2.49	6.68	14 (4)	2.68	2576	0.4
3000 MW							
Adverse	870	0.55	20.06	220	8.05	1582	11.6
Average	6413	2.49	20.06	55	34.47	2576	1.8

3

(1) Flows and thermal discharges derived from Sections 3.3 and 5.1, Site Certification Application.

(2) Average - Average winter river flow and average river H_2O Temperature 52°F.

(3) Adverse - Minimum river flow and minimum river temperature 39°F.

(4) Area of plume projected based on the ratio of adverse to average plume areas at 3000 MW generating capacity.

Eg: Average 500 MW Plume Area= $22\ ft^2 \times \frac{55\ ft^2}{220\ ft^2} = 5.5\ ft^2$.

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The percent of river flow required to quench the thermal discharge was determined for the 500, 1000, and 3000 MW generating capacity under adverse winter operating conditions and for 3000 MW under average winter operating conditions. These results are tabulated in Table III-2.

Under average winter conditions no more than 1.8 percent of the river flow is required to bring plume temperatures to within 5°F of ambient; under adverse winter conditions, 11.6 percent is required.

Heat Dissipation in Little Dram Branch and the Rim Swamp

Estimates of the temperature reduction of heated water discharged to Little Dram Branch and the rim swamp located between the river and the plant site follow. A 3000 MW plant discharging 20 cfs water from cooling tower blowdown is assumed for all cases.

As previously discussed, the Little Dram Branch and the rim swamp both have extensive forest canopies that can effect heat transfer in at 3
least four ways:

1. Short wave (solar) radiation is reduced by shading effect. This tends to cool the water.
2. Long wave (atmospheric) radiation is increased because the canopy tends to radiate as a black body at the prevailing air temperature, whereas the atmosphere radiates only as a gray body, with an emissivity in the range of 0.80 - 0.97. This tends to warm the water.
3. Wind speed is greatly reduced, probably to near zero, thus reducing evaporative and conductive losses. This tends to warm the water.
4. Due to reduced circulation and nearby transpiration, the air between the water surface and the canopy tends to be at a

higher relative humidity than the surrrounding atmosphere. This reduces the vapor pressure gradient and, hence, evaporation. This tends to warm the water.

The fourth effect is the most difficult to quantify, since values of increased relative humidity are not given in the literature. Hence, it is not considered further, except to note its tendency to increase the water temperature. However, effects 1-3 have been quantified, as described in the methods section. By determining meteorological parameters appropriate to the study area, it is possible to obtain "corrected" values of K and E for use in equation (1) and (18). These are presented in Table III-1a. The values determined by Thackston (1974) and the values corrected for the canopy effect are both used in subsequent calculations.

Two equilibrium temperatures should be considered. The first is that used by Thackston (1974) for the Mobile, Alabama region. It is 3
probably the most appropriate, since the swamp areas are not normally flushed by the river. However, to be consistent with the presentations in Table 5.1-1 in the Site Certification Application (where the results for direct discharge into the river are presented), the river temperature should also be used as an equilibrium temperature. However, this value is probably too low, because the equilibrium temperature, as well as the exchange coefficient, is altered by the canopy.

The Little Dram Branch is assumed to have no base flow for all of the alternatives to be examined. A rectangular section 2 feet deep by 5 feet wide is assumed through which the 20 cfs move at 2 ft sec^{-1}. The length of this creek is approximately 9210 ft. Thus, its surface area is 1.06 acres. The section of the rim swamp to be examined has an area equal to 131 acres. Since the river will be tending toward flooding at elevations above 50 ft only the area below 50 ft is considered in the analysis.

The effect of the canopy is illustrated in Table III-3 The effluent temperature leaving each disposal site is slightly greater because of the canopy. The canopy in Little Dram Branch causes a 0.3 - 0.7^{o}F higher final effluent temperature than without canopy. In the rim swamp the canopy causes a 2.3 - 4.7^{o}F higher final effluent temperature than without canopy, under summer and autumn conditions. Tables III-4 and III-5 compare the reduction in effluent temperature, using each of two equilibrium temperatures in Little Dram Branch and the rim swamp, with and without the canopy effect, respectively. 3

Little Dram Branch has little ability to dissipate heat from the effluent waters using either of the equilibrium temperatures, due to its small surface area and short travel time. However, the rim swamp is very effective in dissipating the waste heat from the effluent waters, using either the equilibrium temperatures. Effluent water temperatures at the discharge from the rim swamp are within a degree of either the Thackston equilibrium temperature or the river temperature under all hydrometeorological conditions, even when the canopy is considered.

TABLE III-3

EFFECT OF CANOPY ON PREDICTED SWAMP EFFLUENT TEMPERATURE

	Little Dram Branch				Rim Swamp			
	Fraction Canopy, F	Effluent Temperature With Canopy[a] °F	Effluent Temperature No Canopy[a] °F	ΔT °F	Fraction Canopy, F	Effluent Temperature With Canopy[a] °F	Effluent Temperature No Canopy[a] °F	ΔT °F
Adverse Winter	1.0	90.6	90.0	0.6	0.1	60.6	60.2	0.4
Adverse Summer	1.0	103.4	103.1	0.3	0.7	96.3	94.0	2.3
Adverse Autumn	1.0	101.2	100.6	0.6	0.7	83.3	80.1	3.2
Average Winter	1.0	75.5	75.0	0.5	0.1	57.7	57.0	0.7
Average Summer	1.0	93.4	93.0	0.4	0.7	94.2	90.0	4.2
Average Autumn	1.0	91.6	90.9	0.7	0.7	79.7	75.0	4.7

[a]Predicted using swamp equilibrium temperature that incorporates estimate of Thackston, 1974 for Mobile, Alabama.

TABLE III-4

PREDICTED EFFLUENT TEMPERATURES WITH CORRECTIONS FOR CANOPY

Little Dram Branch[a]	Tower Effluent Temperature[b] °F	Exchange Coefficient, K[c] BTU/ft^2-day, °F	Thackston Equilibrium Temperature, E[d] °F	Pred. Swamp Effluent Temperature °F	River Equilibrium Temperature, E[e] °F	Pred. Swamp Effluent Temperature °F
Adverse Winter	91.3	68	66.7	90.6	35.8	89.7
Adverse Summer	103.6	82	97.1	103.4	60.7	102.1
Adverse Autumn	101.6	59	84.6	101.2	62.3	100.6
Average Winter	76.0	101	65.1	75.5	58.6	75.3
Average Summer	93.2	121	96.4	93.4	82.2	92.6
Average Autumn	92.0	103	82.5	91.6	82.9	91.6
Rim Swamp[f]						
Adverse Winter	91.3	97	60.4	60.6	38.7	39.0
Adverse Summer	103.6	96	96.3	96.3	65.1	65.3
Adverse Autumn	101.6	74	82.9	83.3	65.1	65.8
Average Winter	76.0	127	57.7	57.7	52.6	52.6
Average Summer	93.2	134	94.2	94.2	81.4	81.4
Average Autumn	92.0	117	79.7	79.7	80.1	80.1

[a]Surface area = 1.06 acres

[b]From Table 5.1-1. Cooling Tower Effluent Flow = 20 cfs.

[c]Corrected for canopy

[d]Corrected for canopy and using open water E for Mobile from Thackston, 1974

[e]Corrected for canopy and using open water E as temperature of river.

[f]Swamp area = 131 acres below 50 ft contour.

TABLE III-5

PREDICTED EFFLUENT TEMPERATURES ASSUMING NO CANOPY, OPEN WATER

Little Dram Branch[a]	Tower Effluent Temperature[b] °F	Exchange Coefficient, K^c BTU/ft^2-day, °F	Thackston Equilibrium Temperature E^c °F	Pred. Swamp Effluent Temperature °F	River Equilibrium Temperature, E^d °F	Pred. Swamp Effluent Temperature °F
Adverse Winter	91.3	100	60	90.0	39.0	89.1
Adverse Summer	103.6	130	94	103.1	71.0	101.9
Adverse Autumn	101.6	110	80	100.6	68.0	100.1
Average Winter	76.0	130	57	75.0	52.0	74.7
Average Summer	93.2	165	90	93.0	79.6	92.3
Average Autumn	92.0	150	75	90.9	75.3	92.0
Rim Swamp[e]						
Adverse Winter	91.3	100	60	60.2	39.0	41.5
Adverse Summer	103.6	130	94	94.0	71.0	71.0
Adverse Autumn	101.6	110	80	80.1	68.0	68.1
Average Winter	76.0	130	57	57.0	52.0	52.0
Average Summer	93.2	165	90	90.0	79.6	79.6
Average Autumn	92.0	150	75	75.0	75.3	75.3

[a]Surface area = 1.06 acres

[b]From Table 5.1-1. Cooling Tower Effluent Flow = 20 cfs.

[c]From Thackston, 1974, for Mobile, Alabama.

[d]Assuming swamp equilibrium temperature is same as river. Source: same as note a

[e]Swamp area = 131 acres below 50 ft contour.

3

Choctawhatchee River Environment. A description of the Choctawhatchee River and its river dynamics has been presented in an earlier section of Chapter III. A discussion of water quality of the river is presented in a later section of this chapter. A discussion of the biological community of the river is presented in Chapter IV.

Little Dram Branch Environment. Little Dram Branch winds through sandy uplands, mostly agricultural fields. Its channel is small and flow is reportedly intermittent. During field observations, four weeks after flood, it had a steady flow of water about 6-12 in. deep and 6-8 ft wide. Flow was estimated to be 3-4 feet per second. Its floodplain is generally about 100-200 feet wide.

Vegetation of this system has a dense canopy characteristic of
lands subject to periodic inundation. The dense canopy and wet ground
produce a cool, humid environment, unlike that of the drier, more open 3
uplands. The upper canopy is dominated by sweet bay, red bay, and slash
pine. Sweetgum, diamond-leaf oak, swamp tupelo, and red maple are common
on the fringes. Common understory trees and shrubs include hawthorn,
yaupon holly, tree sparkleberry, and blue-beech. Catbriar vines are
common in the interior and wild grape on the fringes (Table III-6).

Few vertebrates are found exclusively in the floodplain of Little Dram Branch, but many find it valuable for occasional foraging, nesting, and cover. There are three basic components in this habitat available to animals: the canopy; the ground litter; and the branch proper.

The canopy produces seeds and fruits and attracts many small invertebrates. These attract warblers, woodpeckers, Cardinals, Mockingbirds, other small birds, bats, squirrels, rough green snakes, and several species of rat snakes. These in turn attract larger carnivores, hawks, owls, long-tailed weasels and bobcats.

TABLE III-6

DOMINANT VEGETATION IN THE
LITTLE DRAM BRANCH FLOODPLAIN

TREES AND LARGE SHRUBS

Magnolia grandiflora, Southern Magnolia

Persea borbonia, Red Bay

Pinus elliottii, Slash Pine

Carpinus caroliniana, Blue Beech

Quercus laurifolia, Diamond Leaf Oak

Liquidambar styraciflora, Sweet Gum

Crataegus sp., Hawthorn

Ilex vomitoria, Yaupon Holly

Acer rubrum, Red Maple 3

Vaccinium arboreum, Tree Sparkleberry

SHRUBS, HERBS, AND VINES

Sabal minor, Bluestem Palmetto

Lyonia lurida, Fetter Bush

Lucothoe racemosa, Swamp Lucothoe

Rhododendron viscosum var. *serrulatum*, Swamp Azalea

Rhus radicana, Poison ivy

Vitis rotundifolia, Muskadine

Vitus aestivalia, Summer Grape

Similax bona-nox, Greenbriar

Similax laurifolia, Greenbriar

Parthenocissus quinquefolia, Virginia creeper

Saururus cernuus, Lizards Tail

Ground litter (detritus) attracts a web of animals whose food chains are based not on living plants but upon decaying plant matter. Bacteria and fungi begin the process by initiating the decomposition of litter. Small invertebrates continue this breakdown by consuming the partially decomposed litter. Other invertebrates consume these detritivores. These in turn are preyed upon by many small reptiles and amphibians (herpes); such ground birds as Robins, Brown Thrashers, Ovenbirds, Blue Jays, Mockingbirds, and Carolina Wrens; and by the armadillo and several shrews. Spotted and striped skunks, the grey fox, racoons, bobcats, weasels, and opposums feed on ground invertebrates, herpes, rodents, and occasionally small birds. Rodents, especially cotton rats and cotton mice, feral hogs, deer, and squirrels harvest nuts and fruits which fall from the canopy.

The creek food web is detrital based. Small invertebrates, 3
especially larval forms of insects, feed on detritus and its detritivores. These are consumed by such larger invertebrates as crayfish; by mosquito-fish and other small minnows; as well as turtles, newts, and salamanders. All of these attract wading birds (Green Heron, Little Blue Heron, American Egret, and Snowy Egret) water snakes, skunks, opossums, racoons, and weasels.

<u>Rim Swamp Environment</u>. The rim swamp ranges from about 500 to 1500 feet wide. It is without a definite channel, though it does contain flowing water during wet periods of the year. During the flood in April, 1975, water flow was observed at about 1 foot per second; three weeks after the flood receded almost no flow was observed.

Vegetation of the rim swamp is discussed in detail in Chapter V. Northerly, in the area of corridor alternative 3, it is similar to the

floodplain. Southerly, in the vicinity of Highway 90, it becomes a cypress-bay association. The vegetational change is gradual, and the approximate boundary between the two is wide and diffused. (See Fig. III-1.)

The dominant species of the northern portion of the rim swamp canopy is swamp tupelo. Green ash, bald cypress, and red maple are found frequently. American elm is found occasionally (Table V-2).

The canopy of the cypress-bay area is mostly pond cypress, swamp tupelo and sweet bay. Red bay and red maple are common at the swamp's edges. The understory is the young of these species. There is very little ground cover. The presence of bay trees indicates this system is gradually becoming drier. This shifting from a pure cypress to a bay-head system is probably caused by the gradual filling of the swamp with detritus --. there are no drainage ditches in this area. The process is enhanced by low water flow. 3

Through a pattern of succession, wetlands evolve into uplands. Tributaries deposit detritus and silt to a point where cypress becomes established. Cypress adds additional detritus, and in turn older cypress die. Bay and other trees become established in old cypress stumps, and swamp tupelo become established in the shallower water. This continues through stages of succession as other species are introduced into the drier environment. Finally the ecosystem becomes a mesic hammock. This process may have been hastened in this locale by the logging of cypress some eighty years ago.

There are two major components of the rim swamp attracting and supporting wildlife. These are the canopy and standing water. Due to a low plant diversity, heavy shading, and fluctuating water levels, this system probably has the lowest diversity of animals of any near the plant site.

Invertebrates utilizing the canopy attract tree frogs, the rough green snake, several warblers, and a few other small insectivorous birds. Wading birds, vultures, and the Wild Turkey commonly roost overnight in the canopy of this ecotype.

Where there is standing water year-round, such plants as sawgrass, yellow-eyed grass, bur-reed and duck potato occur in dense stands. These emergent plants are commonly associated with such submersed species as bladderwort, water primrose and water mint. Often growing profusely, they afford little room for aquatic animals. The mosquito-fish is the only common nekton. Young bream (bluegill, redear, redbreast) are present, but seldom attain an appreciable size. Turtles, especially the small stinkpot, are sometimes found, but are not common except in periods of low water, when fish concentrate in small pools. Water snakes and moccasins are present, feeding upon small fish and amphibians. Many frogs
and toads utilize this area during their breeding seasons. Wading birds 3
forage for small fish, reptiles, and amphibians.

A small, drainage course runs in the area between the plant site and the rim swamp. It is crossed or closely paralleled by each of the alternative pipeline corridors (Figure V-2). It is narrow -- 3-6 feet wide and shallow -- 1-3 inches deep -- with occasional pools about a foot deep. Its floodplain vegetation is mesic-like, but more dense than the mesic island. Its waters are much like Little Dram Branch in that they are cool and dark. A small spring and run empty into the branch about half-way between the road and the Caryville distribution corridor.

Ecological Impact of Effluent Discharge. Dissipating the heated effluent into the Choctawhatchee River appears to be the best alternative. Little ecological impact should result to the river system (Chapter IV) and only minor hydrologic and environmental changes should be incurred by constructing an intake-discharge corridor (Chapter V).

The impact of the effluent water discharge on the rim swamp and Little Dram Branch involves two considerations -- thermal load and increased water flow. Both of these factors could cause slow long-term chronic changes in both of these wetland areas -- many if not all the species would be lost. There is also the unforseen upset in plant operation that could cause acute thermal stress.

The canopy of Little Dram Branch is very dense. The penetration of wind and solar radiation is low. Temperatures are generally lower than in surrounding areas, and branch water temperatures are generally near 70°F. Relative humidity is high. With only limited dissipation of heat from the effluent water, water temperature from 90 to 100°F can be expected the entire length of this small floodplain system.

The rim swamp presents a related, although quite different, set 3
of circumstances. Its canopy is not as dense -- 50-75 percent cover, compared to 90 percent over the branch. Thus, penetration of wind and solar radiation is greater, resulting in higher water and air temperature and lower relative humidity. The aquatic portion of the rim swamp is wider and deeper than that of the branch. Dissipation of the thermal load would probably be harmless when the water level is high and a current is present. However, when water levels are low, hot water could pool and the effects on the vegetation would be similar to those near Little Dram Branch.

Most of the literature dealing with thermal effects on trees focuses on minimum temperature needed for seed germination, or on the decimation of floodplain species when aquatic temperatures reach 120°F or more (as at the Savannah River Project). No literature was found on the stressing effects of heated waters in the range of the Ellis Plant discharge. However, if these floodplain ecosystems are heated for long periods 20 - 25°F above the temperatures for which they are adapted, severe stress could

occur. Trees would be unable to reproduce or maintain themselves; many, if not all, of the species, would be lost.

Chronic stresses will cause irreversible damage to the forests in the floodplains of Little Dram Branch and the rim swamp. The Choctawhatchee River is better suited to the incidence of either acute or chronic stress. A dynamic river system is unlikely to be affected by chronic stress and can recover in a short time -- perhaps a matter of days -- from an acute stress. The forest systems of the branch and swamp once lost might require decades to recover.

Wetland animals could suffer immediate effects. Like the wooded vegetation, these species are adapted to intermittent contact with cool or moderately warm waters. The heated water could cause prolific benthic populations of heat-tolerant midge larvae and oligochaetes to develop. Terrestrial wildlife, faced with loss of habitat and food sources as the forest system disappears, could leave the impact area or die. Species composition 3
could be expected to change radically at all trophic levels in both the terrestrial and aquatic systems of the areas.

The alternatives of disposing of the heated effluent into either Little Dram Branch or the rim swamp are both unsatisfactory. Disposal into Little Dram Branch will not allow cooling of the thermal dischage and could create an adverse ecological impact. Disposal into the rim swamp will effectively dissipate the heat, but the ecological impact could be severe. The rate and extent of damage to these areas are unknown, but the risk is unwarranted.

The disposal of effluent waters from the plant into the Choctawhatchee River is the best and recommended alternative. The discharge site for effluent water should be located in the river approximately 100 ft down stream from the water intake site.

Water Quality

Introduction

In this portion of the study the ambient water quality of the Choctawhatchee River near Caryville is considered. Data from U. S. Geological Service (USGS) have been assembled as well as water quality information obtained during the investigation in the spring of 1975. The water requirements of the R. F. Ellis, Jr. Electric Generating Plant -- the predicted water intake, cooling water discharge, and wastewater streams -- are detailed in Sections 3.3 to 3.6 and 5.1 to 5.4 of the Site Certification Application. This section considers the effects of these water uses on water quality of the river.

Effects of power plant discharges on the chemical and biological characteristics of receiving waters are extensively documented in published literature and reports. The impact of wastewater effluents from electric generating plants are varied. They include localized changes in the temperature and chemical composition of the natural waters, which, in turn, change the biochemical reactions. These changes may affect the biological community at all levels.

Changes in the chemistry of a receiving water are readily observable, but the biological effects may be sufficiently small to remain undetected for long periods. The background water quality information gathered on the Choctawhatchee River can be used as a guide in predicting the environmental effects on this reach of the river.

Methods

River samples were taken in the spring of 1975, during flood flow on March 18, 1975, and normal flow, May 13, 1975. A water sample from the floodplain was also taken on the latter date to compare with water in the main channel.

Standard analytical techniques summarized below were employed to determine routine water quality parameters (EPA Methods for Chemical Analysis of Water and Wastes, 1974).

Total Alkalinity	--	Titration with 0.02N H_2SO_4 Methyl-orange Endpoint
Chloride	--	Mercuric Nitrate Method
Color	--	Comparison with Platinum Cobalt Standards
Hardness	--	EDTA Titration
Ammonia Nitrogen	--	Macro-kjeldahl Distillation Followed by Nesslerization
Total Kjeldahl Nitrogen	--	Macro-kjeldahl Digestion
Nitrate	--	Automated Cadmium Reduction Method
Total Phosphorus	--	Persulfate Digestion Followed by the Automated Single Reagent Method
Total Dissolved Solids	--	Gravimetric Method
Suspended Residue	--	Gravimetric Method
Sulfate	--	Gravimetric Barium Chloride Method
Copper, Iron, Lead, Zinc and Manganese	--	Atomic Absorption Spectrophotometric Method
Mercury	--	Flameless Atomic Absorption, Cold Vapor Method

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Results

Various characteristics of the Choctawhatchee River have been measured by the USGS near the proposed site. Flow records have been kept since 1929. Temperature and conductivity data are continuously recorded and have been kept since 1965. Other parameters have been sampled periodically.

The flow data are detailed in Section 2.5 of the Site Certification Application and summarized in Table 2.5-7. The annual pattern of average monthly flows is plotted in Figure III-15. The average monthly flows are considerably greater than the lowest monthly mean flows (Figure 2.5-21).

Average monthly temperatures (Figure III-16) range from 52°F to 82°F (11.1°C to 28.3°C). Daily temperature extremes vary between 39°F and 89°F (4°C and 32°C). Highest temperatures occur in summer 3
during periods of low flows. Summer water temperatures of 85-89°F naturally approach the 90°F maximum allowable temperature for Florida fresh water (Chapter 17-3 FAC).

As might be expected, specific conductance (Figure III-17) correlates negatively with flow. Conductance and hardness values show that this reach of the river is well upstream of salt intrusion from the Gulf of Mexico and that the river is soft water (total hardness <60 to 100 mg $CaCO_3$/l).

The chemical parameters (mean and range) are summarized for the period of record in Table III-7. Table III-8 presents the data obtained during the spring 1975 survey. The values found in this survey compare well with USGS records (Table III-7). These two tables are summarized

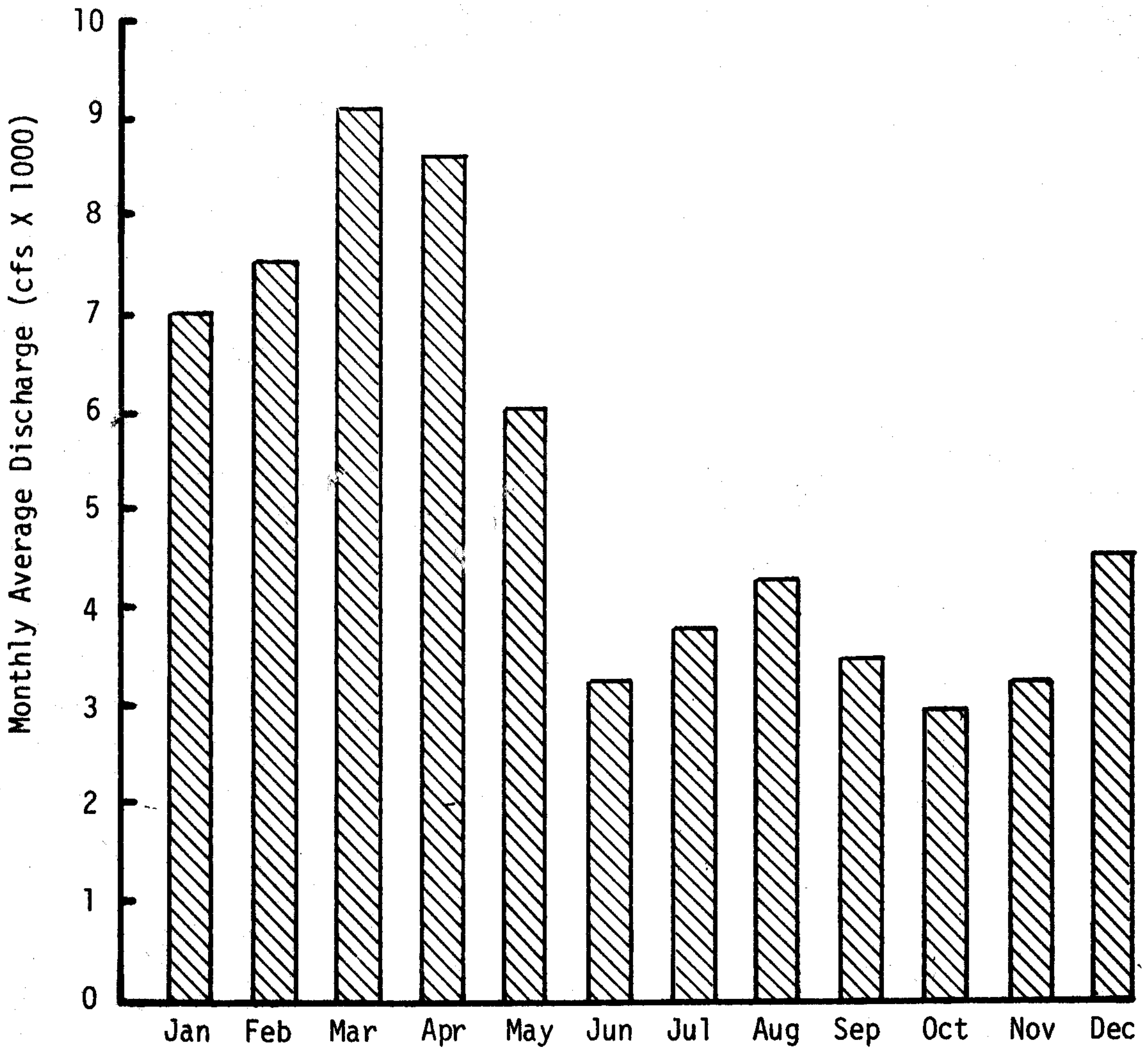

FIGURE III-15. MONTHLY DISCHARGE AVERAGES FOR THE CHOCTAWHATCHEE RIVER AT CARYVILLE. DRAWN FROM TABLE 2.5.7. 3

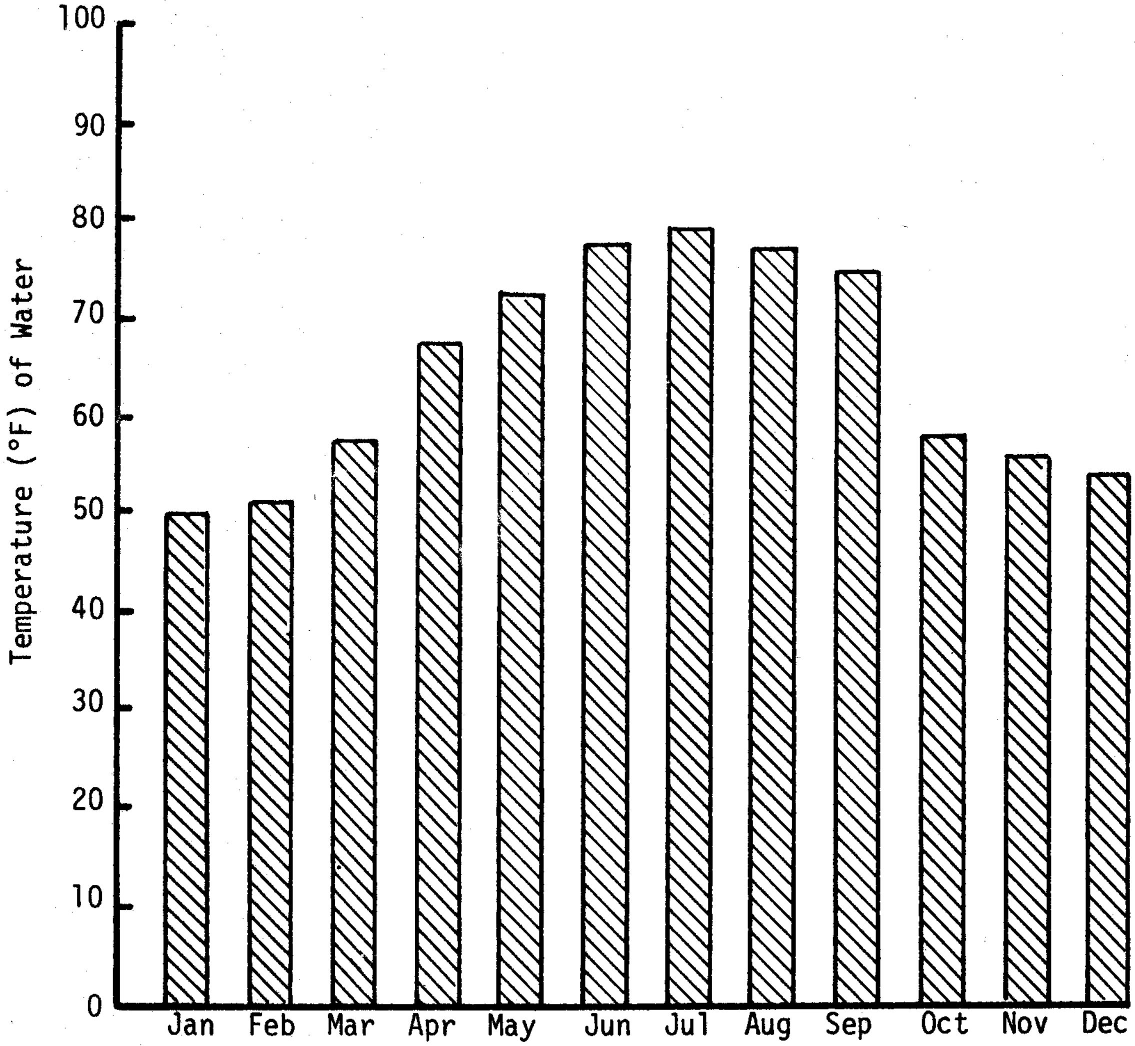

FIGURE III-16. MONTHLY TEMPERATURE AVERAGES 1965-1973 --
USGS SURVEY DATA.

3

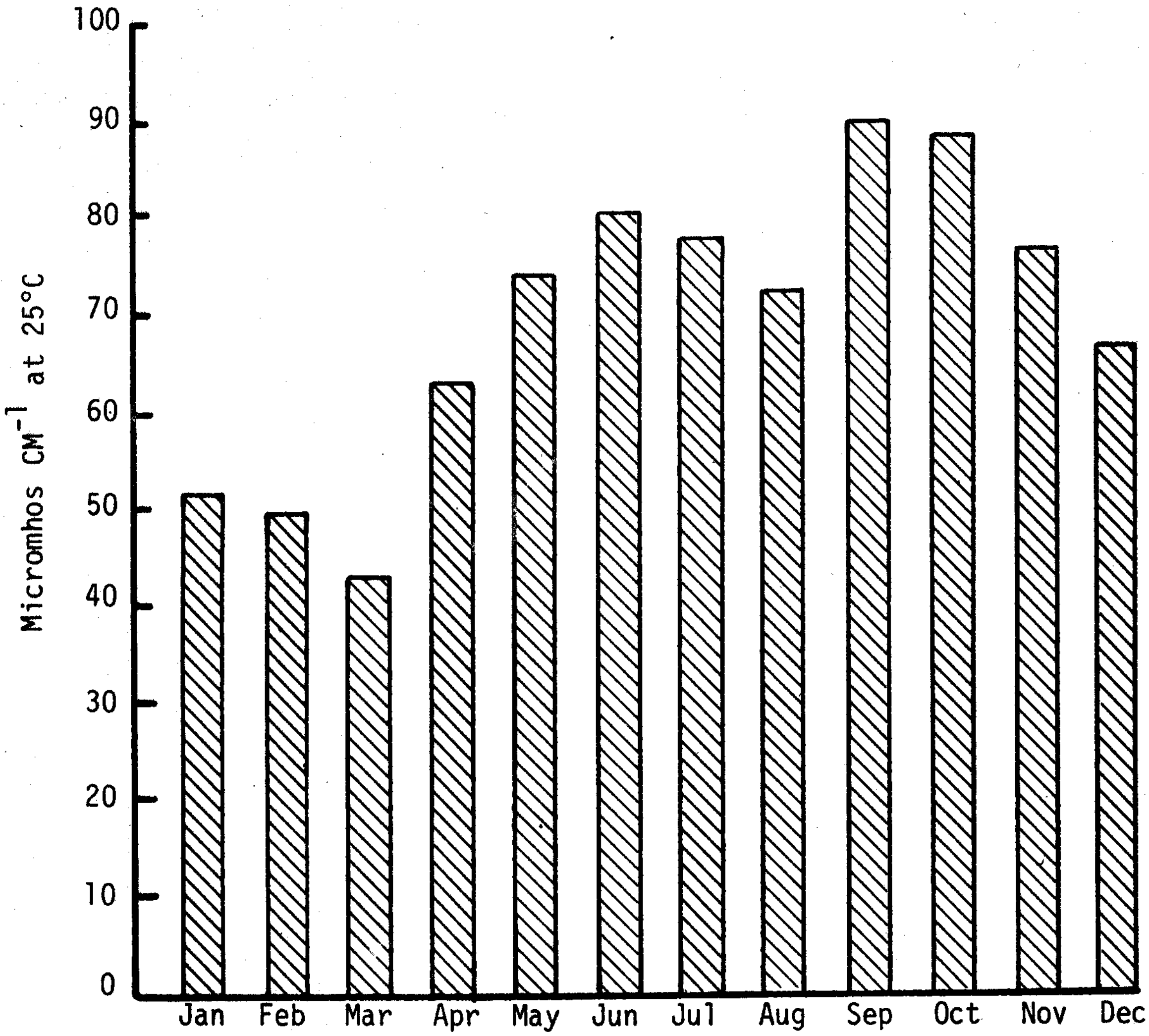

FIGURE III-17. MONTHLY SPECIFIC CONDUCTANCE AVERAGES FOR 1965-1973 -- USGS SURVEY DATA. 3

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TABLE III-7

MEAN VALUES FOR SELECTED WATER QUALITY PARAMETERS
FOR THE CHOCTAWHATCHEE RIVER AT
CARYVILLE, FLORIDA*

Parameter	Mean	Range	
pH (Units)	6.84	5.9 - 7.4	
Color (Platnium Cobalt Units)	34.6	0 - 200	
Total Dissolved Solids (mg/l)	54.2	28 - 112	
Hardness ($mgCaCO_3/l$)	30.2	12 - 50	
Sodium (mg/l)	2.75	1.8 - 3.8	
Potassium (mg/l)	0.88	0.5 - 1.4	
Calcium (mg/l)	9.25	4.3 - 16.0	3
Magnesium (mg/l)	1.19	0.4 - 1.9	
Silica ($mgSiO_2/l$)	6.96	3.8 - 9.3	
Chloride (mg/l)	4.09	2.8 - 10	
Sulfate (mg/l)	1.55	0 - 4.0	
Bicarbonate (mg/l)	31.00	3 - 59	
Carbonate (mg/l)	0	0	
Fluoride (mg/l)	0.14	0 - 0.4	
Total Phosphate (mg P/l)	0.09	0 - 0.23	
Nitrate (mgN/l)	0.64	0.1 - 1.7	
Iron (μg/l)	308.2	0 - 2600	
Manganese (μg/l)	51.5	0 - 100	

*USGS Survey Data; 1965 - 1973.

TABLE III-8

WATER QUALITY IN THE CHOCTAWHATCHEE RIVER AT CARYVILLE, FLORIDA *

Parameter	River Stations			Rim Swamp
	March 18, 1975	May 13, 1975		May 13, 1975
	L-2	L-3	T-1	C-1
Alkalinity ($mgCaCO_3/l$)	16	16	18	40
Chloride (mg/l)	5.0	3.0	2.0	3.0
Color (P.C.U.)	162	128	127	97
Total Hardness ($mgCaCO_3/l$)	44	26	22	42
Sulfate (mg/l)	1.7	--	--	--
Ammonia (mgN/l)	0.15	0.15	0.17	0.17
Total Kjeldahl (mgN/l) Nitrogen	0.73	0.53	0.65	0.48
Nitrate (mgN/l)	2.30	0.22	0.38	0.30
Total Phosphorus (mgP/l)	0.018	0.11	0.13	0.11
Total Dissolved Solids (mg/l)	45	70	67	90
Total Suspended Solids (mg/l)	28	22	24	9
Copper (mg/l)	<0.01	<0.01	<0.01	<0.01
Iron (mg/l)	1.3	1.5	2.3	2.2
Manganese (mg/l)	0.09	0.13	0.12	0.12
Mercury (mg/l)	--	<0.0002	<0.0002	<0.0002
Zinc (mg/l)	0.030	0.038	0.036	0.024
Lead (mg/l)	--	0.03	<0.02	<0.02

*Analytical data reported to two significant figures; none are carried beyond right-most retained digit of detection limit.

3

in Table III-9 to provide a comparison of the chemical parameters in the river water with the pertinent state water quality standards that have been established (Chapter 17-3 FAC).

The water of the Choctawhatchee is soft, slightly colored (0-200 PCU) with a pH ranging 5.9 to 7.4. Color shows no apparent pattern, but likely varies with discharges from lowlands in the watershed. Values of the major cations and anions in the Choctawhatchee River are low--as would be expected for drainage from a relatively undisturbed watershed, where wetlands, forests, and grasslands have the opportunity to retain nutrients and reduce the dissolved solids.

In the Choctawhatchee River there are adequate concentrations of the biogenic salts--nitrate and phosphate--to support a well-developed food web based on periphyton. However, turbidity limits periphyton 3
production. Ambient iron concentrations in the river are already higher than limits specified in Chapter 17-3 FAC for receiving waters following mixing with effluent discharges. These concentrations, however, are probably associated with chelation in the color colloids and are not from cultural sources. The sulfate and potassium concentration (1.55 and 0.88, respectively) are low.

Predicted Effects of Plant Operation

The potential impacts on the water quality from plant operation are from the effluent discharge from the cooling tower and other auxillary waste streams that could (1) alter the various chemical parameters in the river; (2) introduce residual chlorine that could have toxic effects on the biological community; and (3) elevate river temperatures in

TABLE III-9

COMPARISON OF WATER QUALITY CONCENTRATION IN THE CHOCTAWHATCHEE RIVER WITH RELEVANT FLORIDA WATER QUALITY STANDARDS

Parameter	Limit FAC 17-3 Class III Water[1]	Survey 1975 Sampling Survey Results[2]	United States Geological Survey Records[3]
pH (Unity)	Shall Not Be Modified by More than 1.0 Unit - Range 6.0 - 8.5		6.84
Color (Platinum Cobalt Units)	No Standard		34.6
Total Dissolved Solids mg/l	Not to Exceed 500 mg/l Monthly Average or 1000 mg/l At Any Time		54
Suspended Solids mg/l	<25 or Maximum 10 Percent Increase Above Background	24	
Conductivity μmho/cm at 25°C	500 or 100 Percent Increase	24 - 90[4]	
Hardness mg/l as $CaCO_3$	No Standard		30.2
Sodium mg/l	No Standard		27.5
Potassium mg/l	No Standard		0.88
Calcium mg/l	No Standard		9.25
Magnesium mg/l	No Standard		1.19
Silica mg/l	No Standard		6.96
Chlorides mg/l	Shall Not Exceed 250		4.09
Sulfate mg/l	No Standard		1.55

(1) 17-3 FAC Class III Fresh Water for Recreational Use and Wildlife Propagation.
(2) From Table III-8.
(3) From Table III-7.
(4) Range from Figure III-17.

TABLE III-10

Comparison of Selected Water Quality Parameters in Florida Rivers

Parameter	Peace River[1]	Suwannee River[1]	Apalachicola River[1]	Choctawhatchee River[2]	Yellow River[1]
Total Dissolved Solids mg/l	212	93.8	54.4	54.2	35.6
Hardness mg$CaCO_3$/l	354	108	61.6	30.2	24.8
Potassium mg/l	1.8	0.5	1.1	0.88	0.4
Chloride mg/l	1.5	6.0	4.3	4.09	3.5
Sulfate mg/l	8.2	10.8	2.8	1.55	0.3

(1) Taken from USGS Records Reported in LaRock and Bittaker (1973).

(2) Taken from Table III-1.

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localized areas and affect the life forms suspended in the water column.

Water effluents discharged to the river are principally the cooling tower blowdown, the bottom ash water bleed-off, the treated fly ash water bleed-off and waste water basin effluent. This latter includes 2.5 gpm of secondary treated sanitary sewage. The cooling tower effluent is discharged directly to the river without treatment. Treatment processes are proposed which will remove heavy metal and biogenic salts from the other waste effluents as may be required. Oil and grease will be physically separated and removed as solid waste.

Filtration of all intake river water removes the plankton and precludes the return of BOD to the river from the destruction of organic matter. The amount of the plankton removed by this process is considered in Chapter IV. Solids filtered from the river water will be sent to the bottom ash disposal area to settle. Most of the clarified effluent is used as supplemented make-up for the ash sluice recycle system. Suspended solids range to 30 mg/l in the bottom ash water bleed-off. This will amount to a discharge of 1.2 mg/l in the waste stream. This low level discharge of suspended solids will have negligible impact on the river. Ambient levels of suspended solids are 1-2 orders of magnitude higher than this projected discharge.

Recycling the cooling water causes solids in this water to become concentrated in direct proportion to the number of cooling cycles.

Since the build up of these solids cause scaling in the condenser tubes, a portion of the cooling water must be continuously removed and discharged. The level of total dissolved solids (TDS) in the circulating water system is controlled by continuous "blowdown" to maintain a

conductivity of 550 μmhos (TDS=369 mg/l) in the cooling system. This allows the system to operate between 4 and 10 cycles of concentration and results in a waste discharge ranging from 305 to 545 mg/l TDS at pH 8.3. Details for the lowest volume-highest TDS discharge and the highest volume-lowest TDS discharge are tabulated in Tables 3.5-8 and 3.5-9 of the Site Certification Application. Section 5.2 of the Site Certification Application models the dissolved solids plumes.

At 3000 MW generating capacity, the largest dissolved solids plumes are incurred by the low volume-high concentration discharge; but in no cases do the predicted concentrations exceed those stipulated by Chapter 17-3, FAC. However, the greatest total quantity of dissolved solids is discharged by the maximum volumetric discharge (1500 gpm for each 500 MW). Change in the water chemistry of the whole river is more important than the localized size of the discharge plume. Tables III-11 to III-13 summarize the predicted increases for 500, 1000, and 3000 MW generating capacity for selected solids in the river under "worst case" river flow conditions -- adverse autumn conditions (Table 5.1, Site Certification Application). The impact will be less at other times of the year, since river flows are greater. Adverse autumn conditions (lowest river flow, highest temperature and maximum power generation) is a rare event occurring with a probability of 2×10^{-7}. Average autumn flows will produce negligible increases in total dissolved solids. These tables show that the increases in chemical constituents are relatively insignificant. This is particularly true at the 500 and 1000 MW generating capacities.

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Figure III-18 plots the increase in whole river concentrations for total dissolved solids, calcium and sulfate. Sulfate increases markedly

TABLE III-11

Predicted Effect of Cooling Tower Discharge at 500 MW Capacity on Selected Water Quality Parameters in the Choctawhatchee River - Autumn Conditions

Parameter	Ambient River Concentration	Waste Discharge Concentration	Conditions after Discharge: Adverse (604 cfs) River Conc.	Adverse (604 cfs) % Change	Average (3525 cfs) River Conc.	Average (3525 cfs) % Change
Waste Discharge (cfs)(1)		3.34				
Total Dissolved Solids (mg/l)(2)	54.2	305	55.9	3.1	54.5	0.5
Suspended Solids (mg/l)(3)	44.0	0.6	44.0	0	44.0	0
Calcium (mg/l)(2)	9.25	6.5	9.29	0.3	9.26	< 0.05
Potassium (mg/l)(2)	0.88	5.6	0.91	3.5	0.89	< 0.1
Chloride (mg/l)(2)	4.09	23.5	4.21	3.1	4.11	< 0.1
Sulfate (mg/l)(2)	1.55	114.0	2.18	40.7	1.66	7.0

3

(1) Adapted from Table 5.1-1, Site Certification Application.

(2) Based on Average USGS Data Table III-3.

(3) Based on Spring 1975 survey in high water conditions (Table III-2, 44 mg/l) and a maximum release of 30 mg/l in bottom ash discharge, giving 0.6 mg/l in the effluent.

(4) Based on Table 3.5-8, Site Certification Application.

TABLE III-12

Predicted Effect of Cooling Tower Discharge at 1000 MW Capacity on Selected Water Quality Parameters in the Choctawhatchee River - Autumn Conditions

Parameter	Ambient River Concentration	Waste Discharge Concentration	Conditions after Discharge: Adverse (604 cfs) River conc.	Adverse (604 cfs) % Change	Average (3525 cfs) River Conc.	Average (3525 cfs) % Change
Waste Discharge (cfs)[1]		6.68				
Total Dissolved Solids (mg/l)[2]	54.2	305	57.6	6.2	54.8	1.0
Suspended Solids (mg/l)[3]	44.0	0.6	44.0	0	44.0	0
Calcium (mg/l)[2]	9.25	6.5	9.32	0.7	9.26	0.1
Potassium (mg/l)[2]	0.88	5.6	0.94	7.0	0.89	1.2
Chloride (mg/l)[2]	4.09	23.5	4.35	6.3	4.13	1.0
Sulfate (mg/l)[2]	1.55	114.0	2.81	81	1.76	14.0

(1) Adapted from Table 5.1-1, Site Certification Application.

(2) Based on Average USGS Data Table III-3.

(3) Based on Spring 1975 survey in high water conditions (Table III-2, 44 mg/l) and a maximum release of 30 mg/l in bottom ash discharge, giving 0.6 mg/l in the effluent.

(4) Based on Table 3.5-8, Site Certification Application.

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TABLE III-13

Predicted Effect of Cooling Tower Discharge at 3000 MW Capacity on Selected Water Quality Parameters in the Choctawhatchee River - Autumn Conditions

Parameter	Ambient River Concentration	Waste Discharge Concentration	Conditions after Discharge			
			Adverse (604 cfs)		Average (3525 cfs)	
			River Conc.	% Change	River Conc.	% Change
Waste Discharge (cfs)(1)		20.06				
Total Dissolved Solids (mg/l)(2)	54.2	305	65.8	21.5	55.9	3.2
Suspended Solids (mg/l)(3)	44.0	0.6	44.0	0	44	0
Calcium (mg/l)(2)	9.25	6.5	9.65	2.3	9.29	0.4
Potassium (mg/l)(2)	0.88	5.6	1.00	21	0.91	0.3
Chloride (mg/l)(2)	4.09	23.5	4.87	19	4.20	3.1
Sulfate (mg/l)(2)	1.55	114	5.15	230	2.20	42

3

(1) Adapted from Table 5.1-1, Site Certification Application.

(2) Based on Average USGS Data Table III-3.

(3) Based on Spring 1975 survey in high water conditions (Table III-2, 44 mg/l) and a maximum release of 30 ma/l in bottom ash discharge, giving 0.6 mg/l in the effluent.

(4) Based on Table 3.5-8, Site Certification Application.

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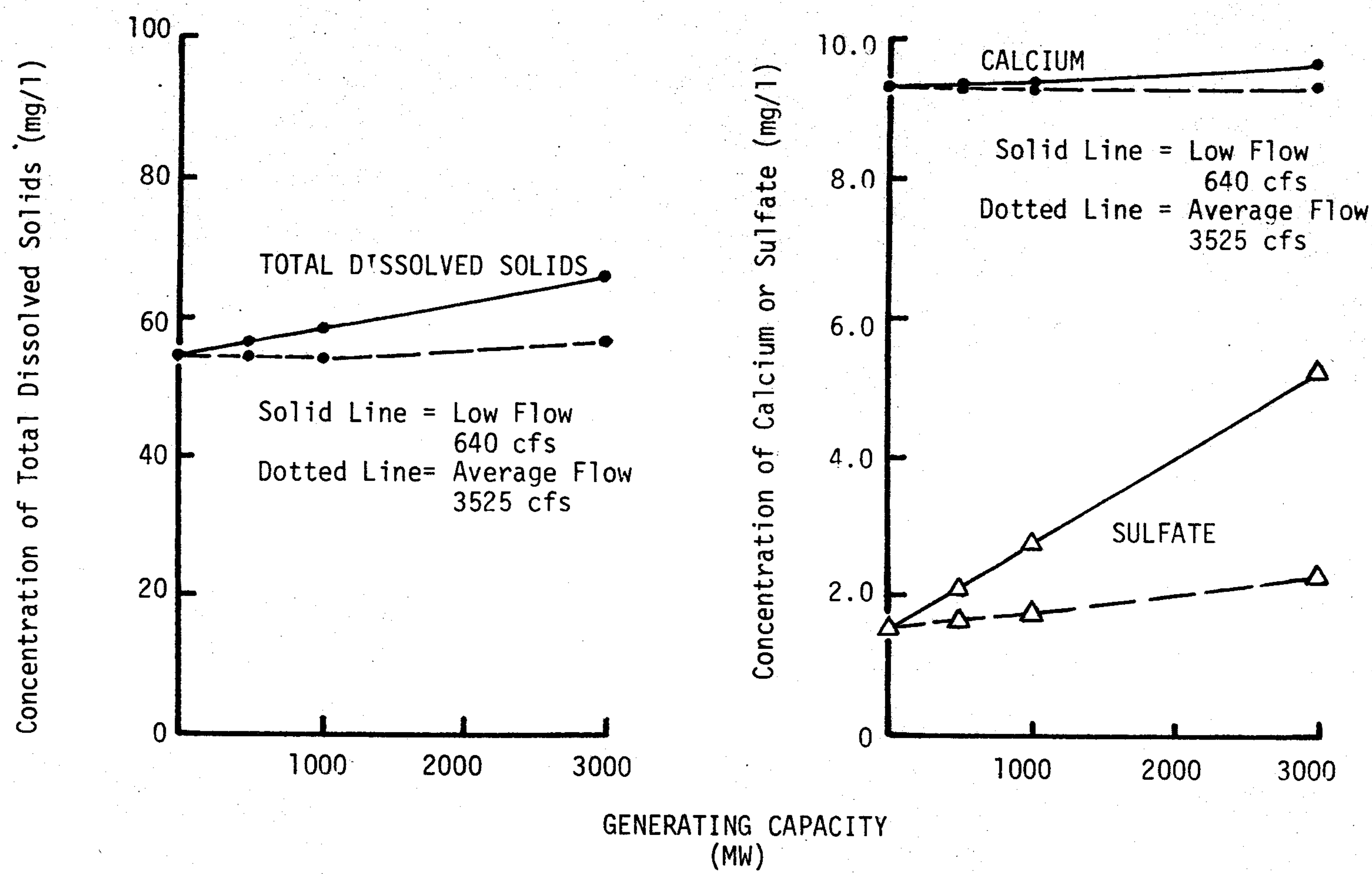

Figure III-18. Whole river increases expected in selected chemical parameters under average and adverse conditions during autumn.

3

under adverse operating conditions, but not under average operating conditions. At 3000 MW generating capacity under adverse conditions, the sulfate concentration will exceed the natural range of variation for the Choctawhatchee River (0-4.0 mg/l). However, this concentration of sulfate is still lower than concentrations found in other Florida rivers (Table III-10). At these concentrations, organisms are relatively insensitive to sulfate (Becker and Thatcher, 1973); and sulfate reduction and associated anoxic bottom conditions are not likely to develop. The occurrence of adverse conditions is improbable. Under average conditions, the increase will not approach the limit of natural variation (where no adverse environmental effects are in evidence).

Intermittent chlorination to prevent slime build-up will result in residuals of 0.3 to 0.6 mg/l in the cooling tower blowdown for short periods of one to two hours at various intervals. During summer, chlorination 3
will be required one or two times daily -- in winter once to twice per week. After mixing with the other waste streams, residuals will range 0.14 to 0.30 mg/l, assuming no chlorine demand in the other wastes. Actual residuals discharged to the river will be considerably less. Chlorine concentration will be less than 10 ppb in the river. This low concentration of residual chlorine will have no discernible impact on the river.

The effluent from the cooling tower will be lower in dissolved solids than the river water as a result of its being heated. However, this water will have a negligible impact on the oxygen balance in the river because of the small volume added, relative to the river flow. Under adverse operating conditions, this effluent is about 3.0 percent of the river flow. For normal operating conditions, the effluent is a negligible portion of

the river flow. The dissolved oxygen will be unaffected in the river downstream.

Because of the large volume of river flow, the thermal impact of the
plant effluent will be confined to a limited area and will have minimal biologi-
cal effects. The thermal effects will be greatest in winter. The effluent
temperatures under various operating conditions are shown in Figures 5.1-2
to 5.1-7 of the Site Certification Application. The biologic effects are
discussed in Chapter IV. The rise in temperature in the whole river will
be less than 0.1°F under average operating conditions, and not more than
1.19°F under adverse conditions (Table 5.1-2 Site Certification Applica- 3
tion.) These temperature increases will not degrade water quality.

A zone of mixing will be requested, in accordance with Chapter 17-3 FAC, as amended in March, 1975, to comply with all Florida regulations.

In summary, the discharge of treated effluents from the cooling tower and other plant sources will not affect the water quality of the Choctawhatchee River. There will be no significant change in ionic balance, total dissolved solids, or temperature. No metals or oil or grease will be discharged. Outside of a small mixing zone, the thermal impact on the river will be negligible.

IV

CHOCTAWHATCHEE RIVER: BIOLOGICAL CHARACTERISTICS

Plankton

Introduction

Plankton are free floating organisms suspended within the water column of all aquatic systems. They span all trophic levels and consist primarily of three components: 1) the phytoplankton -- free floating microscopic plants (algae); 2) the zooplankton -- free living microscopic animals (protista, rotatoria, mollusca and crustacea); and 3) the meroplankton -- free floating eggs and/or larvae of certain invertebrates and fishes.

The plankton community in flowing water systems, i.e. rivers, are functions of current velocity, water temperature, light penetration, and nutrient supply. Both velocity and turbidity limit the role of phytoplankton in riverine systems, due to the free floating nature of these organisms. In 3
standing water (lakes or ponds) the phytoplankton are a primary component and play a vital role in supplying food for the upper trophic levels. In many river systems, natural stresses limit the euplankton (a natural, free floating phytoplankton assemblage) and the food base is provided by sessile plants and attached algae or organic material washed in from the watershed. Much of the river flora, often dominated by diatoms, consists of benthic algae washed from their substrate. River algal populations, therefore, often increase during periods of increased water flow as attached algae are suspended in the water column. (Organisms attached to loose rocks or gravel tend to be more easily liberated than those attached to solid rock or aquatic plants). The Choctawhatchee River is an example of this kind of system. However, some rivers such as the Mississippi are large and extensive enough to contain

euplankton. This is not a common characteristic for rivers in the United States. Phytoplankton observed in rivers almost always originate from lakes or river backwaters.

The energy flow in a river ecosystem is dependent on the watershed. In such a system the terrestrial component (watershed) is large compared to the aquatic (river). Therefore, the organic material which supports the food web of the river comes from land based primary production (both naturally and culturally induced) which is washed in from the watershed.

The current velocity, river turbidity, and forest cover may be limiting factors on aquatic primary producers. In this situation, the relative contribution of aquatic primary producers is very small and the aquatic ecosystem is detritus based.

This may be contrasted to a lacustrine system where the aquatic component is large compared to the terrestrial. In this situation, the allochthonous detritus forms a small percentage of the base of the food web, the major source of energy for consumers is derived from aquatic primary production.

Hydrologic conditions indicate that aquatic primary productivity in the Caryville reach of the Choctawhatchee may well be severely limited, especially during spring high water. Therefore, detritus from the watershed supports a major portion of the food web.

Temperature plays an important role in regulating algal flora. Increases in ambient river temperatures encourage the growth of Chlorophyceae, especially Cladophora, and Cyanophyceae, which reach maximum development in warm waters. Diatoms, on the other hand, tend to dominate in periods of low temperature. Seasonal light conditions interacting with temperature also regulate phytoplankton populations. This interaction may mask the direct effects of temperature.

Because phytoplankton synthesize cell material by photosynthesis, turbidity and water clarity greatly influence phytoplankton production in aquatic systems. Hydrometerological and geological conditions in the watershed determine the amount of suspended solids in the water column. This, in turn, determines the degree of light penetration. In rivers with high turbidity, photosynthesis is strongly limited and phytoplankton will be sparse.

The phytoplankton community of the Choctawhatchee River was characterized during the spring of 1975 to provide a data base for determining effects of the proposed electric generating facility operation.

Except for a cursory examination of meroplankton to determine the presence of Striped bass eggs and larvae, the zooplankton of the Choctawhatchee River was not considered. Populations of zooplankton are generally highly variable and except in cases of extreme organic pollution they are not good 3
indicators of water quality, nor do they function significantly in energy flow. The zooplankton in flowing waters consist mainly of protozoa and rotifers. This contrasts with that of lakes where microcrustaceans predominate (Hynes, 1970).

Methods

Composite (surface and mid-depth) plankton samples were collected at six selected sampling station locations utilizing a Van Dorn water sampling device. Samples were preserved with 10 drops of non-acidic Lugol's solution per 100 ml of sample and 10 ml of neutralized formalin in a one-liter cubitainer. Samples were then labeled as to station location, time and date, and placed in a cool, light excluding box for shipment back to the laboratory.

Plankton samples were concentrated and analyzed utilizing the Utermohl (1958) sedimentation technique. Four strip counts were made of each settled sample for an estimate of numbers of organisms per liter. Species identification was carried to the lowest possible taxonomic level, utilizing a Zeiss

inverted D microscope. Major taxonomic references used were Drouet and Daily (1956); Drouet (1968); Prescott (1954, 1962); Witford and Schumacher (1969); and Patrick and Reimer (1966).

In addition to estimates of population density, diversity indices using the Shannon-Weaver Index of Diversity ($\bar{H}$) and Evenness (J) were computed to compare the various stations. Station similarities were also compared using Morisita's Index of Faunal Affinity (Morisita, 1959) and a phenogram based on cluster analysis was computed to graphically relate the various stations.

A modification of the procedures outlined in Standard Methods for the Examination of Water and Wastewater, APHA (1971) was used to estimate plankton biomass. After thorough mixing and shaking, a 250 ml aliquot of sample was filtered through a Gelman glass filter. These filters were placed in a crucible and dried to constant weight at 105°C for 24 hours. Dry weights were then recorded. The materials were ashed at 550°C to oxidize organic matter. After cooling, distilled water was added to the ashed filters (to reintroduce waters of hydration) and the filters were again dried to constant final weight.

Results

The May survey showed that phytoplankton populations were relatively low in the Choctawhatchee River. Table IV-1 details the species and cell numbers at 6 river stations and 1 floodplain station (Figure IV-1). The average cell densities (330 per ml) for the river stations were slightly more than those (286 per ml) of the floodplain, but both sets of data represent low populations compared to those of standing water phytoplankton. These latter may

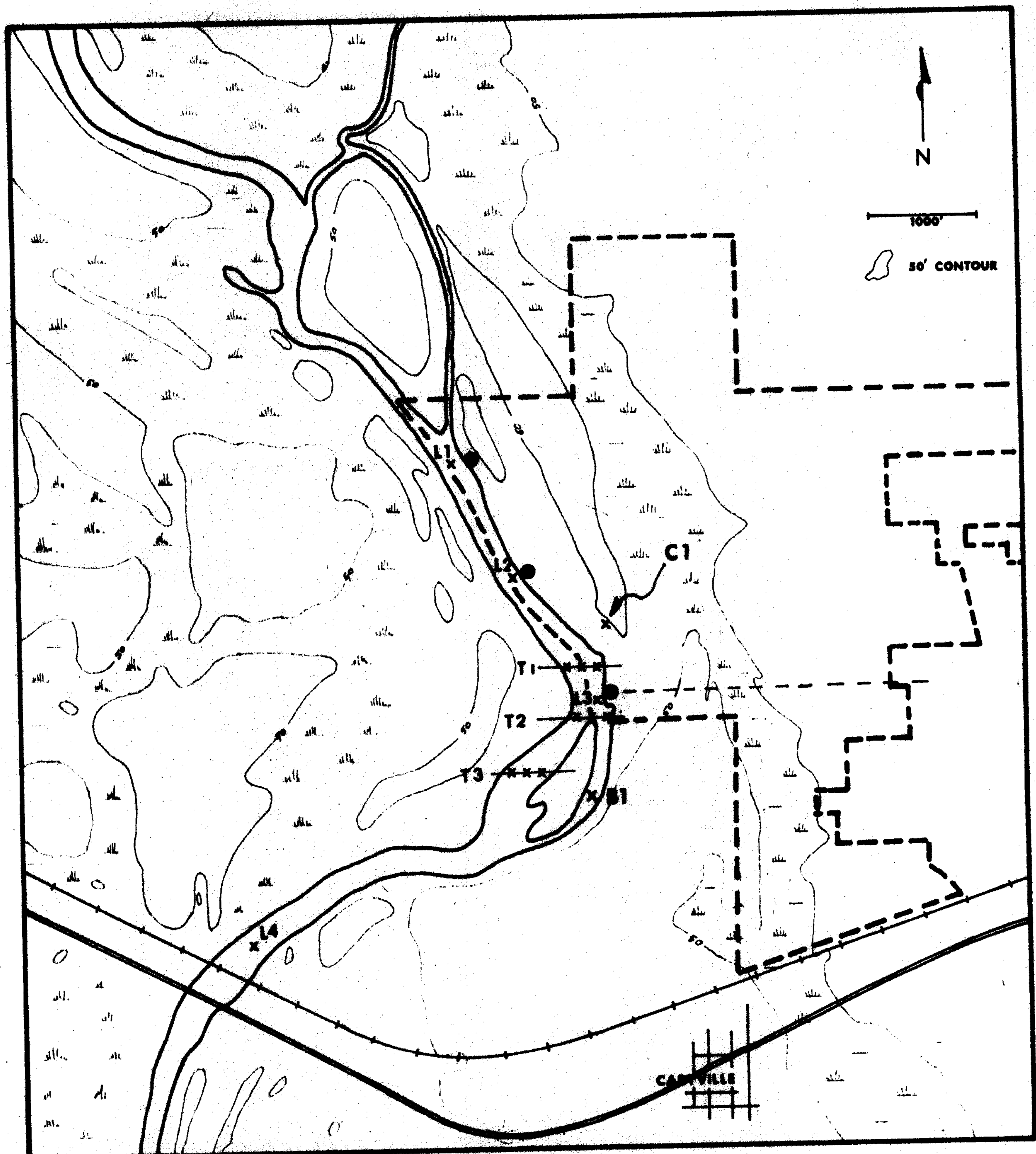

FIGURE IV-1 CHOCTAWHATCHEE BIOLOGICAL SAMPLING STATION LOCATIONS

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TABLE IV-1

A LIST OF PHYTOPLANKTON SPECIES AND CELL DENSITIES OBSERVED FROM COMPOSITE WATER SAMPLES COLLECTED FROM CHOCTAWHATCHEE RIVER STATIONS L1, L2, L3, L4, T1, T3, and C1, CARYVILLE, FLORIDA, MAY 13, 1975

Species Observed	Station	L1	L2		L3		L4	T1		T3		C1
	Replicate	1	1	2	1	2	1	1	2	1	2	1
Myxophyceae (Blue-green Algae)												
Actinastrum sp.							6					
Anabaena sp.		6										
Anacystis sp.		6	12	12	6	6	12	6	6	19	12	6
Coelosphaerium sp.		6	6							6	6	6
Gomphosphaeriae sp.					6	6						
Merismopedia sp.			6	6			6			6		6
Oscillatoria sp.												6
Unidentified Blue Green filament		31	12	37	12	6	37		19			12
Chlorophyceae (Green Algae)												
Ankistrodesmus nannoselene Skuja		6		12		25	6				6	
Arthrodesmus sp.								6				
Carteria sp.									6			
Chlorella sp.		19		25		31	19	6	25	31		25
Closterium sp.					6		6			6		
Cryptomonas spp.		31	19	43	6	50	68	6	31	19	19	12
Scenedesmus spp.		19	6	25			25	6	12	19	19	6
S. acumunatus (Lag.) chodat				6		12						
S. brasiliensis Bohlin				6		6						
Staurastum spp.		6										48
Unidentified Green Algae		62	130	50	56	56	99	43	31	68	50	
Euglenophyceae												
Euglena acus			12		12							6
Phacus spp.		6		6				6	6	12	6	6
Trachelomonas spp.		6			6				6		6	

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TABLE IV-1 (Continued)

A LIST OF PHYTOPLANKTON SPECIES AND CELL DENSITIES OBSERVED FROM COMPOSITE WATER SAMPLES COLLECTED FROM CHOCTAWHATCHEE RIVER STATIONS L1, L2, L3, L4, T1, T3, and C1, CARYVILLE, FLORIDA, MAY 13, 1975

Species Observed	Station	L1	L2		L3		L4	T1		T3		C1
	Replicate	1	1	2	1	2	1	1	2	1	2	1
Chrysophyceae												
Mallomonas caudata Conrad				12		6						
Dinophyceae (Dinoflagellates)												
Gymnodinium spp.			6									
Peridinium spp.			6									
Bacillariophyceae (Diatoms)												
Achnanthes spp.		19			6	19		12	6			12
A. lanceolata (Breb.) Grun: Cl. & Grun.				6					6			
A. lanceolata var. dubia Grun.		6		6								
Biddulphia laevis Ehr.					6							
Caloneis bacillum (Grun.) Cl.						6						
Capartograma crucicula (Grun. ex Cl.) Ross									6			
Cyclotella spp.					6	6	6	6			19	
C. stelligera Cl. in Grun.			6							6		12
Cymbella affinis Kütz.		6	6	6	6						6	
C. naviculiformis Auers.			6			6						
C. turgida var. pseudogracilis Chol.			6	6		6			6		6	
Epithermia turgida (Ehr.) Kütz.				12								
Eunotia curvata (Kütz.) Lagh.		6						6				

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TABLE IV-1 (Continued)

A LIST OF PHYTOPLANKTON SPECIES AND CELL DENSITIES OBSERVED FROM COMPOSITE WATER SAMPLES COLLECTED FROM CHOCTAWHATCHEE RIVER STATIONS L1, L2, L3, L4, T1, T3, and C1, CARYVILLE, FLORIDA, MAY 13, 1975

Species Observed	Station	L1	L2		L3		L4	T1		T3		C1
	Replicate	1	1	2	1	2	1	1	2	1	2	1
Bacillariophyceae (Diatoms) (Cont.)												
E. formica Ehr.								12				
E. pectinalis var. minor (Kütz.) Rabh.					6				6		6	
E. praerupta var. bindens Grun.		6			6				37		6	
Fragilaria leptostauron (Ehr.) Hust.				6								
F. vaucheriae (Kütz.) Petrs.						6		6				
Frustulia vulgaris Thwaites			6	6	12				6			
Gomphonema gracile Ehr.			6	6					6			
G. gracile var. naviculoides (Wm. Sm.) Grun.		6	6	6								
G. parvulum Kütz.			6	6	6				12	6		6
Gyrosigma spencerii (Quek.) Griff & Henfr.												6
G. scalproides (Rabh.) Cl.												
Melosira granulata var. angustissima Müll.		6					6	6	6			6
M. varians C. A. Arg.		6					6					
M. species No. 1				6			6					
Navicula aikensis Patr.												
N. capitata Ehr.						6					6	6
N. contenta var. biceps (Arn.) V. H.		12			6			6	6	6		
N. hambergii Hust.		6										
N. mutica Kütz.										6	6	
N. pupula var. capitata Hust.			12			19	6	6			6	
N. radiosa var. tenella (Breb.) Grun.		6		6				6			12	

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TABLE IV-1 (Continued)

A LIST OF PHYTOPLANKTON SPECIES AND CELL DENSITIES OBSERVED FROM COMPOSITE WATER SAMPLES COLLECTED FROM CHOCTAWHATCHEE RIVER STATIONS L1, L2, L3, L4, T1, T3, and C1, CARYVILLE, FLORIDA, MAY 13, 1975

Species Observed	Station	L1	L2		L3		L4	T1		T3		C1
	Replicate	1	1	2	1	2	1	1	2	1	2	1
Bacillariophceae (Diatoms) (Cont.)												
N. rhyncocephala var. germani (Wallace) Patr.		19			6		19	6	6	6	6	31
N. schroeteri var. escambia Patr.			6					12				6
Unidentified Naviculoids					12	6	6		12	6	19	
Neidium affine var. capitatum Mölder					6							
Nitzschia accularis Wm. Sm.				6			12					
N. palea (Kütz) Wm. Sm.		25	19	19	24	31	24	6		19	6	37
N. parvula Levis				6		12		50	31		6	6
N. spp.		31		6	12	6	12	6	6	6	12	
Pinnularia brauni (Grun.) Cl.			6		12		12	31	6		6	
Rhopalodia gibberula var. VanHeurkii O. Müll.		6		6						6		
Stauroneis phoenicenteron Ehr.					6							
Surirella linearis Wm. Sm.								6				
Synedra ulna (Nitz.) Ehr.		6	12	6	6	12	12	37	6	6	19	
Unknown Pennates		31	6	6		6			12	6	37	19

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TABLE IV-1 (Continued)

A LIST OF PHYTOPLANKTON SPECIES AND CELL DENSITIES OBSERVED FROM COMPOSITE WATER SAMPLES COLLECTED FROM CHOCTAWHATCHEE RIVER STATIONS L1, L2, L3, L4, T1, T3, and C1, CARYVILLE, FLORIDA, MAY 13, 1975

Species Observed	Station	L1	L2		L3		L4	T1		T3		C1
	Replicate	1	1	2	1	2	1	1	2	1	2	1
Ciliophora												
Species No. 1				6				6				
Species No. 2			6									
TOTAL NUMBER OF INDIVIDUALS PER ML.		407	330	379	254	357	411	305	324	265	308	286
TOTAL NUMBER OF SPECIES PER ML.		28	25	32	25	24	22	25	29	20	25	22

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range into the millions per ml. The low densities found in the Choctawhatchee generally agree with population levels of other rivers (10 - 1000 organisms/ml; Hynes, 1970).

The majority of species observed were benthic forms which had likely been washed from upstream substrate surfaces. Diatoms (Bacillariophyceae) representing approximately 50 percent of the phytoplankton population were the most prevalent group. Chlorophyceae (green algae) were nearly as important, viz. 40 percent. Cyanophyceae were not common, only comprising 10 percent of the population.

The low densities recorded at all stations are reflected in the organic biomass estimates. These range from 2.0 to 4.4 gm/m^3 and are plotted in Figure IV-2. These values show no trend through the study area and are typical of oligotrophic waters. 3

Figure IV-3 plots the Shannon-Weaver diversity index ($\overline{H}$) and evenness values (J) for the stations. Again, no trends are indicated, but the overall diversity is high ($\overline{H}$ = approximately 3 on a scale of 0-5) with extremely high evenness (J = 0.8 - 0.9) indicating an even distribution of numbers among the taxa. Morisita's index showed the expected similarity among the river stations contrasted to the floodplain station. This cluster analysis is presented in Figure IV-4 and ranks the stations in descending order of similarity. Two closely clustered groups of stations, L-1, L-2, L-4, L-3B and L-2A, T-3A, L-3A, array themselves against several less similar stations, T-3B, T-1B and T-1A, with C-1 being least like any other station.

Results of the May survey indicate that, during periods of flood associated with high turbidity, the Choctawhatchee River supports a relatively

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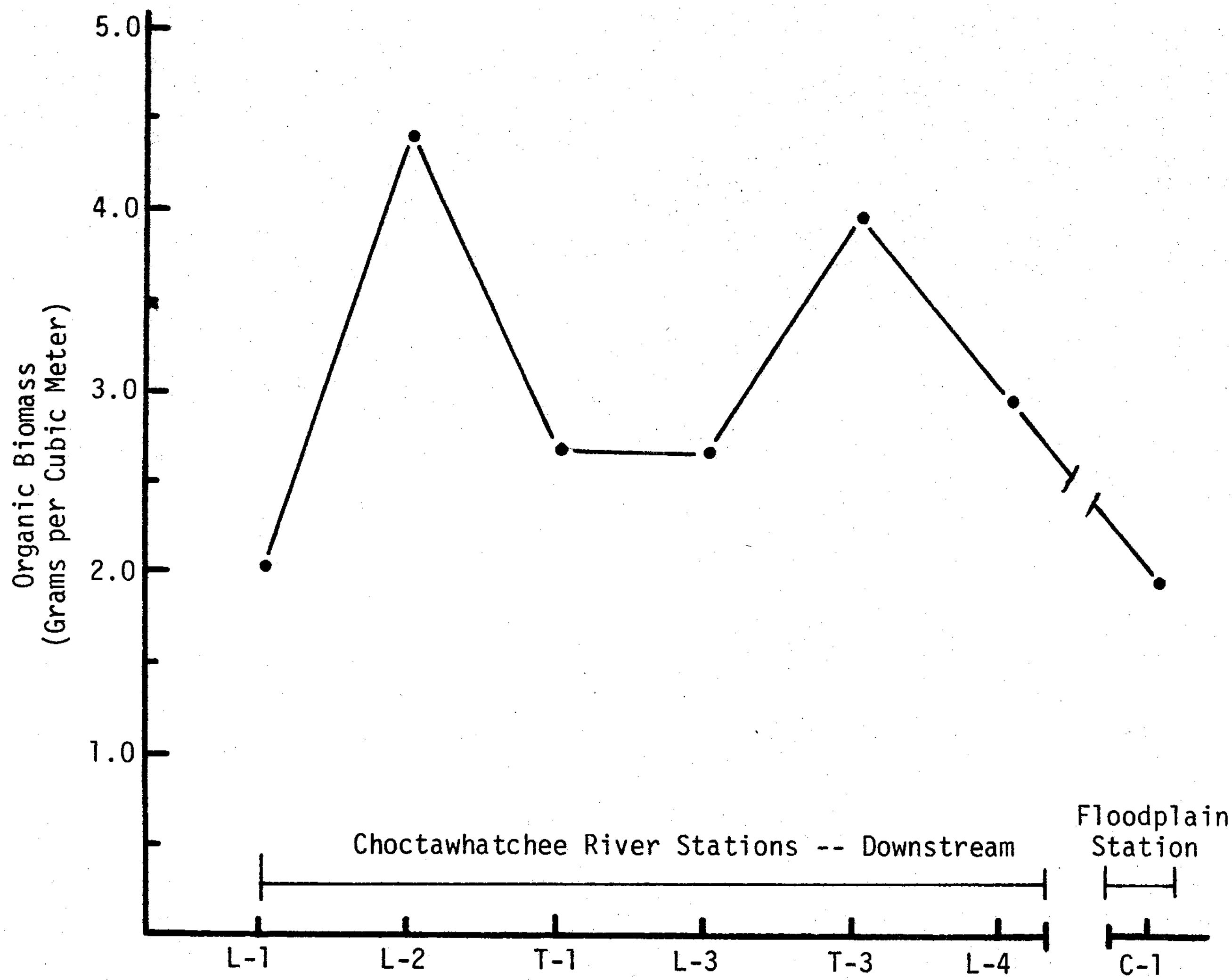

FIGURE IV-2. CHOCTAWHATCHEE RIVER PLANKTON ORGANIC BIOMASS DETERMINATIONS (GRAMS PER CUBIC METER VS. RIVER STATION LOCATIONS, MAY 13, 1975)

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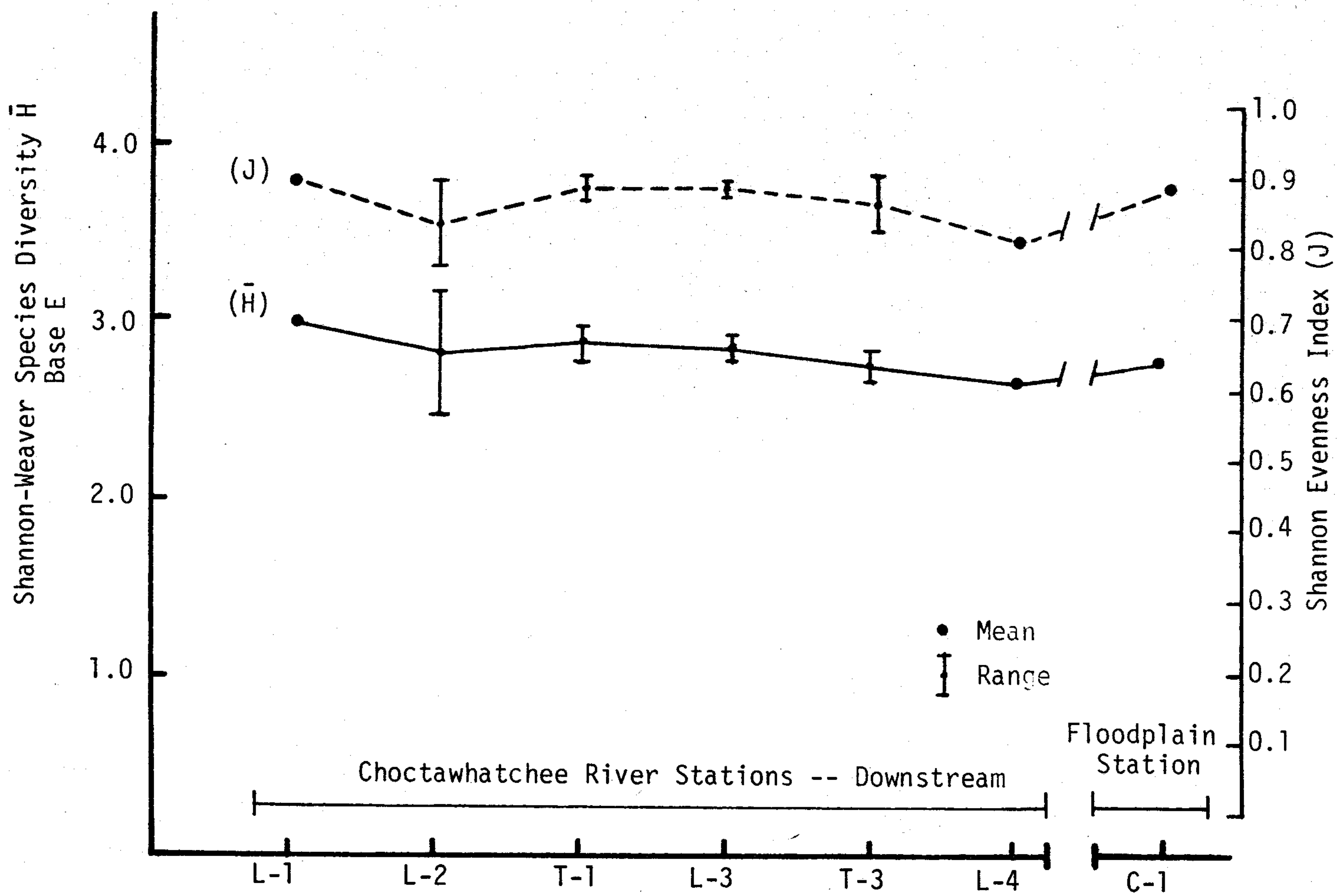

FIGURE IV-3. MEAN AND RANGE VALUES FOR CHOCTAWHATCHEE RIVER PLANKTON SHANNON-WEAVER SPECIES DIVERSITY INDICES AND SHANNON-EVENNESS VALUES, MAY 13, 1975. STATIONS L1, L4, C1 WERE NOT REPLICATED.

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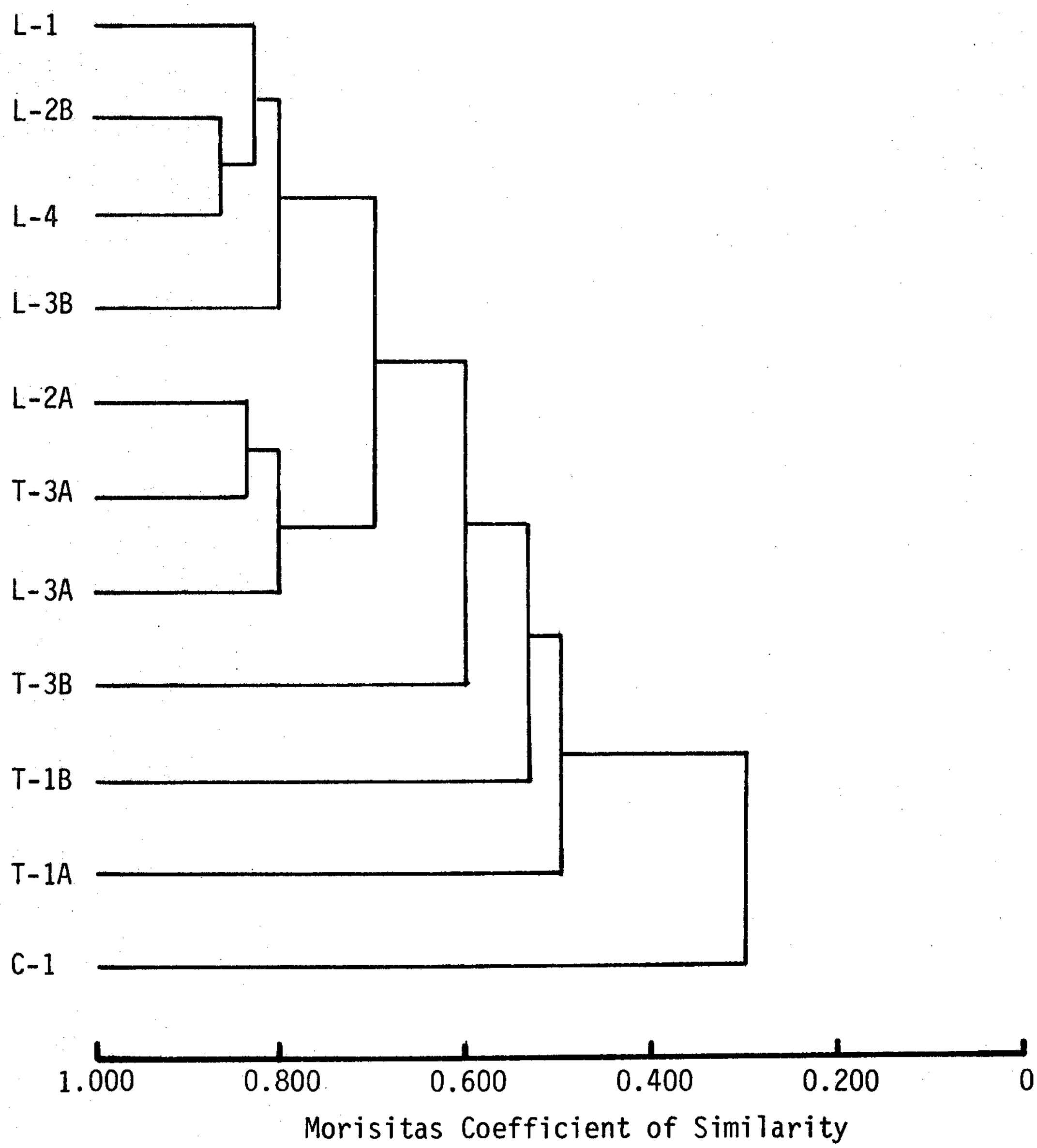

FIGURE IV-4. CLUSTER DIAGRAM OF SIMILARITY VALUES FOR CHOCTAWHATCHEE RIVER PHYTOPLANKTON COPHENETIC CORRELATION COEFFICIENT = 0.925 (Station replicates are denoted as A and B).

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sparse phytoplankton population. The river system is not seriously affected by agricultural runoff or point source discharges. The watershed has little cultural or agricultural development on it; therefore, the major factor that appeared to limit phytoplankton production during the May sampling was turbidity. Turbidity is often the limiting factor in a wide variety of riverine environments (Hynes, 1970). In this case, the turbidity due to recent flood run-off would constitute a definite natural stress. Turbidity as measured by Secchi disc readings averaged 0.7 meters during the sampling period. Nutrients (phosphate and nitrate) did not appear to be limiting factors during the study, as these nutrients averaged 0.12 and 0.30 mg/l, respectively (Stations L-1, T-1, C-1). Temperature was not limiting to phytoplankton production, as recorded values averaged 22°C (71.5°F) throughout the water column. These values are well within the temperature range for optimal algal growth, 20°C to 30°C, as reported by Fogg (1965).

3

Predicted Effects of Plant Operation

The response of photosynthetic microorganisms to increased temperature has been studied in recent years by a number of investigators both in the laboratory and in situ. Thermal effects on phytoplankton, periphyton and/or primary production in natural and artificial streams have been reviewed recently by EPA (1973). Trembley (1960) and Cairns, et al. (1967, 1972) report a gradual shift in algae population from a diatom to a blue-green algae dominated community with increased temperature conditions (Figure IV-5.) Wallace (1955) examined pure and mixed algae cultures under controlled thermal conditions. The heat-tolerant fresh-water diatom Gomphonema parvulum grew optimally at 22°C (71.6°F) and continued to grow well up to 34°C (93.2°F). Nitzschia linearis grew optimally at 22°C (71.6°F),

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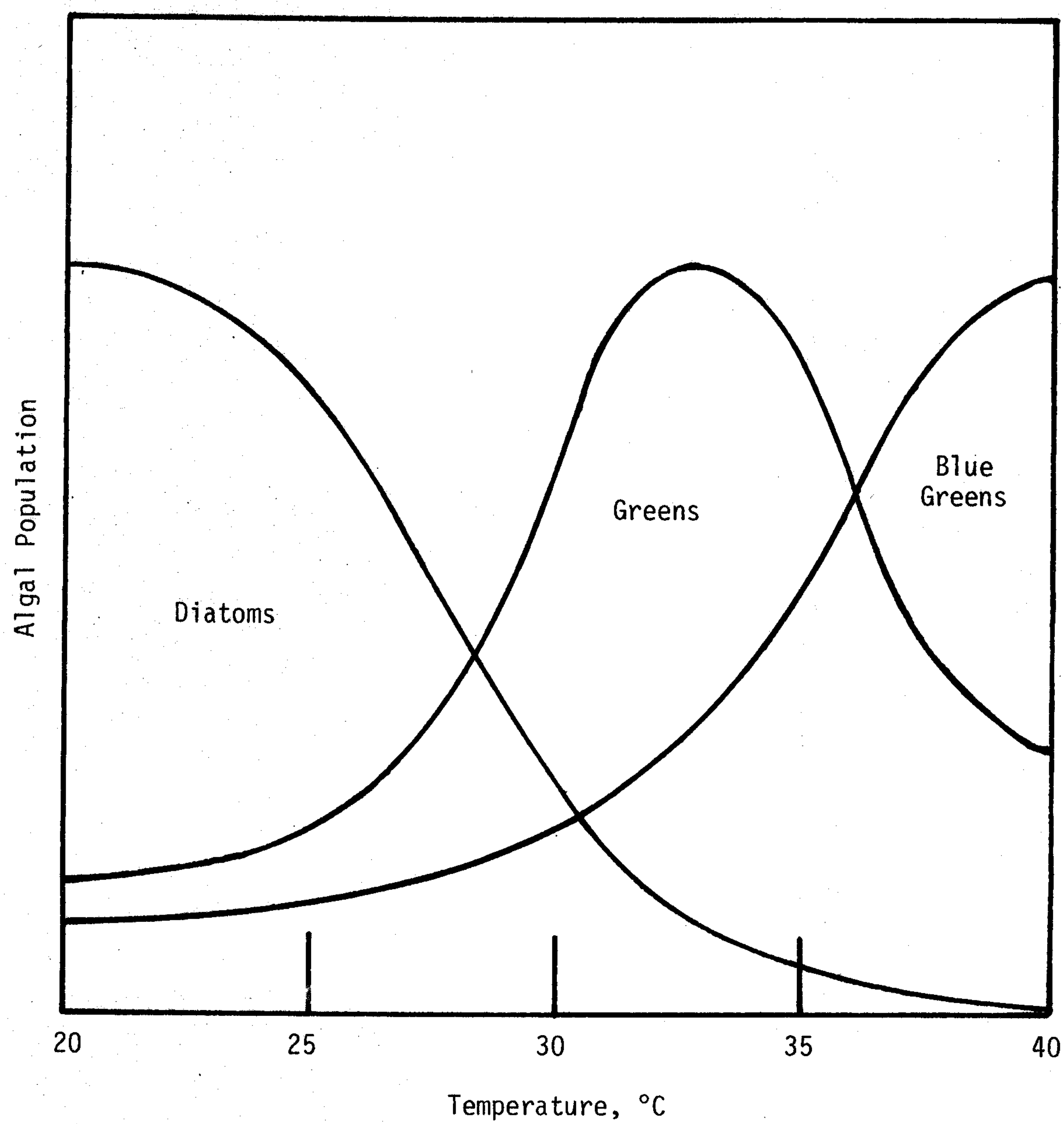

FIGURE IV-5. ALGAE POPULATION SHIFTS WITH CHANGE IN TEMPERATURE (Cairns, 1972). 3

but practically ceased growth at 30°C (86°F). Patrick (1969) reported that temperature rises caused periphyton to increase in biomass up to 29-30°C (92.8°F). Kevern and Ball (1965) noted increases in gross productivity as temperatures rose from 20°C to 25.6°C (68°F to 78°F). However, since there was an equal increase in respiration rates, there was no significant net productivity. In addition to changes in photosynthetic/respiration values and ratios, algae respond to thermal changes or stresses by altering cell composition with respect to protein and lipid content as well as wall structure and pigment composition.

R. A. Smith (1974) reported the seasonal pattern of photosynthetic rates for phytoplankton entrained in a thermal plume. During winter, temperature elevations within the plume brought plankton closer to an optimum photosynthetic temperature, while in summer, water temperatures were often raised beyond the optimum. These results are graphically presented in Figure 3
IV-6. Optimum temperature ranges for plankton at three mid-Atlantic power plant sites were estimated to range between 23 and 33°C (73 and 91°F). Figure IV-7 illustrates that the relative photosynthetic rates increase with temperature when ambient temperatures are low, but become depressed when temperatures exceed 30 to 35°C (86 to 95°F). Other effects of extreme temperatures are lower diversities and replacement of some species by heat tolerant forms.

In most river situations, it is often difficult to isolate thermal effects on phytoplankton and/or periphyton. Light levels, as effected by shading or turbidity, interact to modify population maxima in diversity, biomass, etc. Nutrient availability may also mask or mimic a temperature effect such that every situation of thermal discharge must by and large be looked on as unique.

The operation of the cooling towers of the proposed generating

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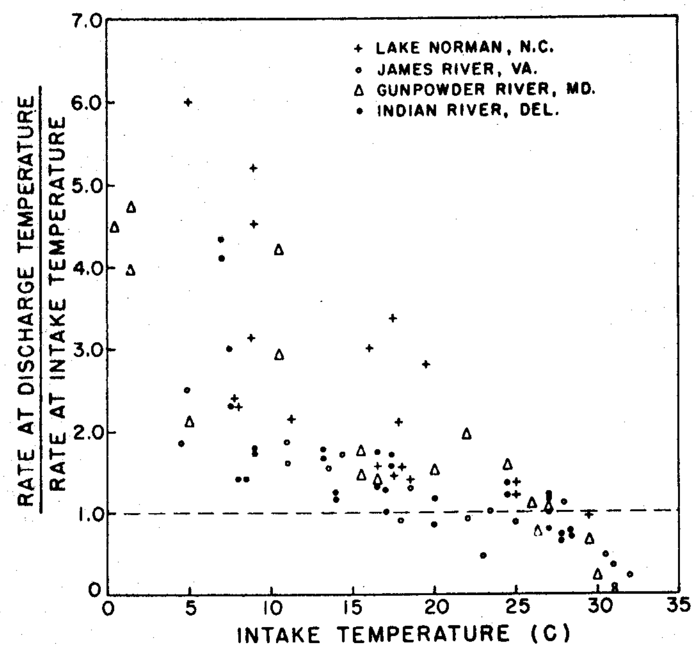

FIGURE IV-6. RATIO OF INTAKE PHOTOSYNTHETIC RATE MEASURED AT DISCHARGE TEMPERATURE TO INTAKE PHOTOSYNTHETIC RATE MEASURED AT INTAKE TEMPERATURE VS. INTAKE TEMPERATURE (R.A. SMITH, et al., 1974). 3

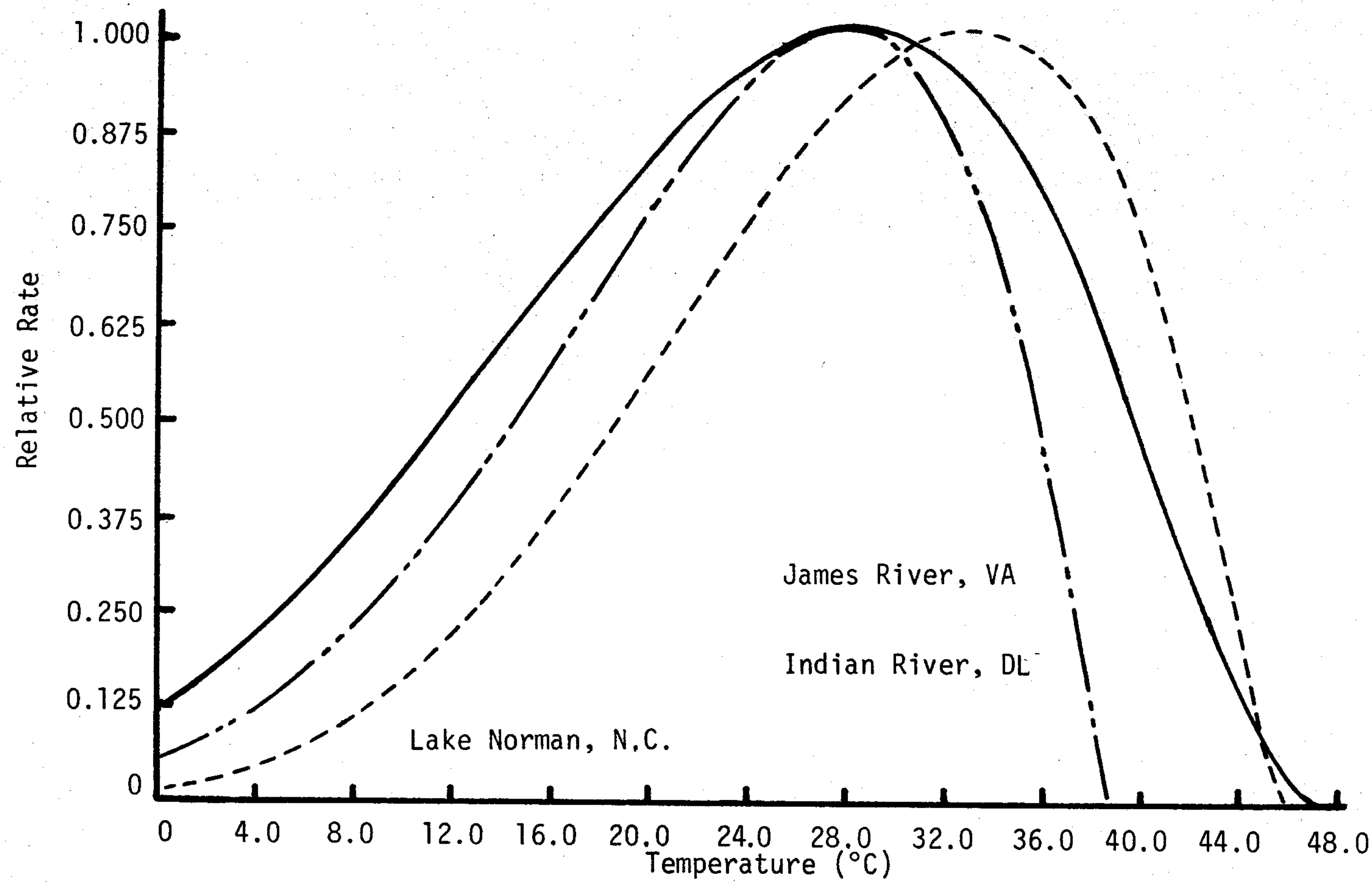

FIGURE IV-7. RELATIVE PHOTOSYNTHETIC RATE VS TEMPERATURE AT THREE EASTERN SITES. CURVES ARE BASED ON REGRESSION EQUATIONS AND SATURATING LIGHT INTENSITY (R. A. Smith, 1974).

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station may subject the phytoplankton to two major stresses: 1) entrainment and destruction within the cooling system; and 2) thermal shocks within the discharge plume. Predictions of the impact of these factors are based on phytoplankton standing stock, volume of intake water, and volume and temperature of discharge.

All intake water will be filtered, therefore any entrained plankton will be destroyed. If the plankton community is assumed to be homogeneous in the water column, the loss of this resource at any population density will be equal to the percentage of the river flow taken into the plant at the given time. The loss of plankton from intake entrainment is then:

$$\% \text{ Loss} = (100)\ (\text{Q Intake}/\text{Q River})$$

Autumn conditions are worst case for entrainment in the intake because river flows are least; the intake consumes the maximum percent of the river flow. These losses and the probability of their occurrence are tabulated for autumn, winter, and summer operating conditions in Table IV-2.

Under average operating conditions the plankton loss due to intake entrainment will be less than 3 percent, 2.37 percent for 3000 MW at average autumn conditions, which is insignificant in terms of the overall plankton community. Losses would be higher under adverse operating conditions (see Table IV-2), but these are unusual events with a probability of occurrence of 2×10^{-7} and less. At worst case, 3000 MW at adverse autumn conditions, this plankton loss could be 16.6 percent. However the rarity of the event mitigates the importance of such loss.

The second stress, entrainment in the thermal discharge plume, is more difficult to quantify. Thermal damage is a function of time and intensity of thermal impact. Florida law (Chapter 17-3 FAC) defines the maximum allowable temperature rise as 5°F. In the interest of a conservative assessment, a Δ T of 5°F is used as a threshold of damage to plankton.

TABLE IV-2

PREDICTED LOSSES OF PLANKTON DUE TO ENTRAINMENT
IN THE COOLING WATER INTAKE

Hydrometerological Conditions (1)			Percent of the Plankton Community Destroyed			
			Generating Capacity			
Description (2)	Probability of Occurence (1)	River Flow (CFS)	500 MW	1000 MW	3000 MW	
Adverse Winter	2×10^{-7}	870	1.90	3.80	11.5	
Adverse Summer	6.1×10^{-8}	870	1.90	3.80	11.5	3
Adverse Autumn	9.7×10^{-8}	604	2.76	5.52	16.6	
Average Winter	0.125	6413	0.20	0.40	1.30	
Average Summer	0.125	3805	0.36	0.73	2.20	
Average Autumn	0.125	3525	0.39	0.79	2.37	

(1) From Table 5.1-1, Site Certification Application.

(2) Adverse seasonal conditions at 3000 MW based on 45,000 gpm intake. Average conditions based on 37,500 gpm intake.

TABLE IV-3

PERCENT OF PLANKTON ENTRAINED IN 5°F RISE IN TEMPERATURE PLUME AT WINTER CONDITI[ONS]

Condition	Probability of Occurence	River Flow (cfs)	Heated Discharge (cfs)	Percent
Adverse Winter(1)	2×10^{-7}	870		
500 MW			3.34	1.0
1000 MW			6.68	2.8
3000 MW			20.06	11.6
Average Winter	0.125	6413		
500 MW			3.34	0.2(2)
1000 MW			6.68	0.4(2)
3000 MW			20.06	1.8

3

(1) Taken from Table 5.1-1, Site Certification Application.

(2) Calculated based on the ratio of adverse/average plume cross-section for 3000 MW times adverse plume cross-section at 500 and 1000 MW.

The maximum exposure times for plankton entrained in the plume can be found from Figure 5.1-1. Maximum exposure to any heated water is 4.1 minutes at adverse winter conditions; exposure to a ΔT greater than 5 °F is less than 25 seconds. However, this is sufficient time to damage entrained plankton. The percentage of the plankton damaged will be the percent of the river flow entrained in the discharge water to quench the heated plume to within 5°F of ambient river temperature. The predicted thermal plumes based on the Hirst (1972) model are presented in Section 5.1 of the Site Certification Application . A method to predict the percent of the river flow needed to quench the thermal plumes was discussed in Chapter III in the section on various discharge alternatives.

That analysis (Table III-2) can be translated directly to percent plankton entrained in the thermal plume (Table IV-3). Winter conditions (Figure 5.1-1 Site Certification Application) are worst case 3
for heat shock. Under average winter conditions no more than 1.8 percent of the plankton community is likely to suffer damage due to thermal shock. An 11.6 percent damaged could occur under adverse winter conditions but this is an extremely unlikely event (probability 2×10^{-7}) which mitigates the importance of such loss.

The total loss in the plankton community from plant operation is the sum of the losses from entrainment in the intake and entrainment in the thermal discharge plume. Overall, the worst case is for winter operating conditions. These losses are tabulated in Table IV-4 below:

TABLE IV-4

TOTAL PLANKTON LOSS DUE TO INTAKE AND DISCHARGE PLUME ENTRAINMENT

Condition	Probability of Occurrence	Generating Capacity 500 MW	1000 MW	3000 MW
Adverse Winter	2×10^{-7}	2.9	6.6	23.1
Average Winter	0.125	0.4	0.8	3.1

The impact of the total loss of 23 percent of the plankton under adverse operating conditions for 3000 MW is greatly diminished by the rare probability (2×10^{-7}) of its occurrence. Under average operating conditions the total loss of the plankton resource is only 3.1 percent. This is inconsequential. Similar losses could be expected for the average operating conditions during summer and autumn.

Under average operating conditions, the ambient river temperature increases (Table 5.1-2, Site Certification Application) will be less than 0.1°F. This should have no downstream biological effects. Under adverse operating conditions the ambient river temperature could increase 1.18°F which could increase metabolic rates in the river by 1 to 3 percent. The occurrence of these worst case conditions are improbable (2×10^{-7}), and should be negligible.

Recycling the cooling water will result in a build-up of dissolved materials. Chapter III predicts the concentrations of inorganic salts impacting the river under various operating conditions. These can be compared with USGS data to show the whole river increases in dissolved solids. None of these exceed the Florida water quality standards (Chapter 17-3 FAC) nor will any of these increases have significant effects on downstream biota.

Chlorine will be the only treatment additive used in the recirculating cooling water system. Maximum concentration at the condenser discharge will be 1.0 mg/l, with an average of of 0.3 to 0.6 mg/l. Further loss of residual in the discharge pipe will readily bring the effluent residual into compliance with the EPA maximum of 0.2 mg/l (200 ppb). Chlorination frequency will be once or twice a day during summer, and once or twice per week during winter. This will mean an intermittant discharge to the river of residual chlorine.

Acute toxicity of chlorine on aquatic organisms is well documented (Becker and Thatcher, 1973, Hamilton, et al., 1970, and Brungs, 1973). The effects depend on concentration and contact time. Acute effects will be very slight or non-existent considering the short contact which will result from plankton in the plume. A discharge of 20 cfs at 0.2 mg/l residual could result in maximum whole river concentrations of 1.0 ppb (summer and fall), and 0.6 ppb (winter), for one to two hours daily. These are absolute maximum conditions assuming no dissipation of the residual, i.e. no chlorine demand. Actual river concentrations may be as much as an order of magnitude lower. The probability of adverse operating conditions is extremely low. Whole river residuals would then range from 4 to 6 ppb for short durations. 3
Whole river increase in chlorine or chloramine concentration will be at or below the thresholds for toxicity,even for sensitive organisms. Residual chlorine in the discharge will have minimal impact on the river system.

The predictions of effects of thermal and chemical discharge are based on percentage of river water impacted without regard to biomass present and represent minimal effects to planktonic forms, especially phytoplankton. Considering the small populations encountered in this spring survey or other ecological conditions which could develop in the course of the year, operation of the generating station will have minimal impact on the plankton of the Choctawhatchee River.

Periphyton

Introduction

The periphyton or "Aufwuchs" community is an assemblage of attached microorganisms (primarily algae) growing on various substrates submerged in water. In clear flowing water these sessile algae may develop large standing crops; for example 100gm dry wt/m^2 in Silver Springs (Odum, 1956). These microorganisms, therefore, often provide the major food base for river ecosystems.

Major factors which limit or control periphyton growth are current, light, temperature, nutrients and substrate. Current exerts two effects: it provides a constant nutrient supply and carries away dead organic matter. However, current velocities during flood periods can cause scour which may substantially remove periphyton growths. Adequate light penetration is essential for growth of periphytic algae. Turbid waters strongly effect periphyton development by limiting the light necessary for their photosynthetic development. In contrast, large standing crops develop in suitable substrates in clear (non-turbid) flowing water. Temperature effects on periphyton are similar to those for phytoplankton as discussed in the previous section. Optimum growth occurs between 15°C and 25°C. Stability of the substrate is very important in determining periphyton growth. Shifting substrates such as sand or small pebbles provide poor habitat for periphyton in contrast to stable rocky substrates. The periphyton community lends itself well to biological investigations of water pollution. These organisms remain at fixed locations and are sensitive to changing environmental conditions. Their populations and biomass are relatively easy to quantify using standard laboratory procedures and are adaptable to a variety of statistical analyses.

When natural limiting factors do not exert overriding effects, periphyton are excellent indicators of stream nutrient status.

Methods

Periphytic algae were collected from the Choctawhatchee River from artificial and natural substrates, Porellá pinnata Linn (leafy liverwort) and Brachelyma robustum, during December, 1974; March, 1975; and May, 1975. Stations upstream, downstream and in the proposed impact area were chosen, both in mid-channel and near the river banks.

Artificial substrates (glass slides) were suspended in the river at selected station locations for a period of four weeks. Following incubation, slides were collected and preserved in 5 percent formalin for species identification. Selected artificial substrate samples were supplied by field biologists from Southern Services. Table IV-4 (Fig. IV-8) 3
provides a brief description of these stations. Additional artificial substrates were collected by field biologists from Water and Air Research, Inc. during May, 1975. Table IV-5 presents a description of the WAR, Inc. station locations. (See Figure IV-1.)

Biomass determinations were made at a limited number of stations utilizing the methods outlined in Standard Methods for the Examination of Water and Wastewater, APHA, 1971.

The diatoms (Bacillariophyceae) were selected as the major group to be investigated, since this component of the periphyton has been shown to be most amenable to monitoring community structure at the species level (Cairns, et al, 1972).

Diatom species proportional counts were performed on periphyton

TABLE IV-4

SOUTHERN SERVICE'S SAMPLING STATION LOCATIONS

Station Identification	Location
(1) C1L	Choctawhatchee River; approximately 200 yards above confluence with Wrights Creek; right side
(2) C1R	Choctawhatchee River, approximately 250 yards above confluence with Wright's Creek; right side, looking downstream
(3) W1C	Wright's Creek; approximately 30 yards upstream from confluence with Choctawhatchee River; center
(4) C2L	Choctawhatchee River; approximately 80 yards upstream from the Louisville and Nashville (L&N) railroad trestle near Highway No. 90 bridge; left side, looking downstream
(5) C2R	Choctawhatchee River; approximately 80 yards upstream from the Louisville and Nashville (L&N) railroad trestle near Highway No. 90 bridge, right side, looking downstream
(6) C3L	Choctawhatchee River; approximately 150 yards below Interstate Highway No. 10 bridge; left side, looking downstream
(7) C3R	Choctawhatchee River; approximately 200 yards below Interstate Highway No. 10 bridge, right side, looking downstream
(8) C4L	Choctawhatchee River; approximately 200 yards below confluence with Dram Branch; left side, looking downstream
(9) C4R	Choctawhatchee River; approximately 200 yards below confluence with Dram Branch; right side, looking downstream.

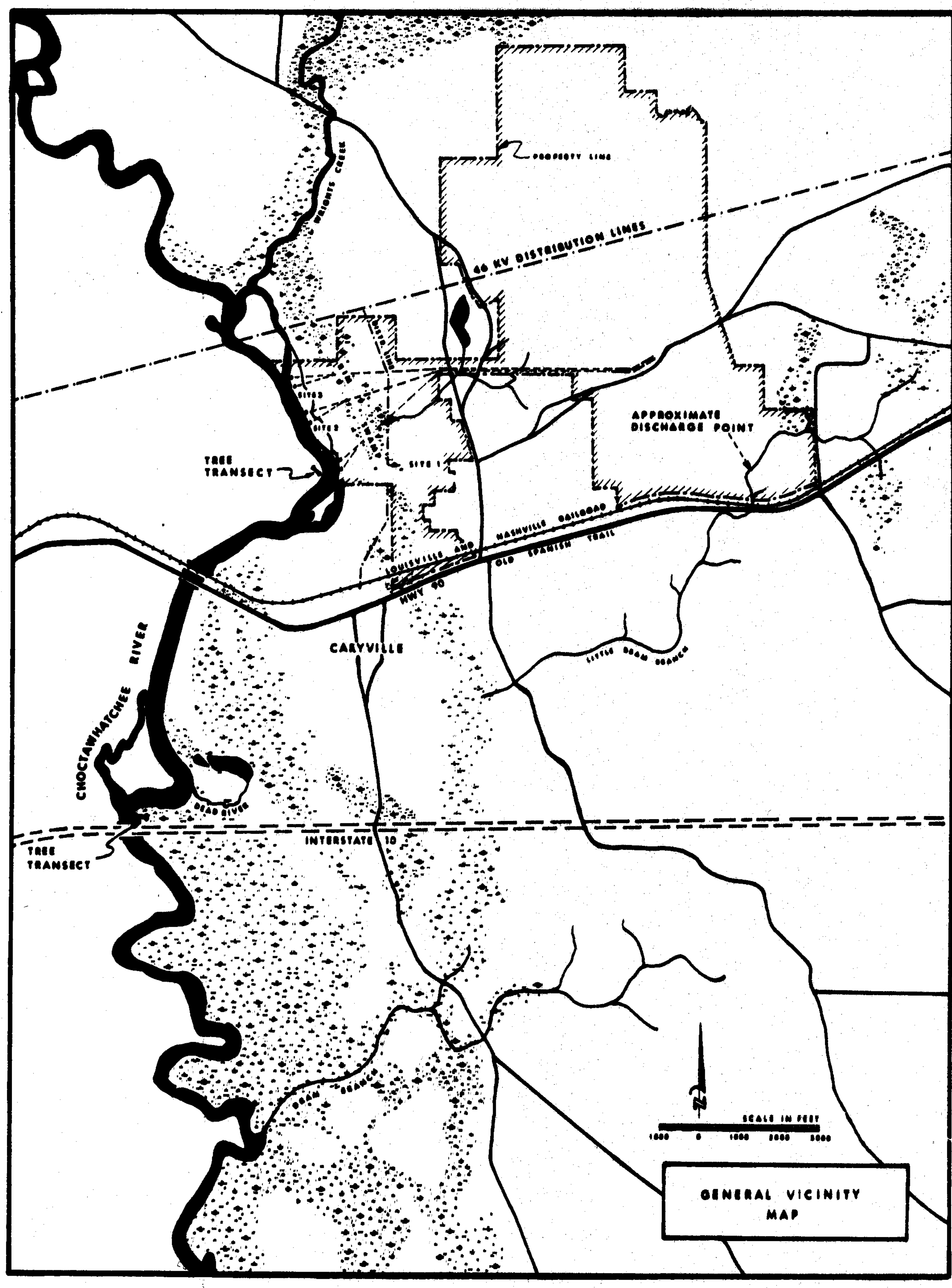

FIGURE IV-8. BIOLOGICAL SAMPLING STATION LOCATIONS: SOUTHERN SERVICES.

Amendment 3 9/75

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TABLE IV-5

WATER AND AIR RESEARCH, INC. (WAR) PERIPHYTON, PHYTOPLANKTON, AND BENTHIC INVERTEBRATE SAMPLING STATION LOCATIONS

Station Identification	Location
L-1	Choctawhatchee River approximately 135 yards below the confluence with Wright's Creek (0.4 mile down river from transmission line); center of river
L-2	Choctawhatchee River; approximately 400 yards below the confluence with Wrights Creek; center of river
T-1	Choctawhatchee River; 180 yards above the proposed intake-discharge corridor route (0.96 mile downstream of trnasmission line); tree transect station across river
L-3	Choctawhatchee River; located at the site of the proposed intake discharge corridor (0.9 mile upriver of Interstate 90 bridge); east river bank 3
T-2	Choctawhatchee River; 200 yards downstream from the proposed intake-discharge corridor (0.8 mile upriver of Interstate 90 bridge); transect station across river
T-3	Choctawhatchee River, 300 yards downstream from the proposed intake-discharge corridor; transect station across river
B-1	Choctawhatchee River, 0.86 miles upstream of Interstate Highway 90 bridge, behind island, located approximately 100 yards from the discharge pipes from the Caryville Saw Mill
L-4	Choctawhatchee River; 350 yards upstream from the Interstate Highway 90 bridge, center of river
C-1	Floodplain Forest; approximately 500 yards Northwest of river station L-3, along corridor route; samples collected during high water period (May 13-15, 1975)

communities both from artificial and natural substrates. Periphyton material was treated by Standard Techniques (EPA Manual, 1973, Biological Field and Laboratory Methods) to facilitate identification at the species level. Cleaned diatoms were concentrated and permanent slides prepared.

Diatoms were identified to the species and variety level with an inverted microscope using a Zeiss Flourite oil immersion lens (1000 X). Diatom species proportional counts were made by a strip count method; approximately 300 valves were identified per slide. Tally sheets were devised to record data and a species file of each organism was maintained for slide number, date, location, species descriptions, and the critical reference used for identification of the organism. The major taxonomic references used in this study were Patrick and Reimer (1955); Hustedt (1950, 1961, 1964); and Schmidt, et al. (1874-1959). As a measure of quality assurance, specimens were sent to Dr. C. W. Reimer, Department of Limnology, Academy of Natural Sciences of Philadelphia, for taxonomic verification. 3

In addition to taxonomic identification and population density measurements, diversity indices using the Shannon-Weaver index of diversity ($\bar{H}$) and evenness (J) were computed to compare the various stations. Similarity was also tested using Morisita's index of faunal affinity (Morisita, 1959) and a phenogram based on cluster analysis was computed to relate the various stations.

Results

The periphyton consisted almost entirely of diatoms. The species proportional counts (300 valves) are presented in detail in Table IV-6.

TABLE IV-6

A LIST OF DIATOM SPECIES OBSERVED FROM ARTIFICIAL AND NATURAL PERIPHYTON SUBSTRATES COLLECTED FROM THE CHOCTAWHATCHEE RIVER IN THE VICINITY OF CARYVILLE, FLORIDA DURING DECEMBER, 1974 AND MAY AND MARCH, 1975

Species Observed	Artificial Substrates, December 5, 1974 (Glass Slides)[a]								Artificial Substrates March 13, 1975 (Glass Slides)[a]		Natural Substrates, May 13, 1975 (Porella and Brachelyma)[b]								Artificial Substrates (Glass Slides)[a]	
	CR1 R*	WR1 C***	CR2 L**	CR2 R*	CR3 L**	CR3 R*	CR4 L**	CR4 R*	CR1 L**	CR4 R*	T1	T2	T3	L1	L2	L3	L4	B1	L4	B1
ACHNANTHES																				
affinis Grun.	8		19	11			7	13	2	1			4					1		
exiqua var. heterovalve Krass.	2			1		1		4	1					2						
hauckiana var. rostrata Schulz.		6		2																
inflata (Kütz) Grun.									1							5		1		
lanceolata (Breb.) Grun: Cl. and Grun.	10	10	2	12	3	45	10	9	1	2	2	1	2	4	1	2	45	4		1
lanceolata var. dubia Grun.		176	2	5	7	3	15	7	2	5	2		3	3	2	1		3		1
lanceolata var. lanceolatoides (Sov.) Reim.					2		2	2					1					1		
lanceolata var. omissa Reim.									1	5										
östrupi (A. Cl.) Hust.																		1		
minutissima Kütz.	15	4	2	9	3	3	11	14	8	10	32	2	19		7	2	33	6	7	36
peragalli Brun. and Herib.										2										
species No. 1	20	2	1	2	3	5	17	10	13	3		3	7	2	2		2	8		
species No. 2	3	1		4		6		1		3	1			6	1		1			
AMPHORA																				
ovalis var. pediculus Kütz.			1				2	1							1					
AMPHIPLEURA																				
pellucida Kütz.	1	1	5	2			1	1	7	9	1		1	2	1	3	1			
ANOMOENOEIS																				
serians var. brachysira (Breb.) Hust.									1	1										
BIDDUDULPHIA																				
laevis Ehr.						1	1			1										

TABLE IV-6 (Continued)

Species Observed	Artificial Substrates, December 5, 1974 (Glass Slides)[a]								Artificial Substrates March 13, 1975 (Glass Slides)[a]		Natural Substrates, May 13, 1975 (Porella and Brachelyma)[b]								Artificial Substrates (Glass Slides)[a]		
	CR1 R*	WR1 C***	CR2 L**	CR2 R*	CR3 L**	CR3 R*	CR4 L**	CR4 R*	CR1 L**	CR4 R*	T1	T2	T3	L1	L2	L3	L4	B1	L4	B1	
CALONEIS																					
bacillum (Grun.) Cl.											1					3					
CAPARTOGRAMMA																					
crucicula (Grun. ex C.) Ross						2	1			3			1	1	1						
COCCONEIS																					
disculus (Schum.) Cl.							1		2	1	1		1	2							
fluviatilis Wallace	10	2	8	17	84	55	90	51	3	4	1	3	6	2	4	15	5	1	1		3
placentula var. euglypta (Ehr.) Cl.		81	4	35	190	185	35	15	5	4		1		3		2	1		1		
CYCLOTELLA																					
stelligera Cl. in Grun.							1				3		4		1						
CYMBELLA																					
affinis Kütz.	.15	18	13	21	1	4	1	1					4	3							
aspera (Ehr.) Cl.													1								
delicatula Kütz.													1	2							
microcephala Grun.		1		1				2						1							
naviculiformis Auers.				1					1	1											
tumida (Berb.) v. Heurck	8	1	4	1		2	1	3	1	6				1							
turgida (Greg.) Cl.									3	5											
turgida var. pseudogracilis Chol.	10		7	12	1	2	1	4	4	9	66	34	13	29	65	13	19	35	2	1	
species No. 1										1											

TABLE IV-6 (Continued)

Species Observed	Artificial Substrates, December 5, 1974 (Glass Slides)[a] CR1 R*	WR1 C***	CR2 L**	CR2 R*	CR3 L**	CR3 R*	CR4 L**	CR4 R*	Artificial Substrates March 13, 1975 (Glass Slides)[a] CR1 L**	CR4 R*	Natural Substrates, May 13, 1975 (Porella and Brachelyma)[b] T1	T2	T3	L1	L2	L3	L4	B1	Artificial Substrates (Glass Slides)[a] L4	B1
DIPLONEIS																				
ovalis (Hilse) Cl.		1							1	1		1	1	1			2	2		
puella (Schum.) Cl.					1	1			1									1		
EPITHEMIA																				
turgida (Ehr.) Kütz.											1							1		
EUNOTIA																				
curvata (Kütz.) Lagr.			1				2		29	5	1	4	12	5	5	7	3	5		5
formica Ehr.								4	1		1			1	1	9				
naeglii Migula																				1
praerupta var. bindens Grun.			2		6	2	9	5	29	16	6	24	18	9	12	161	15	18	1	4
pectinalis var. minor (Kütz.) Rabh.	4	9	15	5	1	1	3		10	9	1	5	6	2		18	2	4	2	2
vanheurkii var. intermedia (Krass. ex Hust.) Patr.												2	6	2		9	4	2		
species No. 1										2									1	1
Unidentified Girdle Valve										1	1	14	36		11	49		18		
FRAGILARIA																				
capucina Desm.									9	5	7	8	2		4		8	6	6	19
leptostauron (Ehr.) Hust.						1		1		1										
leptostauron var. dubia (Grun.) Hust.													2							
vaucheriae (Kutz.) Petrs.							5			7	2	22	2		3	6		2	14	2
FRUSTULIA																				
vulgaris Thwaites	9	2	14	2		6	1	7	29	20	11	6	13	17	6	22	17	17		

TABLE IV-6 (Continued)

Species Observed	Artificial Substrates, December 5, 1974 (Glass Slides)[a]								Artificial Substrates March 13, 1975 (Glass Slides)[a]		Natural Substrates, May 13, 1975 (Porella and Brachelyma)[b]								Artificial Substrate (Glass Slides)[a]	
	CR1 R*	WR1 C**	CR2 L**	CR2 R*	CR3 L**	CR3 R*	CR4 L**	CR4 R*	CR1 L**	CR4 R*	T1	T2	T3	L1	L2	L3	L4	B1	L4	B1
GOMPHONEMA																				
abbreviatum (Ag.) Kütz.										1										
accuminatum Ehr.																				1
accuminatum var. brebissonii (Kütz.) Cl.									1											
accuminatum var. coronata (Ehr.) Wm. Sm.															1	1				
gracile Ehr.									3	1	2				8	2	1	1	2	15
groveri n. sp.										1			1							
intricatum var. pumila Grun.	27	6	53	68	4	33	10	9	10	19	4	34	16	13	24	9	5	10	2	1
parvulum Kütz.	13	3	15	34		6	2	11	15	26	78	57	44	15	43	13	41	16	267	224
GYROSIGMA																				
scalproides (Rabh.) Cl.										4				1		1				
spencerii (Quek.) Griff. and Henfr.	2	1	3	2	1	1	7	2	8	5		1	1	2	2	3				
HANTZSCHIA																				
amphioxys (Ehr.) Grun.									1											
MELOSIRA																				
granulata var. angustissima Mull.													1							
varians C. A. Ag.						1	1			4			1			3				
species No. 1													1		1			1		

TABLE IV-6 (Continued)

Species Observed	Artificial Substrates, December 5, 1974 (Glass Slides)[a]								Artificial Substrates March 13, 1975 (Glass Slides)[a]		Natural Substrates, May 13, 1975 (Porella and Brachelyma)[b]								Artificial Substrate (Glass Slides)[a]	
	CR1 R*	WR1 C***	CR2 L**	CR2 R*	CR3 L**	CR3 R*	CR4 L**	CR4 R*	CR1 L**	CR4 R*	T1	T2	T3	L1	L2	L3	L4	B1	L4	B1
NAVICULA																				
aikensis Patr.	1		26		15	13	23	98	8	23	2	3	5	4	2	2	1	3		
capitata Ehr.					1		1	3		3	1				1					
contenta var. biceps (Arn.) V.H.						1	3		2	8	4	73	35	4	3	9	4	3		
cryptocephala Kütz.	32	16	13	16		5	3	4	6	7	2	2	11	9	5	7	5	6	1	
exiqua var. capitata Patr.	1	3					1		1	2	1				1					
hambergii Hust.					1				2	1	1									
mutica Kütz.	1					1	1		4		1	2	1		5	1	4	5		
pusio Cl.										1										
pupula var. capitata Hust.	2		2		1		4	3	2	3		1	3	2					1	
radiosa Kütz.	1									1								8		
radiosa var. tenella (Bréb.) Grun.					2	7	4	8	22	9	16	3	17	33	23	16	17	33		2
rhyncocephala Kütz.							1		8	7	1				1			2		
rhyncocephala var. germani (Wallace) Patr.			47	19	11	15	23	27	6	28	5	3	9	14	7	7	1	19	2	
salinarium var. intermedia (Grun.) Cl.			3	8		1	1	1					1							
savannahiana Patr.					1															
schroeteri var. escambia Patr.	125	4	75	74	9	53	22	24	5	26	9	7	18	16	3	2	37	11		
subhamulata Grun.	2	1																		
tripunctata (O. F. Mull.) Bory.									1											
viridula var. rostellata (Kütz.) Cl.									4	2		1		3		1		2		
species No. 1							5	3	1	2										
species No. 2								2	1	1										
species No. 3									1	1										
species No. 4									1					1						
Unidentified Naviculoid	3	3	6		1		5	1	2	5	5	1	5	2	3		2	2		
NEIDIUM																				
affine var. capitatum Molder.							1	1	2				2							

3

TABLE IV-6 (Continued)

Species Observed	Artificial Substrates, December 5, 1974 (Glass Slides)[a] CR1 R*	WR1 C***	CR2 L**	CR2 R*	CR3 L**	CR3 R*	CR4 L**	CR4 R*	Artificial Substrates March 13, 1975 (Glass Slides)[a] CR1 L**	CR4 R*	Natural Substrates, May 13, 1975 (Porella and Brachelyma)[b] T1	T2	T3	L1	L2	L3	L4	B1	Artificial Substrate (Glass Slides)[a] L4	B1
NITZSCHIA																				
acicularis Wm. Sm.							1		1									1		
acuta Hantz.	2	2	2					1			1			1						
amphibia Grun.	11	5	1			1	1	1		1	1		2			1	1			
angustata (Wm. Sm.)																1				
dissipata (Kütz.) Grun.									1											
fonticola Grun.			1		1	1	4	2	3	7	2	1	1				4	1		
gracilis Hantz.					1			2	2	1	1							1		
ignorata Krass.					1				1				2	1			4			
lorenziana var. subtilis Grun.							1													
paradoxa Gmelin.							4	10												
palea (Kütz.) Wm. Sm.	7		28	48	2	11	5	2	13	9	21	11	19	25	4	15	7	14	2	1
parvula Levis.									4	1		2	3	1		3	2			
recta Hantz.							1	2	1	1	3		1	4	2		1	4		
sinuata var. tabellaria Grun.												1								
tryblionella var. victoriae Grun.	1					1	1	2		1							1			
species No. 1						1			1											
Unidentified Nitzschia spp.			2	3		1	2	6	3	1	9	2	5	9	3	6	4	14		
OPEPHORA																				
martyi Herb.	1						1			2	1					1				
PINNULARIA																				
brauni (Grun.) Cl.	1	1	2	1		1		1	3	2			6	2	3	1		3		
obscura Krass.									2	3			1							
species No. 1						1	1		1				2				1			
species No. 2								1		1										

TABLE IV-6 (Continued)

Species Observed	Artificial Substrates, December 5, 1974 (Glass Slides)[a] CR1 R*	WR1 C***	CR2 L**	CR2 R*	CR3 L**	CR3 R*	CR4 L**	CR4 R*	Artificial Substrates March 13, 1975 (Glass Slides)[a] CR1 L**	CR4 R*	Natural Substrates, May 13, 1975 (Porella and Brachelyma)[b] T1	T2	T3	L1	L2	L3	L4	B1	Artificial Substrates (Glass Slides)[a] L4	B1
STAURONEIS																				
anceps f. gracilis (Ehr.) Cl.									1											
phoenocenteron Ehr.						1				1										
smithii var. incisa Pant.									2	2										
SURIRELLA																				
linearis Wm. Sm.						1	1		4	1				1		1		1		
linearis var. helvetica (Brun.) Miest.		1																		
robusta Ehr.							1													
SYNEDRA																				
acus Kutz.										1										
ulna (Nitz.) Ehr.	3	2	3	1	5	16	14	3	3	13	30	28	10	16	38	37	9	24	45	49
TABELLARIA																				
fenestrata (Lyng.) Kütz.												1								
TOTAL NUMBER OF INDIVIDUALS[+] COUNTED PER STATION	351	363	382	417	359	498	352	385	328	382	342	364	390	279	311	470	310	322	357	366
TOTAL NUMBER OF SPECIES OBSERVED PER STATION																				

LEGEND

R* Right, or East side of river station. Glass slides furnished by Southern Services.

C*** Center of river station. Glass slides furnished by Southern Services.

L** Left, or West side of river station. Glass slides furnished by Southern Services.

a Incubation period four weeks.

b Hand squeezing of two common natural substrates, Porella pinnata Lenn. (leafy liverwort) and Brachelyma robustum (Card.) E.G. Britt. (common water moss).

[+]Diatom Species Proportional Count

Table IV-7 summarizes the common species inhabiting artificial and natural substrates collected during December, 1974; March and May, 1975. The following definitions for relative abundance were employed:

Rare-------occurring 1-5 times in a count of approximately 300 valves (0.3-1.9 percent of the population)

Uncommon---occurring 6-20 times in a count of approximately 300 valves (2.0-6.9 percent of the population)

Common-----occurring 21-50 times in a count of approximately 300 valves (7.0-16.9 percent of the population)

Abundant---occurring 51-100 times in a count of 3
approximately 300 valves (17.0-33.3 percent of the population)

Dominant---occurring more than 100 times in a count of approximately 300 valves (33.3 percent or more of the population).

The ecology of the common forms reported in Table IV-7 are addressed in Lowe, 1974, Environmental Requirements and Pollution Tolerance of Freshwater Diatoms. This author compiled a number of "spectral ranges" (devised by other investigators -- Hustedt, 1937,1938; Smith, 1966; Kolbe, 1927; Kolwitz and Marsson, 1908) defining the various chemical and physical parameters that limit the distribution of diatoms in their environment.

In general, the periphyton flora found in the Choctawhatchee River is characteristic of "soft" water conditions relatively free of organic enrichment and circum-neutral in pH value.

TABLE IV-7

SYSTEMATIC LITERATURE CITATIONS, AND RELATIVE ABUNDANCE OF COMMON DIATOMS REPORTED FROM ARTIFICIAL AND NATURAL SUBSTRATES COLLECTED FROM THE CHOCTAWHATCHEE RIVER, DURING DECEMBER, 1974, AND MARCH AND MAY, 1975

ACHNANTHES BORY

Achnanthes lanceolata (Breb) Grun.: Cl. and Grun.
Patrick and Reimer, 1966, p. 269, Pl. 18, Figs. 1-10.

Relative Abundance: Rare to common from artificial substrates and natural substrates (i.e. *Porella* sp. and *Brachelyma* sp.).

Achnanthes lanceolata var. *dubia* Grun.
Patrick and Reimer, 1966, p. 271, Pl. 18, Figs. 11-15.

Relative Abundance: Rare to dominant from glass slides; 3
rare from natural substrates.

Achnanthes minutissima Kutz.
Patrick and Reimer, 1966, p. 253, Pl. 16, Figs. 9-10.

Relative Abundance: Rare to common from natural substrates *Porella* sp. and *Brachelyma* sp.; Rare to common from glass slides, May, 1975; Rare to uncommon from glass slides, December, 1974, March, 1975.

COCCONEIS Ehr.

Cocconeis fluviatilis Wallace
Patrick and Reimer, 1966, p. 243, Pl. 15, Figs. 11-12.

Relative Abundance: Common to abundant from glass slides during December, 1974; Rare to uncommon from natural substrates collected during May, 1975.

Cocconeis placentula var. *euglypta* (Ehr.) Cl.
Patrick and Reimer, 1966, p. 241, Pl. 15, Fig. 8.

Relative Abundance: Uncommon to dominant from glass slides during December, 1974; Rare to uncommon from natural substrates collected during May, 1975.

Table IV-7 (cont.)

CYMBELLA Agardh.

Cymbella turgida var. psuedogracilis Cholnoky
Cholnoky, 1958, p. 112, Pl. 2, Figs. 49-50.

Relative Abundance: Uncommon to abundant from natural substrates (Porella sp. and Brachelyma sp.) during May, 1975; rare to uncommon from artificial substrates during December, 1974, and March, 1975.

EUNOTIA Ehr.

Eunotia pectinalis var. minor (Kutz) Rabh.
Patrick and Reimer, 1966, p. 207, Pl. 12, Figs. 13-14.

Relative Abundance: Rare to uncommon from both natural and artificial substrates.

Eunotia praerupta var. bindens Grun.
Patrick and Reimer, 1966, p. 195, Pl. 10, Fig. 15.

Relative Abundance: Uncommon to dominant from natural substrates (Porella sp. and Brachelyma sp.) collected during May, 1975; Rare to uncommon from artificial substrates collected during December, 1974, March and May, 1975. 3

FRUSTULIA Rabh. Nom. Cons., Non Agardh

Frustulia vulgaris (Thwaites) Det.
Patrick and Reimer, 1966, p. 309, Pl. 22, Fig. 3.

Relative Abundance: Uncommon to common from glass slides, March, 1975; Rare to uncommon from both artificial and natural substrates during December, 1974, and May, 1975.

GOMPHONEMA Ehr. Nom. Cons. Non Agardh

Gomphonema intricatum var. pumila Grun
Hustedt, 1930, p. 375, Text Fig. 697.

Relative Abundance: Rare to common from both artificial and natural substrates throughout study period, with the exception of glass slides examined during May, 1975.

Gomphonema parvulum Kutz.
Hustedt, 1930, p. 372, Text Fig. 713a.

Relative Abundance: Dominant from glass slides, May, 1975, comprising 75-61 percent of the population; rare to common glass slides during December, 1974, and March, 1975, uncommon to abundant from natural substrates _Porella_ sp. and _Brachelyma_ sp.

NAVICULA BORY

Navicula aikensis Patr.
Patrick and Reimer, 1966, p. 473, Pl. 45, Fig. 5.

Relative Abundance: Rare to abundant from glass slides examined during December, 1974, and March, 1975; rare from natural substrates.

Navicula contenta var. _biceps_
Patrick and Reimer, 1966, p. 481, Pl. 45, Fig. 19.

Relative Abundance: Rare to abundant from natural substrates, leafy liverwort (_Porella_ sp.) and water moss (_Brachelyma_ sp.). Rare from glass slides during December, 1974, and March, 1975. 3

Navicula cryptocephala Kutz
Patrick and Reimer, 1955, p. 503, Pl. 48, Fig. 3.

Relative Abundance: Rare to common from glass slides, December, 1974, and March, 1975; Rare to uncommon from natural substrates.

Navicula radiosa var. _tenella_ (Breb. ex. Kutz.) Grun
Patrick and Reimer, 1966, p. 510, Pl. 48, Fig. 17.

Relative Abundance: Uncommon to common from natural substrates (May, 1975), and glass slides (March, 1975). Rare from glass slides during December, 1974.

Navicula rhyncocephala var. _germanii_ (Wallace) Patr.
Patrick and Reimer, 1966, p. 506, Pl. 48, Fig. 8.

Relative Abundance: Uncommon to common from glass slides, December, 1974; rare to common from glass slides, March, 1975; rare to uncommon from natural substrates.

Navicula schroeteri var. _escambia_ Patr.
Patrick and Reimer, 1966, p. 512, Pl. 49, Fig. 1.

Table IV-7 (cont.)

Relative Abundance: Uncommon to dominant from glass slides, December, 1974; rare to common from glass slides, March, 1975; rare to uncommon from natural substrates *Porella* sp. and *Brachelyma* sp., May, 1975.

NITZSCHIA HASSAL nom. cons.

Nitzschia palea (Kutz.) Wm. Smith
Hustedt, 1930, p. 415, Text Fig. 801. 3

Relative Abundance: Common component of artificial and natural substrates during December, 1974, March and May, 1975.

SYNEDRA Ehr.

Synedra ulna (Nitz.) Ehr.
Patrick and Reimer, 1966, p. 148, Pl. 7, Figs. 1-2.

Relative Abundance: Common from glass slides May, 1975; uncommon to common from natural substrates, May, 1975; rare to uncommon from glass slides December, 1974, March, 1975.

Biomass and periphyton growth rates found in the spring 1975 studies are tabulated in Table IV-8. The mean biomass value for the Choctawhatchee River stations was 1.30 g/m^2 with a standard deviation of 0.85 g/m^2. The growth rate averaged 0.05 g/m^2/day with a standard deviation of 0.03 $g/m^2\ day^{-1}$. These values typify an aquatic system either low in available nutrients or limited by light. The suspended solids data (see Chapter III) indicate that the periphyton was limited during the sample period by the effects of current scour and turbidity. Existing nutrient levels could support a periphyton population on artificial substrates up to 10 times the amount collected, but other factors, principally turbidity and scour, prevent maximum growth of these organisms.

Average seasonal (December, March, May) results for Shannon-Weaver ($\bar{H}$) species diversity indices (scale 0-5) and Shannon-Weaver evenness (J) values (scale 0-1.0) for periphyton algae attached to glass slides were highest during March 1975 ($\bar{H}$ = 3.70, J = 0.868); lower in December 1974 ($\bar{H}$ = 2.49, J = 0.70); and least in May 1975 ($\bar{H}$ = 1.21, J = 0.43) as shown in Table IV-9.

Although low diversity values were found on the artificial substrates during May, the natural substrates, i.e. *Porella pinnata* Linn (leafy liverwort) and *Brachelyma robustum* (common water moss), had much higher values ($\bar{H}$ = 2.98, J = 0.79).

In Florida waters, a Shannon-Weaver index ($\bar{H}$) ranging from 2.5-3.0 represents moderate to high species diversity (Cairns and Dickson, 1971). With the exception of four samples collected during December and May, 80 percent of the periphyton samples from the Choctawhatchee River had a diversity of >2.5 and 30 percent were >3.0. The presence of such a high

comprise 72.8 percent of the total population compared to the river edge (34 percent) or the floodplain station (43 percent).

Midge larvae were found at every station except L-4 and L-3E. However, Polypedilum was especially abundant at Stations L-1, T-2M, and B-1. Two genera of midges were found which have not been identified. One of these, labelled "Parachironomus," has been found from Maine to Florida (Beck, W. M., 1975, personal communication) but has not yet been officially named. The other, labelled for the purposes of this study "unidentified," has been neither described nor named in the literature.

Two species of clams were found, the fingernail clam (Musculium sp.) and the Asiatic clam (Corbicula manilensis). The fingernail clam was found at every station sampled except C-1. It was not abundant at any station except upstream at L-1. The Asiatic clam, a potential pest, was not found as fre- 3
quently as expected, and was present in only four stations. This is possibly due to the previous month's heavy flooding which may have washed many clams downstream.

Oligochaetes were found at eleven stations but were abundant only at C-1 and B-1. One species of leech (Helobdella nepheloidea) was found at three stations. The remaining miscellaneous species were found at only a few stations.

Comparison of these results with those presented for artificial substrates in Section 2.7.2.2.2 of the site report reveals divergence in species distribution. This may be expected since macroinvertebrate data from artificial substrates historically have been shown not to correlate readily with the natural substrate community. Overall, the macroinvertebrate community colonizing the artificial substrates (Hester-Dendy samplers) was more diverse than observed in the river sediments. However, this would be expected because

the shifting nature of the channel sediments would tend to support a less diverse system.

Very few studies have recorded tolerances for ionic or metal concentrations. Table IV-14, adapted from Curry (1965), gives tolerance levels for various ions for the larvae of several midge species found in this study. The levels of sulfate, total phosphorus, nitrate, and total hardness found in the river water are well below the maximum tolerance limits reported for midge larvae. Below a certain hardness concentration (20 mg/l), shell forming molluscs (snails and clams) are excluded since they theoretically cannot reproduce (Hynes, 1960). The mean hardness as $CaCO_3$ reported by USGS is 30 mg/l and ranges from 12 - 50 mg/l. During the May survey, values of 22 and 26 mg/l were observed. It is evident that calcium levels
in the Choctawhatchee border the minimum required for shellfish and, there- 3
fore, can be considered a natural limiting factor for resident clams and snails.

Monitoring Metals in the Choctawhatchee River

Preliminary data were obtained pertinent to a chemical and a biological integrative monitor for metals in the Choctawhatchee River. Iskandar and Keeney (1974) and others have begun studying the depth profiles of heavy metals (Pb, Hg, Zn, Cu, Cr, etc.) in lake sediments to document cultural influences.

Sediment metals were determined by elutriation of dried samples into deionized water. This method is modified from the standard Elutriate Test (U. S. Army Corps of Engineers, 1974). Elutriated metals were determined by atomic absorption procedures as used for the water analyses.

TABLE IV-14

MAXIMUM LEVELS OF VARIOUS IONS TOLERATED BY SEVERAL SPECIES OF MIDGE FLY LARVAE: DATA EXPRESSED IN MG/L*

Species	$PO_4^{\equiv}$ Total	Ca^{+}	Mg^{++}	Cl^{-}	$SO_4^{=}$	NO_3^{-}	$CO_3^{=}$	BOD
Procladius sp.	26.2	22.0	4.0	6.0	1.0	43.0	310	82.0
Corynonema sp.	--	23.0	4.5	--	tr	43.0	310	82.0
Microtendipes sp.	--	22.0	4.0	8.5	1.0	--	--	--
Polypedilum fallax	26.2	--	--	--	--	43.0	310	82.0
Tanytarsus (3 spp.)	26.2	22.0	4.0	8.5	1.0	43.0	310	82.0
Cryptochironomus fulvus	26.2	--	--	--	--	43.0	310	82.0
Chironomus (several spp.)	26.2	22.0	4.0	8.5	1.0	43.0	310	82.0

*Adapted from Curry, 1965

3

Background data obtained on copper, lead, iron, zinc, and mercury concentrations leachable from river sediments were collected and tabulated in Table IV-15. Three replicate samples were analyzed from 5 stations in mid-river, one sample from a backwater and one soil sample from the floodplain forest. Iron was present in significant quantities. This is to be expected. No copper was detected, but some samples showed low concentrations of leachable lead, zinc, and mercury. Backgrounds of these metals do exist in lake sediments, even in the absence of cultural development or pollution (Iskander and Keeney, 1974). Some of these result from minerals in weathering soils and others (particularly lead) result from airborne contamination due to automobile fuels. Monitoring metal concentrations in sediments would develop concentration gradients. Increasing rates of deposition would relate to heavy metal contamination. 3

Filter feeding organisms are capable of concentrating metals absorbed on sedimentary particles or carried in bacterial, phytoplankton or zooplankton biomass. The fairly short life history of the individual organisms and their sessile nature are factors which make them excellent indicators of recent past water quality. Since they accumulate metals, each clam acts as an integrator of metal concentration throughout its lifetime.

The Asiatic clam, Corbicula, was assessed as an indicator organism for the presence of heavy metals because it concentrates heavy metals in its tissue, it is relatively stationary throughout its life span, and it is easy to collect, preserve, and analyze, using standard atomic absorption spectrometry.

Clams were collected to be wet ashed and analyzed for heavy metals, using atomic absorption techniques. Tissue was dissected from the shell

IMAGE QUALITY

AS YOU REVIEW THE NEXT GROUP OF IMAGES, PLEASE NOTE THAT THE ORIGINAL DOCUMENTS WERE OF POOR QUALITY.

TABLE IV-15

METAL ELUTRIATIONS FROM CHOCTAWHATCHEE RIVER SEDIMENTS CARYVILLE, FLORIDA

Concentrations in mg/l

Parameter	River Stations														
	Station L-1			Station L-2			Station L-3			Station L-4			Station T-3		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Copper	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	6.0	5.7	3.5	4.4	12	13	5.8	6.1	3.9	6.5	2.4	0.9	5.6	3.9	9.5
Lead	0.05	0.04	0.04	0.02	0.04	0.04	<0.02	<0.02	0.10	0.05	<0.02	<0.02	<0.02	<0.02	<0.02
Mercury	<0.0002	0.019	0.0002	0.0070	0.0030	0.019	0.027	0.027	0.0004	0.0003	0.0082	0.011	0.016	0.032	0.0004
Zinc	<0.003	<0.003	0.013	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.056	<0.003

Parameter	Slough Station B-1			Swamp Station C-1		
	1	2	3	1	2	3
Copper	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	0.91	1.1	10	6.4	4.9	9.6
Lead	0.10	0.05	<0.02	<0.02	<0.02	<0.02
Mercury	0.019	0.021	0.025	<0.0002	0.026	0.010
Zinc	0.10	<0.003	0.017	0.11	<0.003	<0.003

*Analytical data reported to two significant figures; none are carried beyond right-most retained digit of detection limit

and placed in tared beakers for 24 hours drying at 105-110°C to attain constant weight (limited to 1.25 g wet weight). The beakers were cooled in desiccators, weighed, and the dry weights were recorded. A number of Corbicula tissues were split into triplicate subsamples to determine analytical precision. Selected subsamples spiked with known heavy metal concentrations were analyzed to determine the percentage recovered by the wet ashing method. Dried samples were digested with 10 ml of 70 percent nitric acid and 2 ml of 70 percent perchloric acid under a hood at 75°C. Samples were heated until no perchlorate fumes were visible, cooled, and placed in a desiccator to await further analysis. Residues in the beakers were dissolved with 10 ml of distilled deionized water and aspirated directly into a Perkin-Elmer 360 atomic adsorption spectrophotometer (modified after Leonard, E. N., 1971). Detection limits for the various heavy metals are listed as follows in micrograms (μg): cadmium, 2×10^{-3}; chromium, 3×10^{-2}; copper, 1×10^{-2}; zinc $<1 \times 10^{-2}$; and mercury, 1×10^{-2}.

Clams (Corbicula sp.) were obtained upstream and downstream from the proposed discharge site and analyzed as described. Results are shown in Table IV-16. Background values for heavy metal ions in marine animal tissues have been recently published (Greig, 1975, and Sayler et al., 1975), and are cited here only as a comparison in concentration levels to those observed in Corbicula clams even though there is a dissimilarity in environment. These authors report mercury values of 0.131 to 0.172 mg/kg dry weight in the American oyster (Crassostrea virginia) collected near Annapolis, Maryland in Chesapeake Bay. Greig compared two methods of metal analysis and recorded values of 100 - 2,600 mg/kg zinc and 0.5 to 1.3 mg/kg chromium in the channeled whelk (Busycon canaliculatum) on a wet weight

TABLE IV-16

SELECTED METALS FROM THE ASIATIC CLAM (*CORBICULA SPP.*) COLLECTED IN THE CHOCTAWHATCHEE RIVER

	Concentration mg/kg		
	Upstream	Downstream	
Parameter	L-1	L-4	
Copper	48	30	
Mercury	0.0011	0.13	3
Zinc	140	120	
Cadmium	1.5	1.8	
Chromium	8.4	6.7	

*Dry Weight

basis. This author also reported 0.5 to 1.8 mg/kg chromium in the surf clam (Spisula solidissima) also on a wet weight basis.

The metal levels in Corbicula showed that clams downstream from the proposed discharge had a mercury accumulation two orders of magnitude above those sampled upstream. These results suggest an existing or past source of mercury in this part of the river.

Predicted Effects of Plant Operation

The intake structure would create a positive effect by increasing habitat diversity. The bottom and the pilings of the structure would provide improved habitats for benthic organisms. Diversities of benthic organisms were significantly higher on Hester-Dendy samplers (Section 2.7.2.2.2 Site Certification Application) than diversities of the sandy bottom, due 3
to the more favorable habitat provided. The region around the intake structure would likely reflect a similar increase.

The cooling water blowdown effects on benthic macroinvertebrates will be negligible when reflected against the existing natural limiting condition of river substrates. During high water flows (spring and average winter conditions) the plume would extend downstream and not contact the river bottom. During periods of lower flows, perhaps at river flow of less than 1000 cfs, sediment temperature could increase if the plume came into contact with the bottom. This would result in a gradual heating of a small area of the river sediment.

Rotating the predicted plumes shown in Section 5.1 of the Site Certification Application from the horizontal to the vertical plain, overestimates the vertical dispersion because of the buoyancy of the heated water. A prediction of thermal impact using this model would

be a conservative estimate of actual conditions. Near the point of discharge, the river bottom is at elevation 22 feet (MSL) or 15 feet below the effluent water discharge (elevation 37 feet MSL). The maximum radius (Section 5.1) of a plume 5°F above the ambient river temperature is about 10 feet. No impact of greater than 5°F change should effect the benthic organisms,as no portion of the plume this warm should reach the bottom. Warm water plumes with a radius greater than 15 feet might impinge the bottom during adverse winter flows. The portions reaching the bottom are estimated at 1-2°F above the ambient river temperature.

Thermal tolerances for benthos in the Choctawhatchee River should not be exceeded and heat stress should not impact these forms. No unique habitats would be destroyed by the thermal discharge. Hatches of benthic organisms could be entrained in the thermal plume in the same manner as plankton; however, the percent loss, as discussed in 3
the plankton section,would be insignificant.

Chlorine residuals in the river were predicted in the discussion of effects of operation on plankton in this chapter. The maximum whole river concentrations will be unlikely to have any acute or chronic effect on the benthos because of the short contact and low residuals.

Increases in the river levels of dissolved materials are tabulated in Figure III-18. Increases as noted in the sulfate and sodium concentration are not sufficient to create any major stress for benthic invertebrates. A negligible increase in calcium will occur (0.4 mg/l), see Chapter III. The low concentration of calcium is probably a major limiting factor for shellfish and may naturally check further infestation by the exotic Asiatic clam (Corbicula) which has been found in this reach of the river. It is an extremely prolific organism. Infestations by Corbicula represent a nuisance

and an economic liability for power plants. The added calcium due to the discharge from the proposed plant will not likely increase the *Corbicula* population downstream. Future upstream development and increased nutrient loads from agricultural or urban development could increase calcium concentration to an extent which would favor the growth of these nuisance clams. 3

Fish

Introduction

Fish are at the top of the aquatic food web. In aquatic ecosystems, only a few semi-aquatic reptiles, birds, and mammals are above them. They feed on virtually every living component of the riverine ecosystem. A few, such as the various shad and juveniles of other speices, feed on plankton. Most, however, feed on aquatic macro-invertebrates. The remainder feed on other fish and small reptiles and amphibians.

In river systems the species diversity and density of fish are a function of temperature, turbidity, food supply, and cover. They are found throughout the water column -- in the thalweg, along the river's banks, and even in the floodplain during flooding. 3

A few fish bear their young alive (topminnows). Some (Striped bass) eject their eggs directly into the current to hatch and develop. Most, however, lay their eggs in shallow, relatively still water.

Although fish are not a good indicator of environmental stress, they are of concern in this reach of the Choctawhatchee River because the power plant operation could effect fish in several ways. Fish could be subjected to impingement on the water intake screens. Fish larvae and free floating eggs could be entrained in the intake water and lost at the water filters. Fish or their eggs could also be subjected to other effects in the effluent discharge plume. This latter could include the thermal impact of entrapment in the heated plume or cold shock when the plant is shut down; or exposure to chemical effects from chlorine released in cooling tower blowdown, low oxygen content in

the heated effluent, and increases in the concentration of total dissolved solids in the discharge water.

Methods

Table 2.7-14 in the Site Certification Application enumerates the species of fish which have been observed in the Choctawhatchee River and the river basin. No further field sampling was conducted for fish in this portion of the study as this list was believed to be an adequate identification. Rather, the purpose here was to consider these species and evaluate the impact of the plant operation on them.

The complete species list is not reviewed. This section limits itself to the species of commercial or recreational importance, or rare or endangered species which might be affected by operation of the proposed plant. Discussions with the U. S. Fish and Wild Life Service confirmed the relative importance of the species in the Choctawhatchee River that are discussed below. 3

Of particular concern in evaluating the biological effects of the plant is the possible loss of planktonic fish eggs and larvae, as well as the adults. The probability of these events and degree of impact are discussed.

Plankton net samples (Wisconsin, #20 mesh net) were taken in May 1975 and examined for planktonic fish eggs as well as the other plankton forms.

Results

The fish known to occur in the Choctawhatchee River that have planktonic eggs and larvae are Striped bass (*Morone saxatilis*) and two species of shad (genus *Alosa*). Other species of importance are the Gizzard shad (*Dorosoma cepedianum*), the Threadfin shad (*Dorosoma petenence*) and the Atlantic sturgeon (*Acipenser oxyrhynchus desotoi*).

Morone saxatilis - The population of Striped bass (*Morone saxatilis*) in the Gulf of Mexico is natural (i.e., not introduced from the Atlantic Coast). Barkuloo (1970) has shown a morphological distinctness that justifies classification as a new subspecies. Lateral-line scale count is the primary distinguishing feature; individuals from the Gulf of Mexico have significantly higher counts than those from the Atlantic.

The natural range of Striped bass in the Gulf of Mexico extends from the mouth of the Mississippi River to the Apalachicola River. Occasional individuals appear beyond this area -- i.e. in the Suwannee River (Gray Bass, Florida Game and Freshwater Commission, pers. comm.).

All along the northern Gulf area, the Striped bass has disappeared (particularly since 1950) from most river systems in which they regularly occurred. Only two river systems, the Alabama and Apalachicola, still 3
contain natural populations. However, ecological and physical changes have reduced these populations, too, particularly in the Alabama River.

Since early 1970, the U. S. Fish and Wildlife Service has attempted to re-establish the Striped bass in the Choctawhatchee by stocking young individuals. Some have now reached maturity and have been caught upstream as far as Elba and Geneva, Alabama (J. Barkuloo, pers. comm.). Thus far there is no indication of natural reproduction in this population. Spawning usually takes place when the water temperatures range from 58-71°F (March to May). This is the period of highest flow in the river, when water withdrawal by the plant will have the least impact on the river. Drift nets set during the springs of 1973 and 1974 found no Striped bass eggs. However, most of the population are just now (1975) reaching sexual

maturity and this year will be critical for the success of this species in the Choctawhatchee River system. No evidence was found of Striped bass eggs in this present study in May, 1975. Although no Striped bass eggs or young were obtained from drift nets in the Caryville area during 1973, 1974, or 1975, the U. S. Fish and Wildlife Service intends to continue sampling. Some eggs and juveniles have been captured in drift nets set approximately 65 miles downstream from the Caryville site -- at the upper end of the delta area. These are currently being examined to determine if they are Striped bass (J. Barkuloo, pers. comm.)

An important factor in the reproduction of Striped bass is the necessity for the eggs and newly hatched young to stay suspended in the water. Egg and larvae of this species are only moderately buoyant. Since spawning occurs in fresh water, sufficient flow is needed to keep these 3
young stages off the bottom to avoid being covered by silt. At least slightly saline water (4 ppt) is required to increase the lifting capacity of the water enough to keep eggs and larvae more-or-less permanently suspended. Such conditions occur in the lower reaches of the Choctawhatchee River. Therefore, successful reproduction of Striped bass could be expected to occur in that portion of the river, even though the eggs and young would drift with the current for only a short time. If the water quality and attendant ecology in the lower delta and bay remain good, these fish could survive this vulnerable period of life.

The water quality data from the USGS and this present study (Chapter III) show that the Caryville reach of the Choctawhatchee is "soft" fresh water, not oligohaline. Striped bass and other fish with planktonic eggs that rely on turbulence and water density to keep the eggs in

suspension may have difficulty in repopulation this far upstream.

Alosa albamae and *Alosa chrysochloris* - Because of the close phylogenetic relationships and ecological similarities between these two species, they are discussed together. The two differ in certain aspects of their life histories, particularly the frequency and time they are found in brackish or salt water. *Alosa albamae* is an anadromous species, but *Alosa chrysochloris*, although salt tolerant, is not. The two species are similar in that they lay planktonic, non-adhesive eggs that drift with the current.

The Alabama shad (*A. alabamae*) has been reported from most of the
major drainages along the Gulf coast from the Suwannee River, in Florida,
to the Ouachita River, in Arkansas. It also occurs well up the Mississippi
River. The species formerly called the Ohio shad (*Alosa ohiensis*), con- 3
sidered to be confined to the central Mississippi Valley, has recently
been synonymized with *A. alabamae* (Hildebrand, 1963).

Laurence and Yerger (1967) indicate the spawning temperatures range from 17°C-20.5°C. The species lives no more than four years, with survival longest in females (4 years). Males reach three years in a normal life span. Spawning occurs over a sand and gravel bottom, and the eggs are planktonic. Although Laurence and Yerger (1967) were not successful in finding eggs in the Apalachicola River subsequent to spawning, they did obtain small (2.2-2.6 inches) individuals below Jim Woodruff Dam and farther downstream. The greatest number of eggs found were about 150,000, from a female 16.0 inches in length.

The Skipjack herring (*A. chrysochloris*) is distributed along the Gulf coast from Alligator Harbor, Florida, to Corpus Christi, Texas, and

thus occupies a different and somewhat broader coastal range than A. alabamae. As mentioned earlier, this species is confined more to fresh water than A. alabamae. Wolf (1969) suggests that the Skipjack is not anadromous. This species seems to occur further up the Mississippi system than the Alabama shad (A. alabamae). It is common also in Ohio and Pennsylvania (Ohio River), whereas the Alabama shad has never been recorded in either of those states.

Wolf (1969) reports that the Skipjack usually live three years, but in contrast to Alabama shad, both males and females attain the same age. The species has a prolonged spawning period in the Apalachicola River, from early March to late April, within a temperature range of 17.0°C-22.0°C. Egg estimates ranged as high as 960,000 in gravid females, which is considerably higher than reported for the Alabama shad. Both adults and juveniles are piscivorous. 3

Dorosoma cepedianum and Dorosoma petenence - These shad are important forage species, but are of no direct sport or commercial importance. At times both can reach very large populations, but according to Barkuloo (pers. comm.) this does not occur in the Choctawhatchee River.

Acipenser oxyrhynchus desotoi - In the Gulf of Mexico the population of the Atlantic sturgeon ranges from the mouth of the Mississippi River to the Suwannee River. Occasional individuals are found further south; at one time the species occurred regularly as far south as Tampa Bay. Once the species was fished commercially in many of the Gulf coastal rivers, but today the only river supporting a commercial fishery is the Suwannee. During the past 25 years, the species has declined in abundance throughout its range in the northern Gulf. This may be attributable in

part to commercial exploitation (sturgeons reach sexual maturity very slowly compared to most fishes, taking as long as 15 years for the largest species), but the ecological modifications in most of the rivers are probably of greater importance. Pesticides are thought to have played a major role in this regard.

Sturgeon may still spawn in limited numbers in the Choctawhatchee River, as evidenced by the collection of a 4-inch specimen in 1957, near the Alabama-Florida line, and the more recent (1974) collection of a 7-inch individual farther down the river (J. Barkuloo, pers. comm.). It is not known if these fishes were actually spawned in the Choctawhatchee River.

Predicted Effects of Plant Operation. The adverse effects of the heat dissipation system of the plant on fish are the potential impingement on the intake screens; entrainment of fish eggs (Striped bass) in the cooling water system; thermal and/or chemical shocks to fish entering the discharge plume; and cold shock to fish conditioned to the heated plume if the discharge ceases. 3

The submerged intake structure has a design flow velocity across the intake screens not to exceed 0.5 feet per second (Chapter III). Bibko, Wirtenan, and Kueser (1974) report that Striped bass and Gizzard shad, exposed to a current, orient into and swim against the current. Young Striped bass are reported to swim against currents ranging from 1.6 to 2.1 ft/sec for at least 10 minutes without danger of impingement on vertical traveling screens. At velocities of 2.0 and 2.6 ft/sec, fish did

not impinge and were capable of swimming away from the screens (Bibko, Wirtenan and Kueser, 1974).

The configuration of the water intake at the Caryville plant is not the conventional traveling screen structure, but rather is designed with submerged intakes with low intake velocities <0.5 fps -- placed parallel to the river flow to purposefully minimize the impingement of fish and entrainment of planktonic eggs.

Submerged intakes minimize the entrainment of planktonic eggs, since the water is taken from near the river bottom. Planktonic eggs are usually suspended near the surface. However, the spiralling secondary currents in the river bed at intake site 1 (as discussed in Chapter III) will tend to draw some surface waters past the submerged intake and may expose some eggs to entrainment. The positioning of the intakes parallel 3
to the flow utilizes the force of the river flow to sweep materials past the screens.

Assuming that Striped bass and shad eggs occur in the river, the percent devitalized by entrainment in the intake water would be negligible. Assuming uniform distribution throughout the water, this loss would be the same percent as the percent of the river taken in. The percent of the egg crop entrained would be similar to the planktonic community under the previously discussed conditions -- less than 3 percent of the total in the river during average operating conditions, and about 16 percent during adverse winter operating conditions. Adverse winter conditions compare the minimum daily flow of the river (604 cfs) with the maximum water intake of the power plant (45,000 gpm) for 3000 MW, and the water taken in would amount to about 16 percent of the total flow. The proba-

bility of this event occurring is 2 X 10^{-7}. It is unlikely that this would occur during the life of the plant. The water intake at the Caryville site will have even less effect than this on the planktonic eggs or larvae of Striped bass, since these eggs are present in the river only in the spring of the year. Spring has the greatest river flow, which minimizes impact of water withdrawal.

The effects of various factors on fish are reviewed in Parker and Krenkel (1969) and Jenkins (1973). Tolerances to heated discharge of various fish species are reported by these authors and in the EPA's Water Quality Criteria (1972).

Fish entering the discharge plume could be shocked and lost. However, as previously discussed, these plumes will be small during average operating conditions -- less than 3 percent of the total river volume. Fish avoidance during spring, summer and fall should minimize entrainment. 3
During winter months, at low temperatures, fish may be attracted to the warm discharge. Total interruption of this thermal discharge (caused by complete shutdown of the plant) could create a cold shock to fish acclimated to the warmer temperatures. Should this occur, it would be infrequent and affect only a small volume of the river.

As found in Chapter III, the water quality in the whole river is not significantly affected by the discharge of effluent waters with increased concentrations of dissolved solids. There are no species in this portion of the Choctawhatchee River that are sensitive to a residual of <1 ppb chlorine in the river. Low oxygen concentrations in the heated effluent will not depress the dissolved oxygen in the whole river, because the discharge is only from 1 to 2 percent of the total river volume.

The operation of the plant should have little effect on these fish and planktonic fish eggs in the Choctawhatchee River.

Summary of the Aquatic Ecology and the Predicted Effects of Plant Operation

Sufficient information has been developed on the aquatic ecology to predict the impact of the power plant on these aquatic communities.

The biological, hydrological, and chemical data suggest that the primary aquatic production in the Choctawhatchee River near Caryville, Florida is severely limited by the natural forces of river velocity, turbidity, flooding, etc. The food web for fish is based on detritus from the drainage area, rather than on the biologic components of the river.

The planktonic and periphyton primary producers are mostly diatoms. They are sparse, with low biomass; they are light limited by the turbidity of the river. However, the Shannon-Weaver Diversity Indices of each are about 3 (scale 0-5), indicating a fairly diverse population; the evenness coefficient values are about 0.8 (scale 0-1), indicating uniformity; Morisita's Indices indicate similar populations throughout the river.

The benthic macroinvertebrates are sparse and under severe natural stress from the shifting and abrasive nature of the river sediments. The community is predominantly chironomids, oligochaetes, and bivalve mulluscs in descending numbers, respectively. Less abundant groups include ephemeropterans, dipterans, plecopterans, and gastropods, which are indicative of unpolluted water. The Asiatic clam, Corbicula, is present but not abundant. The diversity indices are about 1 (scale 0-5) indicating low diversity-high stress; the evenness values are about 0.7 (scale 0-1) indicating fair uniformity, and a cluster analysis for Morisita's Indices indicate two dissimilar populations -- one in the thalweg and one at the river's edge.

The fish population is moderate but well distributed among forage, rough and game fish. The commercially important or game fish that are of particular interest are Striped bass and shad (Alosa) because of their planktonic eggs.

The operation of a power plant can cause: 1) impingement of fish on the intake screens, 2) the entrainment of fish, plankton, and planktonic fish eggs in the water intake, 3) thermal shock to organisms contacting the thermal discharge plume, and 4) chemical trauma from changes in the water chemistry.

The plankton community in the Choctawhatchee River will be affected by entrainment and thermal shock from the discharge plume. The typical plankton loss under average operating conditions (3000 MW - winter) could total about 3 percent of the population -- 1.3 percent by entrainment and 1.8 percent from thermal shock. This is negligible. 3
Under the worst case condition (3000 MW - winter), this total plankton loss could be about 23 percent -- 11.5 percent by entrainment and 11.6 percent from thermal shock. However, the probability of this occurrence is low. The plankton community will not be affected by the change in water chemistry, the increase in total dissolved solids, or the chlorine residuals.

The periphyton community will not be affected by plant operation. The whole river increases in temperature (<2°F), dissolved solids, and chlorine residuals will have no effect on the periphyton community.

The benthic macroinvertebrates on the river bottom will not be affected by plant operation. Thermal tolerances will not be exceeded on the bottom. Hatches of benthic organisms will be affected

in the same manner as plankton. The increases in total dissolved solids and chlorine residuals in the whole river are not sufficient to affect the benthic community structure. The water intake and discharge structures in the river will create a new habitat for certain benthic macroinvertebrates which require stable substrate.

Fish will be only slightly affected by plant operation. The impingement and entrainment of fish by the water intake will be minimized by the configuration of the intake structure. Fish will avoid the discharge plume, minimizing the effects of thermal shock and low 3
dissolved oxygen. There should be no effect from increased dissolved solids or chlorine residual. Planktonic fish eggs will be affected in the same manner as plankton. However, the impact of entrainment and thermal shock are reduced because the Striped bass and shad (*Alosa*) spawn only in the spring. The portion of the plankton and eggs affected is reduced during this season because of the high river flow.

The construction and operation of the proposed plant should have no adverse effects on the aquatic ecology of the Choctawhatchee River. The river should continue to support its present levels of plankton, periphyton, benthic macroinvertebrates and fish.

V

CHOCTAWHATCHEE RIVER FLOODPLAIN: TERRESTRIAL ECOLOGY OF THE INTAKE-DISCHARGE CORRIDOR

Introduction

A corridor and maintenance road will be required to deliver water from the Choctawhatchee River to the R. F. Ellis Electric Generating Station. The proposed power plant site is approximately one mile east of the river. The corridor will cut through both a floodplain forest and an upland forest, on the east bank between the river and the plant site.

This chapter describes the floodplain ecosystem in the area near the corridor. Three alternate routes for the corridor are considered; the best route selected; and the resource commitment and impact of construction and operation on the area are discussed. The three alternate routes are illustrated in Figure V-1. 3

On the east bank of the Choctawhatchee River the floodplain extends east from the river for about 1,500 feet in the vicinity of the corridors (Figure V-1). It can be differentiated into four vegetation types paralleling the river (Figure V-2). These are the natural levees, the floodplain forest, the tupelo rim swamp, and the "mesic islands," which are small areas of upland vegetation on hillocks between the floodplain and the rim swamp.

Floodplain forests are of high environmental value. They trap nutrients from upland runoff before these enter the river. The productivity of river swamps ranks them among the more fertile of the world's ecosystems (0.7 - 2.2 $Kg/m^2/year$, Odum, 1969). The floodplain forests slow the flow of flood waters; stabilize soil along the banks; and decrease erosion.

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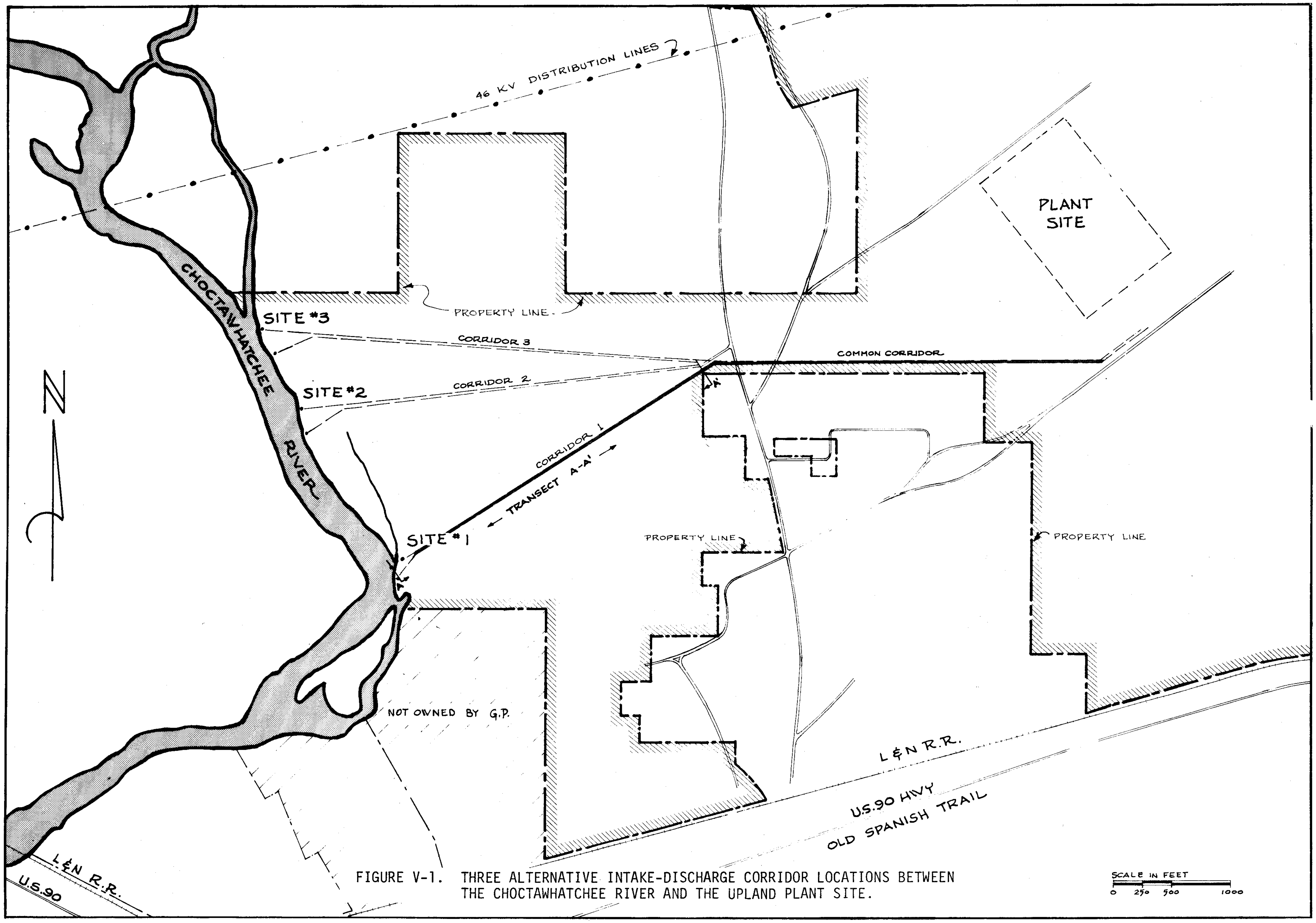
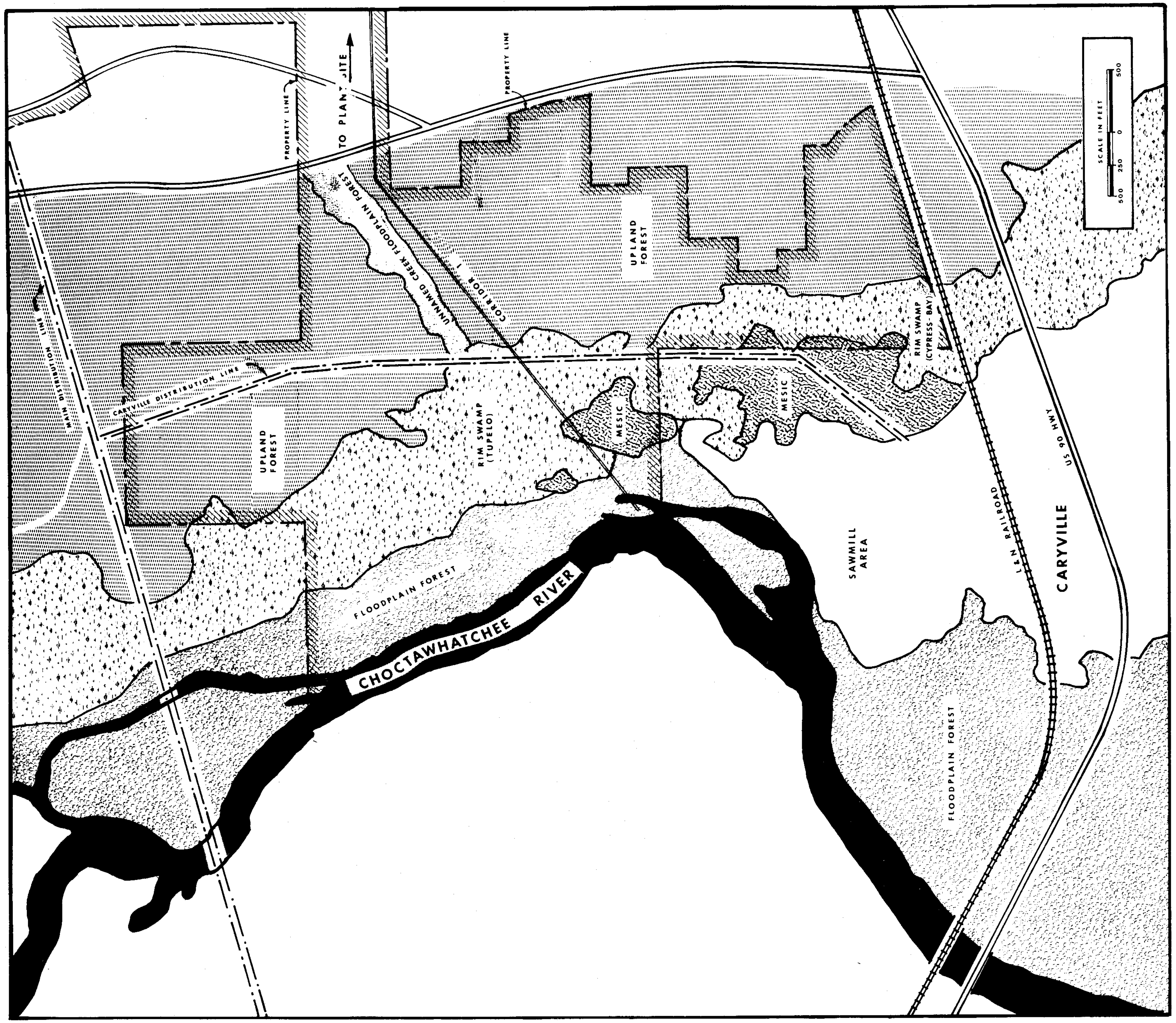


FIGURE V-1. THREE ALTERNATIVE INTAKE-DISCHARGE CORRIDOR LOCATIONS BETWEEN THE CHOCTAWHATCHEE RIVER AND THE UPLAND PLANT SITE.



3

FIGURE V-2. VEGETATION MAP OF THE FLOODPLAIN BETWEEN THE CHOCTAWHATCHEE RIVER AND THE UPLAND PLANT SITE.

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Between the floodplain and the plant site the corridor cuts through an upland mesic hammock and pasture land. Mesic or mesophytic hammocks develop in areas that are not subject to flooding or temperature extremes. These upland forests generally have a thicker canopy and more ground cover than floodplain forests. In upland forests, live oaks dominate in moist areas while conifers dominate in drier sectors. The upland vegetation is discussed and pictured in Section 2.7 of the Site Certification Application.

Methods

Vegetation Associations. Vegetation maps of the corridor areas were prepared by "ground truthing" types and characteristics of habitats appearing on aerial photographs. In the corridor areas, observations were made on natural stress, plant associations and dominance.

For this investigation, a single field trip was sufficient to define the major vegetation zones that would be effected by the corridor. Surveying in May, 1975, provided the additional opportunity to observe the stress on the floodplain forest from recent flooding.

Three alternative corridors (Figure V-1) were examined into the floodplain forest. Full access was prevented by residual flood waters, however, transects were examined through typical natural levees, floodplain forests, tupelo rim swamp, and mesic islands. A small drainage course was examined and the distribution line was walked to provide "ground truthing."

The upland segments of the corridor routes were not walked. A detailed study of these areas had already been made and included in Section 2.7 of the Site Certification Application.

Quantitative measurements of woody vegetation were gathered in the study. Species were identified according to Kurz and Godfrey (1962), Fassett (1940), Hotchkiss (1970), and Burgis and Orsenigo (1969). Importance values, which quantify dominants, were calculated for the flora of the floodplain forest, the tupelo rim swamp, and the mesic islands. Importance values for the natural levees were not calculated because these areas were too narrow in width and irregular in species for meaningful evaluation. Data for upland vegetation in the corridor area can be found in Section 2.7 of the Site Certification Application.

Importance values are developed through a summation of three characteristics: relative density, relative dominance (basal area), and relative frequency. These are determined as follows: 3

(1) $$\text{Relative Density of Species A in Stand X} = \frac{\text{Stand density of Species A in Stand X}}{\text{Total Stand Density of All Species in Stand X}} \times 100$$

(2) $$\text{Relative Dominance of Species A in Stand X} = \frac{\text{Basal Area of Species A in Stand X}}{\text{Total Basal Area of All Species in Stand X}} \times 100$$

(3) $$\text{Relative Frequency of Species A in Stand X} = \frac{\text{Frequency of Species A in Stand X}}{\text{Sum of Frequencies for All Species in Stand X}} \times 100$$

$$\text{Where Frequency} = \frac{\text{Total Number of Plots or Points in Stand X in which species A Occurs}}{\text{Total Number of Plots of Points Sampled}} \times 100$$

The maximum value for each of (1), (2), or (3) is 100 (percent); therefore, the maximum value for the importance index is 300.

Within each vegetation association a transect was chosen at random -- 20 feet wide by 100 feet long (6.1 x 30.5 meters), or 2,000 sq. ft. (186 sq. meters). On these transects all trees were identified and measured for their diameter at breast height (dbh).

Terrestrial Vertebrates. Section 2.7 of the Site Certification Application reports most of the animals that would be expected in the corridor areas. The terrestrial fauna was verified while conducting the floodplain vegetation studies and supplemented by further identification of animals and spoor (evidence of rooting, fecal examination, tracks, calls). Animals captured were identified and released. Robbins, et al. (1966) was used for birds, Burt and Gossenheider (1952) for mammals, Conant (1958) for reptiles and amphibians and Pruitt (1971) for the food habits of mammals, birds, reptiles, and amphibians.

Results

Vegetation Associations. The floodplain on the east bank of the Choctawhatchee River has four major zones: the natural levees, the floodplain forest, the tupelo rim swamp, and the mesic islands. These are illustrated on Figure V-2.

Adjacent to the river are the natural levees which are about five feet higher than the floodplain. In most places the levee extends inland for less than 20 feet. This small tract is dominated by upland mixed hardwoods, pine, and cedar. East of this natural levee is a forested floodplain that extends for about 500 feet, with numerous depressions, swales, and natural drainage channels. This floodplain forest is made up of hardwoods resistant to flooding. Inland of the floodplain forest is a rim swamp that extends for about 1,000 feet. This forest is mixed hardwood and cypress that are tolerant to long periods of inundation. Between the rim swamp and

the floodplain are small elevated areas, about as high as the natural levee, that can best be described as "mesic islands." The forests on the mesic islands, like the levee, are dominated by upland species.

No plant species listed in the United States list of endangered species (Fish and Wildlife Series, 1975) were encountered in this survey. Floodplain vegetation was typical of swamp associations for the southern United States (Monk, 1965). The important flora of the vegetation zones is listed in Table V-1.

On the natural levees there were sufficient trees to form a dense canopy. Many of the 24 species of trees and shrubs were upland varieties. Because of the narrowness of the levee and heterogeneous distribution of species, the importance values were not subject to meaningful evaluation. The canopy was pines (Pinus glabera and Pinus elliottii), red cedar (Juniperis salicicola), cypress (Taxodium distichum), willow (Salix 3
caroliniana), several oak species (Quercus virginiana, Q. laurifolia, Q. lyrata, Q. nigra), sweet gum (Liquidambar styraciflua), basswood (Tilia americana), red maple (Acer rubum) and elm (Ulmus americana var. floridana).

The understory was relatively sparse and mostly young canopy trees. Other vegetation includes blue-beech (Carpinus caroliniana) and eastern hophornbeam (Ostrya virginiana). Yaupon holly (Ilex vomitoria), stiff-cornel dogwood (Cornus storicta) and wild bamboo (Arundinaria sp.), were the majority of the low understory shrubs. Catbriar (Similax spp.) was the most common ground plant, along with occasional patches of floodplain panic grass (Panicum spp.).

In the floodplain forest, green ash (Fraxinus pennsylvanica), swamp tupelo (Nyssa biflora) and red maple (Acer rubrum) formed most of the canopy. The shrub understory (almost wanting) was saplings and suckers of these

TABLE V-1

VEGETATION OF THE VARIOUS ECOSYSTEMS OF THE CORRIDOR SITING STUDY AREA

Plant Species	Natural Levees	Floodplain Forest	Rim Swamp		Mesic Islands
			Tupelo	Cypress-Bay	
TREES AND LARGE SHRUBS					
Pinus glabra (Spruce Pine)	x				x
Juniperus salicicola (Southern Red cedar)	x				x
Taxodium distichum (Bald Cypress)	x	x	x		
Taxodium ascendens (Pond Cypress)				x	
Salix caroliniana (Coastal Plain Willow)	x				
Carya aquatica (Water Hickory)	x				
Betula nigra (River Birch)	x				
Carpinus caroliniana (Blue-beech)	x				x
Ostrya virginiana (Eastern Hophornbeam)	x	x			x
Quercus laurifolia (Diamond-Leaf Oak)	x				x
Quercus lyrata (Overcup Oak)	x				x
Quercus nigra (Water Oak)	x				
Quercus prinus (Swamp-Chestnut Oak)					x
Quercus virginiana (Live Oak)	x				x
Celtis laevigata (Hackberry)					x
Ulmus americana var. *floridana* (Florida Elm)	x		x		x

Table V-1 (continued)

Plant Species	Natural Levees	Floodplain Forest	Rim Swamp Tupelo	Rim Swamp Cypress-Bay	Mesic Island
Morus rubra (Red Mulberry)	x				x
Magnolia grandiflora (Southern Magnolia)					x
Magnolia virginiana (Sweet Bay)				x	
Persea borbonia (Red Bay)				x	
Liquidambar styraciflua (Sweet Gum)	x				x
Platanus occidentalis (Sycamore)	x				
Cercis canadensis (Redbud)					x
Gleditsia aquatica (Water Locust)	x	x			
Ilex opaca var. *opaca* (American Holly)	x				x
Ilex vomitoria (Yaupon Holly)	x				x
Acer rubrum (Red Maple)	x	x	x	x	x
Tilia americana (Basswood)	x				x
Nyssa biflora (Swamp Tupelo)	x	x	x		
Cornus florida (Dogwood)					x
Cornus stricta (Stiffcornel Dogwood)	x		x		x
Vaccinium arboreum (Tree Sparkleberry)					x
Fraxinus pennsylvanica (Green Ash)	x	x	x		x
Cephalanthus occidentalis (Button Bush)			x		
Viburnum scabrellum (Black Haw)					x

3

Table V-1 (continued)

Plant Species	Natural Levees	Floodplain Forest	Rim Swamp Tupelo	Rim Swamp Cypress-Bay	Mesic Island
SHRUBS, HERBS & VINES					
Sabal minor (Bluestem Palmetto)	x				x
Rhus copallina (Winged Sumac)					x
Rhus radicans (Poison Ivy)	x	x	x	x	x
Vitis rotundifolia (Muscadine)	x	x			x
Similax bona-nox (Greenbrier)	x	x			x
Similax laurifolia (Greenbrier)					x
Similax walteri (Floodplain Greenbrier)			x	x	
Ampelopsis arborea (Peppervine)					x
Campsis radicans (Cow-Itch)		x			
Lonicera japonica (Honeysuckle)	x				
Parthenocissus quinquefolia (Virginia Creeper)	x	x			x
Mitchella repens (Partridge Berry)					x
Arundinaria gigantia (Wild Bamboo)	x				
Panicum sp. (Floodplain Panicgrass)	x	x			x
Crinum americanum (Swamp Lily)		x	x	x	
Callicarpa americana (American Beautybush)					x

species, with a few eastern hophornbeam and stiffcornel dogwood. Swamp lily (Crinum americanum) was the only ground plant observed. Table V-2 shows the density, relative dominance, and importance values for the major components of the floodplain forest.

The tupelo rim swamp contains most of the same species as the floodplain forest. Dominant vegetation of the rim swamp and the floodplain forest are compared in relative abundance in Table V-2. Swamp tupelo, important in both systems, is the primary canopy species in the rim swamp. Cypress and ash are also important.

The mesic islands support many of the same species as the natural levees. The major difference is a heavier shrub and ground cover in the mesic islands. The important canopy species are water oak and diamond-leaf oak. Southern magnolia (Magnolia grandifolia), sweet gum, overcup oak, and red maple are also common. The dominant understory tree is blue-beech, 3
followed by American holly and eastern hophornbeam. Tree sparkleberry (Vaccinium arboreum) and American beautybush (Callicarpa americana) are common shrubs. Small catbriars and partridge berry (Mitchella repens) dominate the ground cover with moderate populations. The density, relative dominance, and importance values on the mesic islands are tabulated in Table V-2. Both the levee and the mesic islands are more diverse than the swamp forests because they are drier and contain both swamp and upland vegetation.

The vegetation associations are typical of Southern United States hardwood swamps (Monk, 1965). Frequency and duration of flooding determines the canopy forms. The floodplain forest receives annual flooding in the spring, and water stands for long periods of time in the rim swamp. The

TABLE V-2

IMPORTANCE VALUES OF DOMINANT VEGETATION IN THE FLOODPLAIN: ON THE NATURAL LEVEES, FLOODPLAIN FOREST, TUPELO RIM SWAMP, AND FLOODPLAIN MESIC ISLANDS

Plant Species	Relative Density (%)	Relative Dominance (%)	Relative Frequency (%)	Importance Value
Natural Levees				
Natural Levees too narrow for meaningful evaluation				
Floodplain Forest				
Swamp Tupelo	20	57	25	102
Green Ash	56	17	25	98
Red Maple	20	23	25	68
Eastern Hophornbeam	4	3	25	32
TOTAL	100	100	100	300
Tupelo Rim Swamp				
Swamp Tupelo	65	75	16.7	156.7
Bald Cypress	13	6	16.7	35.7
Green Ash	11	7	16.7	34.7
Red Maple	7	9	16.7	32.7
Florida Elm	2	3	16.7	21.7
Eastern Hophornbeam	2	<1	16.7	18.7
TOTAL	100	100	100.2	300.2
Floodplain Mesic Islands				
Blue-beech	49	33	12.5	94.5
Water Oak	10	22	6.25	38.25
Diamond-leaf Oak	8	16	12.5	36.5
American Holly	10	3	12.5	25.5
Southern Magnolia	2.5	11	6.25	19.75
Sweet Gum	5	1	12.5	18.5
Overcup Oak	2.5	7	6.25	15.75
Eastern Hophornbeam	2.5	4	6.25	12.75
Red Maple	2.5	2	6.25	10.75
Tree Sparkleberry	2.5	1	6.25	9.75
Green Ash	2.5	<1	6.25	8.75
Swamp Tupelo	2.5	<1	6.25	8.75
TOTAL	99.5	100	100	299.50

mesic islands and levees are inundated for shorter periods which allow upland vegetation to develop. No endangered species were found.

Terrestrial Vertebrates. Birds, represented mainly by warblers and wading birds, were the only terrestrial group of migratory vertebrates on the site. All species observed are common throughout Florida. There were no sightings of any species listed in the United States List of Endangered Fauna (Fish and Wildlife Service, 1974). However, the Snowy Egret, listed by the Florida Game and Freshwater Fish Commission (1974) as a "species of special concern," was observed at the river's edge. This Egret is declining in number due to loss of habitat and competition from other species. However, construction and operation of the proposed plant will not affect this species.

Vertebrates encountered in this study are listed in Table V-3. The taxa not already described in Section 2.7 of the Site Certification Application are characterized in Table V-4. 3

Corridor Selection

A corridor approximately 100 feet wide is proposed between the river and the plant site. The maintenance road through the floodplain will be at an approximate elevation of 60 feet (MSL), and will probably be a causeway across the low areas with appropriate culverts and/or trestles.

The locations of the three alternative corridors are presented in Figure V-1. These are the routes through the floodplain from the three alternative water intake sites on the river. A common corridor passes through the uplands to the plant site. The vegetation associations encountered between the river and the plant site are natural levees, floodplain forest, rim swamp, and mesic islands in the floodplain; and mesic forest and pasture land in the upland.

TABLE V-3

VERTEBRATES, OR THEIR SIGN, OBSERVED DURING CORRIDOR SITING STUDIES

AMPHIBIANS	
Cricket Frog	Acris gryllus
Green Tree Frog	Hyla cinerea
Southern Toad	Bufo terrestris
Southern Leopard Frog	Rana sphenocephala
Marbled Salamander	Ambystoma opacum
REPTILES	
Six-lined Racerunner	Cnemidophorus sexlineatus
Five-lined Skink	Eumeces inexpectatus
Ground Skink	Lygosoma laterale
Anole Lizard	Anolis carolinenis
Brown Water Snake	Natrix taxispilota
Southern Ringneck Snake	Diadophis p. punctatus
Black Racer	Coluber constrictor
BIRDS	
Wood Duck	Aix sponsa
Black Vulture	Coragyps atratus
Red-tailed Hawk	Buteo jamaicensis
Snowy Egret	Leucophoyx thula
Little Blue Heron	Florida caerulea
Green Heron	Butorides virescens
Ruby-throated Hummingbird	Archilochus colubris
Belted Kingfisher	Megaceryle alcyon
Pileated Woodpecker	Campephilus principalis
Red-bellied Woodpecker	Centurus carolinus
Tree Swallow	Iridoprocne bicolor
Blue Jay	Cyanocitta cristata
Fish Crow	Corvus ossifragus
Mockingbird	Mimus polyglottos
Blue-gray Gnatcatcher	Polioptila caerulea
Loggerhead Shrike	Lanius ludovicianus
Black-and-White Warbler	Mniotilta varia
Prothonotary Warbler	Protonotaria citrea
Northern Parula Warbler	Parula americana
Red-winged Blackbird	Agelaius phoeniceus
Cardinal	Richmondena cardinalis
MAMMALS	
Armadillo (diggings and tracks)	Dasypus novemcintus
Racoon (skull, tracks & feces)	Procyon lotor

3

TABLE V-3 (Continued)

MAMMALS (Continued)

Opossum (tracks)	Didelphis marsupialis
White-tailed Deer	Odocoileus virginianus
Rabbit (feces)	Sylvilagus sp.

3

TABLE V-4

DESCRIPTION OF SELECTED FLOODPLAIN VERTEBRATES

Birds

The Red-tailed Hawk (Buteo jamscensis)

Two of these birds were observed during the survey. The best field identification marks of this common buteo are the dark belly band and uniformly colored tail, reddish above and light pink below. This predator feeds mostly on rodents, but will consume other mammals, birds, reptiles, or amphibians. It will also feed upon insects and other invertebrates, and has been known to eat carrion. Its major enemies are man and other hawks. It is found throughout the United States, nesting in forests and feeding in open country.

The Snowy Egret (Leucophoyx thula)

One specimen was observed at the river's edge on a sandbar. Its plumage is snowy white; its bill is black with bare yellow skin at the base, and it has black legs and yellow feet. Normally a wading bird inhabiting fresh and salt water marshes, its principal food is shrimp, crayfish, and other crustaceans. It also feeds on other small aquatic animals, mainly fish, insects, frogs, large seeds of various plants, and small snakes. It is a year-round resident throughout most of Florida. It is found from the mid-Atlantic coastal states to Texas and west to Northern California. Once heavily decimated by plume-hunters, it is now common, although there is growing concern over possible competition for nesting areas with the introduced Cattle Egret (Bibulcas ibis). 3

The Green Heron (Butorides virescens)

This heron is common in both fresh and salt waters and is found in small ponds and wooded streams. Several were observed in willows and small trees along the river's edge. It has a blueish-green body, dark reddish-brown neck and head, yellow (immature) or bright orange legs and feet, and a short black crest. It is a year-round resident of Florida. E. A. Chapin (according to Howell, 1932) analyzed 202 stomachs of this species and found their contents to be comprised of 40 percent fish, 24 percent crustaceans (mostly prawns and crayfish), 27 percent insects, and a few spiders and snails. Like other wading birds, it has few enemies other than man. Vultures and crows will eat the eggs and young of unoccupied nests.

The Ruby-throated Hummingbird (Archilochus colubris)

Except for the rare Rufous Hummingbird, this species is Florida's only hummingbird. This tiny bird is green on the back and on the top of its head, and has dull white underparts.

TABLE V-4 (Continued)

The male has a bright red throat. Feeding on the nectar of trumpet-like blossoms and tiny insects and spiders trapped within, it is found in hammocks and wooded floodplain ecotones. It is also found in disturbed places and around houses where honeysuckle and cow-itch are common. It is common throughout the Eastern United States.

The Belted Kingfisher (*Megaceryle alcyon*)

This Kingfisher is common throughout the United States, but is the only species found north of Texas and Arizona. It has a large head and beak, and short legs. It is grayish blue and white. Kingfishers are most commonly seen perched on transmission lines or trees over water, from which they dive for small fish. They also feed on crayfish, frogs, insects, and berries.

The Tree Swallow (*Iridoprocne bicolor*)

This avian is found seasonally throughout North America south of the Arctic Circle. They feed by swooping and diving for small aerial insects over clear areas, such as open water, fields, prairies, and highways. Beal (1918) reported their diet was 80 percent animal matter, half of this being flies (Diptera). Most of their vegetable diet was the fruit of bayberry (*Myrica* spp.), although they also ate seeds of red cedar, dogwood, and 3
Virginia Creeper.

The Fish Crow (*Corvus ossifragus*)

A bird of the Gulf-Atlantic Coastal Plain, preferring coastal waters and larger rivers, it is often found inland with the Common Crow over large lakes and wet prairies. Being solid black and only slightly smaller than the Common Crow, it is best distinguished in the field by its call, a short nasal "car" rather than the familiar "caw" of the Common Crow. This species feeds on plants and animals, usually fish, small crabs, shrimp, crayfish, molluscs, and the fruits of pokeberry, mulberry, hackberry, huckleberry, grapes, swamp tupelo, palmetto, magnolia, sweetbay, redbay, hollies, dogwood, and pawpaw. Like the Common Crow, it will eat unattended eggs and young of other birds.

The Blue-gray Gnatchatcher (*Polioptila caerulea*)

This bird is an inhabitant of aquatic areas where woody vegetation overhangs the water. Its diet consists almost wholly of insects, including flies, grasshoppers, and other defoliating insects, ants, termites, wood-boring beetles, weevils, and spiders. This small bird (length = 4 in.) is recognized by its blue-gray back, light underparts and white eye ring. It is a permanent resident in the coastal plain from Maryland to Texas, and west to Southern California.

The Black-and-White Warbler (*Mniotilta varia*)

Common in deciduous woods, several of these warblers were seen in the floodplain forest. It can be distinguished by its black and white

TABLE V-4 (Continued)

plumage, with a central white streak through the crown. It nests on the ground. It is almost entirely insectivorous, preferring wood borers, various moths, beetles, and caterpilars. It is found seasonally throughout the eastern United States and Canada south of the Arctic Circle. It is a permanent resident of Florida.

The Prothonotary Warbler (<u>Protonotaria citrea</u>)

Common along wooded swamps, rivers, streams, and their floodplains, it has a golden head and plain blue-gray wings in all plumages. It is a summer resident throughout the eastern United States south of New England and northern portions of the Great Lake States. It nests in tree cavities low over the water. It feeds almost entirely on small insects such as ants, beetles, and mayflies, and on other small invertebrates such as spiders.

The Northern Parula Warbler (<u>Parula americana</u>)

Common in summertime in mature deciduous and coniferous forests throughout the eastern United States and southern Canada, especially in river floodplains of the Southeast, it is the only eastern warbler with a blue back and yellow throat. It prefers the use of Spanish moss as nest 3
material. Various insects and invertebrates are utilized as food for this species.

The Red-winged Blackbird (<u>Agelaius phoeniceus</u>)

Abundant in marshes and fields, this species reaches pest proportions in some agricultural areas. Females and immatures are dull brownish-black. Males are solid black with a red and yellow shoulder patch. They feed, fly, and roost in large flocks. They are found throughout the eastern United States and Canada south of the Arctic Circle.

Reptiles and Amphibians

The Marbled Salamander (<u>Amystoma opacum</u>)

This salamander ranges from New England to northern Florida and west to eastern Texas. This chunky salamander occurs in a variety of habitats, from moist sandy areas to dry hillsides. The markings are dark brown (immature) to black in background, with variable light patches on the back and sides.

The Brown Water Snake (<u>Natrix taxispilota</u>)

Light to medium brown, with squares of a darker brown on its back and sides, its belly is yellow to brown and boldly marked with spots and half-moons of dark brown or black. As with other water snakes of this genus,

TABLE V-4 (Continued)

it is sometimes mistaken for the poisonous cottonmouth. It prefers quiet waters of large lakes, rivers, and swamps in the southern United States. It feeds primarily upon fish and frogs. Often arboreal, it may climb from overhanging branches to a height of 20 feet or more.

The Southern Ringneck Snake (*Diadophis p. punctatus*)

A delicate, small snake seldom over 14 inches in length, it is characterized by a dark brown to black ring around the back and sides of its neck, and a row of half-moon shaped spots down the center of its belly. Dorsal coloration is light brown to nearly black. Its underside is yellow to deep red, uniform or with red confined to tail and rear portion of its belly. Ringnecks are usually found in moist areas, near swamps, springs, mesic hillsides, and floodplains. Our specimen was captured on a wooded sandbar adjacent to the floodplain. It feeds on insects, earthworms, salamanders, and small frogs and reptiles. When alarmed, ringnecks of this and the prairie subspecies sometimes twist their tails upward in a tight spiral, thus exposing their bright colors to view. This habit has earned them the names of "corkscrew" and "thimble snakes," (Robbins, et al., 1966). Its range is from southern New Jersey to the Florida Keys; west to the Appalachins and to central Alabama. 3

There are no unique associations along any of the three corridors. Corridor 1 is the shortest route through the floodplain. Table V-5 summarizes the vegetation association removed by each of the corridors. Corridor 1 affects the fewest acres; it removes 3.8 acres of floodplain forest, 4.8 acres of mesic upland forest and 2.4 acres of pasture land.

As previously indicated (Chapter III), the recommended location for the water intake structure on the river is alternative site 1. It is fortuitous that corridor 1 is also the shortest route through the floodplain and affects the least area. Corridor 1 is selected as the best alternative and is recommended as the corridor route between the river and the plant site.

Corridor 1 is approximately 5000 feet long from its terminus on 3
the river to the plant site. A profile of elevations across the floodplain and low lying upland is presented in Figure V-3. This is Transect A-A' along corridor 1 as illustrated in Figure V-1. The length and elevation of each vegetation association is shown. These are approximate values; the transect was not surveyed.

As indicated in Chapter III on River Dynamics, water movement is expected to occur within the floodplain areas, particularly during times of flood flow of the river. Direction of movement is expected parallel, as well as perpendicular to river flow. Subsequently, the use of a solid, uninterrupted service corridor and road bed can be expected to inhibit interflow of water in the low areas north-south of the corridor.

While the results reported in Chapter III indicate the service road effect on blocking flood water flow is of little consequence, appropriately placed and sized culverts or trestles could be utilized in the principal low areas to avoid the possibility of adverse long term changes in the ecosystem.

TABLE V-5

ACREAGE OF HABITAT REMOVED IN
CONSTRUCTION OF THE 3 ALTERNATE CORRIDOR ROUTES

Vegetative Association	Corridor Route (1) 1	2 (Acres)	3	
Natural Levee	0.05	<0.05	<0.05	
Floodplain Forest	0.7	1.5	1.5	
Rim Swamp	3.0	2.7	2.8	3
Mesic Island	0.1	0	0	
Upland Mesic Forest	2.8	3.0	4.1	
Unnamed Creek Floodplain	0	0.2	0.2	
Upland Mesic Forest (2)	2.0	2.0	2.0	
Pasture (2)	2.4	2.4	2.4	
TOTAL	11.0	11.8	13.0	

(1) See Figure V-1.
(2) Mesic Forest and Pasture Removed by Portion of Route Common to All 3 Alternatives (see section 2.7, main certification report)

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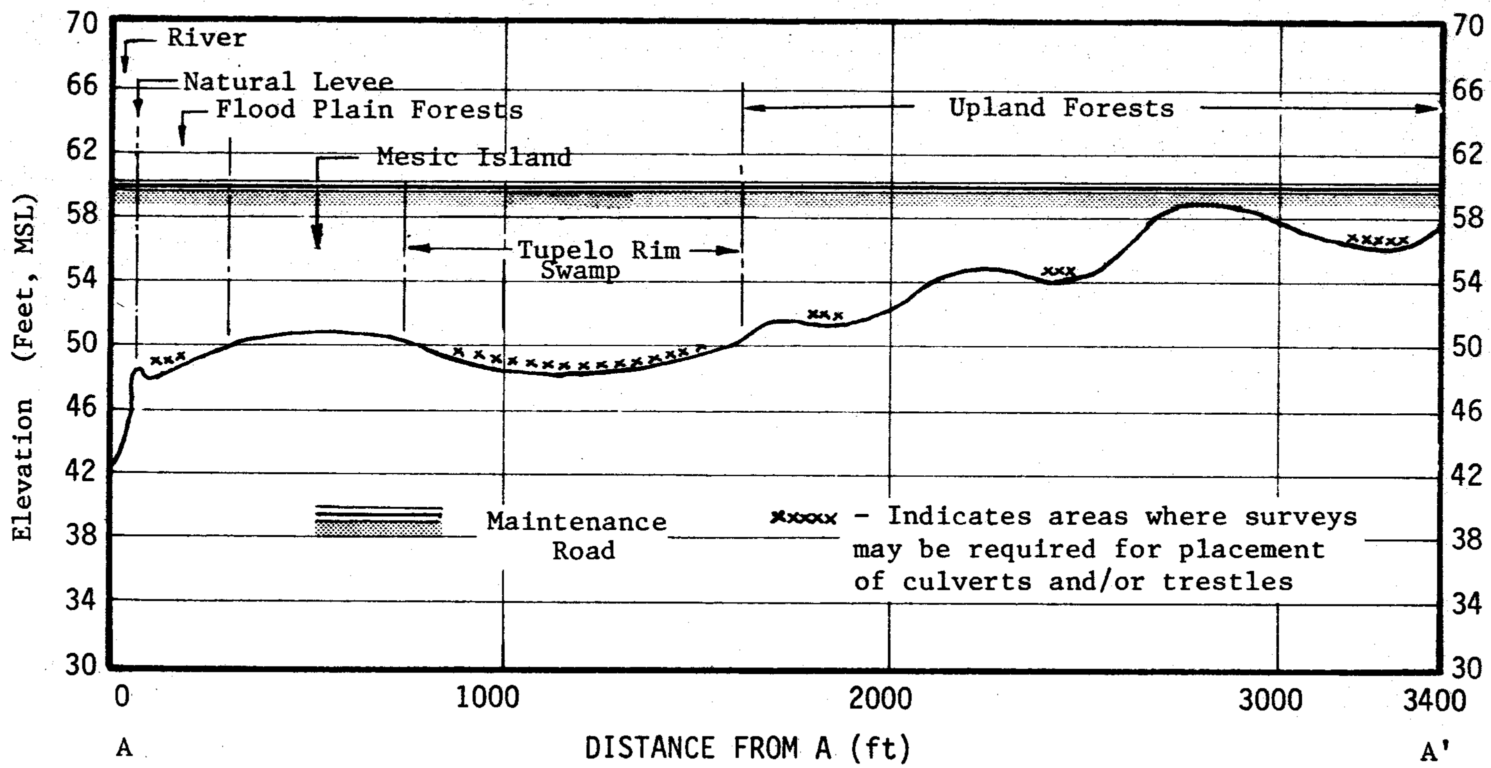

Figure V- 3 Estimated Profile of Transect of A-A' (Figure V-1) on the Recommended Corridor I Connecting the Upland Plant Site with the Choctawhatchee River at the Recommended Water Intake Site.

3

Predicted Effects of Construction and Operation of the Intake-Discharge Corridor

Construction of Corridor 1 will remove about 2.4 acres of pasture land and about 3.8 acres of floodplain forest and 4.8 acres of mesic upland forest. These represent 1-2 percent of the land in the immediate vicinity between the river and the plant site. This commitment of floodplain and forest resource is small, considering that there are 10-15 square miles (6400-9600 acres) of the floodplain and forests within a five mile radius of the plant site. There are no unique vegetative associations along Corridor 1. Some animal habitat will be temporarily destroyed and/or disrupted in the corridor during construction, but this is small compared to the total available habitat.

As indicated, while the maintenance road causeway at 60 feet MSL elevation will block the flow of flood waters, the effects of this service 3
corridor will be negligible to the effects already caused by the existing U. S. Highway 90 and the railroad bridges, which are approximately 3/5 of a mile south of the site. The backwater caused by the highway and the railroad bridge is about 2 to 3 feet, depending on the flood. Maximum blockage from the corridor would be complete cutoff of flood flow over the east bank. Flood flow would be directed back to the channel and west floodplain. This might cause an additional backwater of 1-2 inches. At a 60 foot (MSL) flood stage, approximately 12 percent of the flood is over the east bank (Chapter III). Floods greater than 60 foot (MSL) would overflow the causeway. It is unlikely that the corridor causeway would cause damage to the vegetative associations by holding back flood waters. There was no evidence of stress or change in the floodplain caused by blockage of flood waters by the existing bridges which have much larger causeways and have been in place for 23 years immediately downstream of

of the site. During the recent flood, the flow in the east bank floodplain was observed at <1 fps and at Site 1 was flowing southwesterly back into the river. During floods a causeway could increase the river velocity 0.25 fps; flow at the causeway end could reach 5-6 fps (Chapter III).

Attention to a few factors during corridor construction could minimize disruption of the ecosystems. Trees in the corridor, except under the road bed, should be cut, wherever possible, rather than uprooted. The root mat even though dead will hold soil and protect the corridor from erosion. Roots should be removed from under the road bed to avoid subsidence.

Normal water interchange should be maintained in the low areas. Appropriately placed trestles and/or culverts can be utilized in the causeway to allow water interchange north and south of the corridor.

When corridor 1 is surveyed in detail, standard engineering practices 3
will establish the proper size and placement of these structures.

Construction should be carried on during the driest time of the year. This will minimize the erosion of unstabilized shoulder fill, the spread of fill onto the forest floor, and turbid water run-off into the river. Causeway shoulders should be protected from erosion until natural vegetation has returned or until seeding of the banks has been effected. The impact of corridor construction will be minimal on the terrestrial and aquatic systems if precautions are taken to minimize erosion.

After the initial clearing and construction of the causeway, the lower portions of the corridor will revegetate rapidly with suckers and saplings from cut-over species originally present. Additionally, new species will invade in response to the increased availability of sunlight. New species in the lower, wetter areas of the floodplain may include cattail (*Typha* sp.), lizard's tail (*Saururus cernuus*), rushes (*Juncus* spp.),

primrose willow (Ludwigia sp.) and Carolina willow (Salix caroliniana). Additions to the drier areas will include wild mint (Mentha sp.), American beautybush (Callicarpa americana) and Shining sumac.

An ecotone will develop quickly on the forests' edge along the length of the corridor. This will consist of tree saplings, various shrubs such as hawthorn (Crataegus sp.), tree sparkleberry (Vaccinium arbacescens), and winged sumac (Rhus copallina), and several species of vines such as wild grapes (Vitis spp.), greenbrier (Similax spp.) and Virginia creeper (Parthenocissus quinquifolia). This ecotone will be very dense, and provide abundant cover for wildlife uses.

On the causeway itself, the vegetational associations will be sparse for the first few (3-5) years after construction, due to soil conditions. During this period a plant system with low diversity will become established 3
(these are known as ruderal, or pioneer species). These should include ironwood (Sida acuta), pokeberry (Phytolacea vigida), Natal grass (Rhynchelytrum roseum), and camphorweed (Heterotheca sp.). As soil conditions improve, these species will be replaced by tree saplings and shrubs associated with upland mesic and xeric associations.

The ground and shrub cover of these corridor associations will be more dense than at present, wildlife abundance and diversity can be expected to increase. This dense low cover will provide refuge, habitat, and food for many species not presently found in the surrounding forests.

In summary, the construction of corridor 1 will have minimal effects on the ecology of the floodplains, uplands, forests, and river. A small percentage of the habitat will be removed, but no unique or unusual

features will be damaged. The causeway through the floodplains will block some flood flow along the east bank, but the effects are expected to be negligible, particularly considering the effects already exerted by the existing structures of I-10, US 90 and the rail bridges. 3

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SECTION 1 OF APPENDIX E

The following pages contain appendix material to section 4.1, "Site Preparation and Plant Construction." 3

Amendment 3 9/75
Amendment 2 8/75

SOCIO-ECONOMIC STUDY FOR THE PROPOSED CARYVILLE STEAM PLANT

INTRODUCTION

Map 1 shows the panhandle of Florida. During construction and operation of the proposed Caryville fossil fuel plant, Washington and Holmes counties will be the areas where the man-made environment will receive the greatest effect. Therefore, this report focuses on these counties, presenting concise information on existing conditions and impacts of plant construction and operation on the man-made environment.

1.0 EXISTING CONDITIONS FOR HOLMES AND WASHINGTON COUNTIES

1.1 DEMOGRAPHY

The State of Florida has experienced unparalleled growth in the past decade. In virtually every index used to measure change -- population, employment, income, retail sales, construction, and bank receipts, growth has been evident. Unlike the state as a whole, the panhandle of Florida has been slow to gather growth momentum. The area has been regarded as the last development frontier 3
in Florida. For some parts of the panhandle, particularly the coastal areas, a strong development trend is currently in effect. Yet, in other panhandle areas, including Washington and Holmes counties, growth rates remain slow in relation to developable land. It is anticipated that the entire panhandle, the area served by Gulf Power, will grow at an increasing rate. Subareas of the panhandle will expand in relation to their proximity to the Gulf of Mexico and to nearby major urban centers.

The proposed Caryville fossil fuel plant will be located in both Washington and Holmes counties (Map 2). Construction and operation of the plant will have an effect on the demography of the surrounding area. The effects can be discerned by examining existing and projected demographic data in the Washington/Holmes two-county area. Selected information has been obtained from data available in existing plans and programs, census materials, and from interviews with

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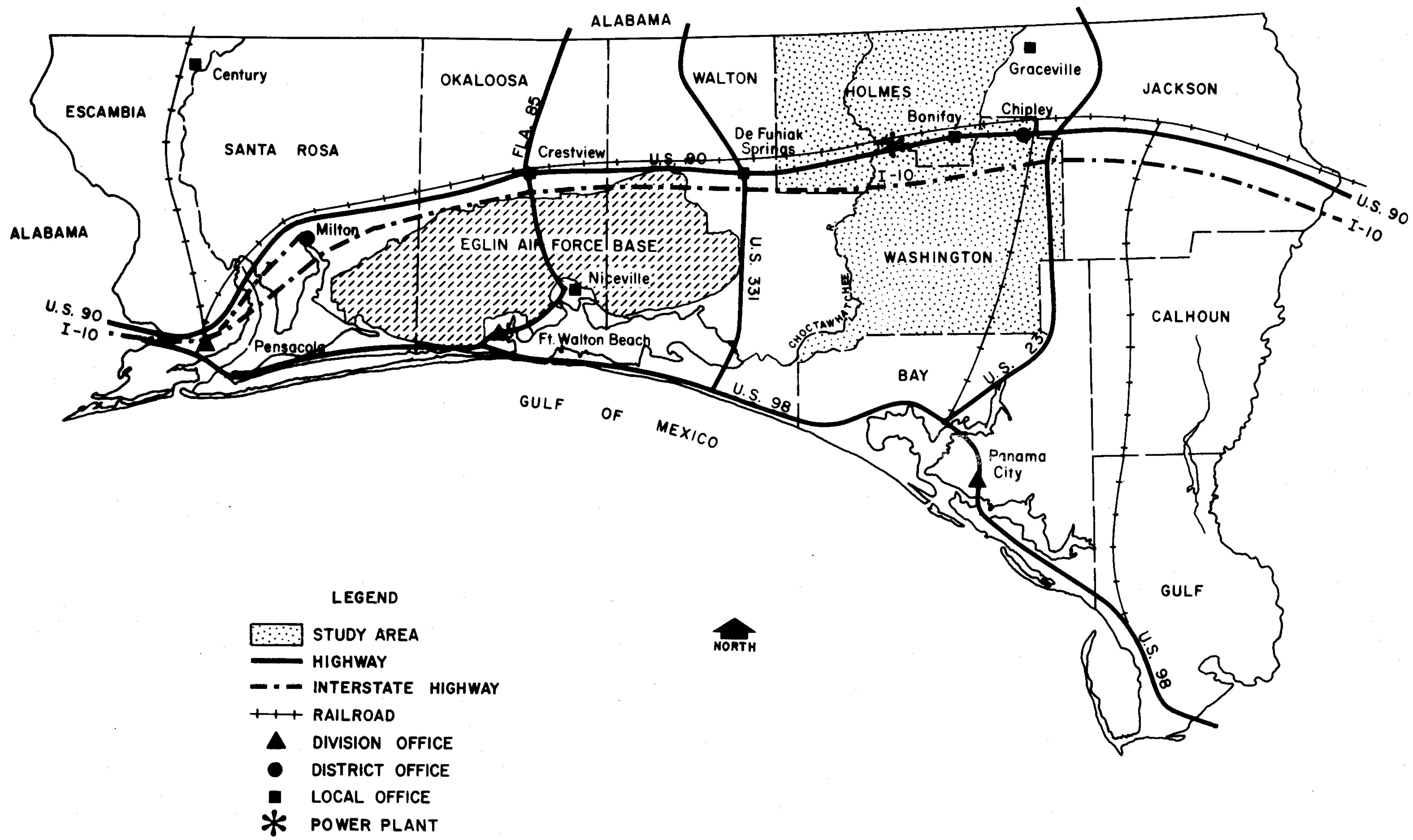


JULY, 1975
ERIC HILL ASSOCIATES, INC.

MAP 1

REGIONAL FEATURES MAP

3

local officials.

1.1.1 Population Growth

For the two-county area, population was virtually unchanged for the 1960-70 decade; Holmes County lost 124 people and Washington County gained 204 people. 3

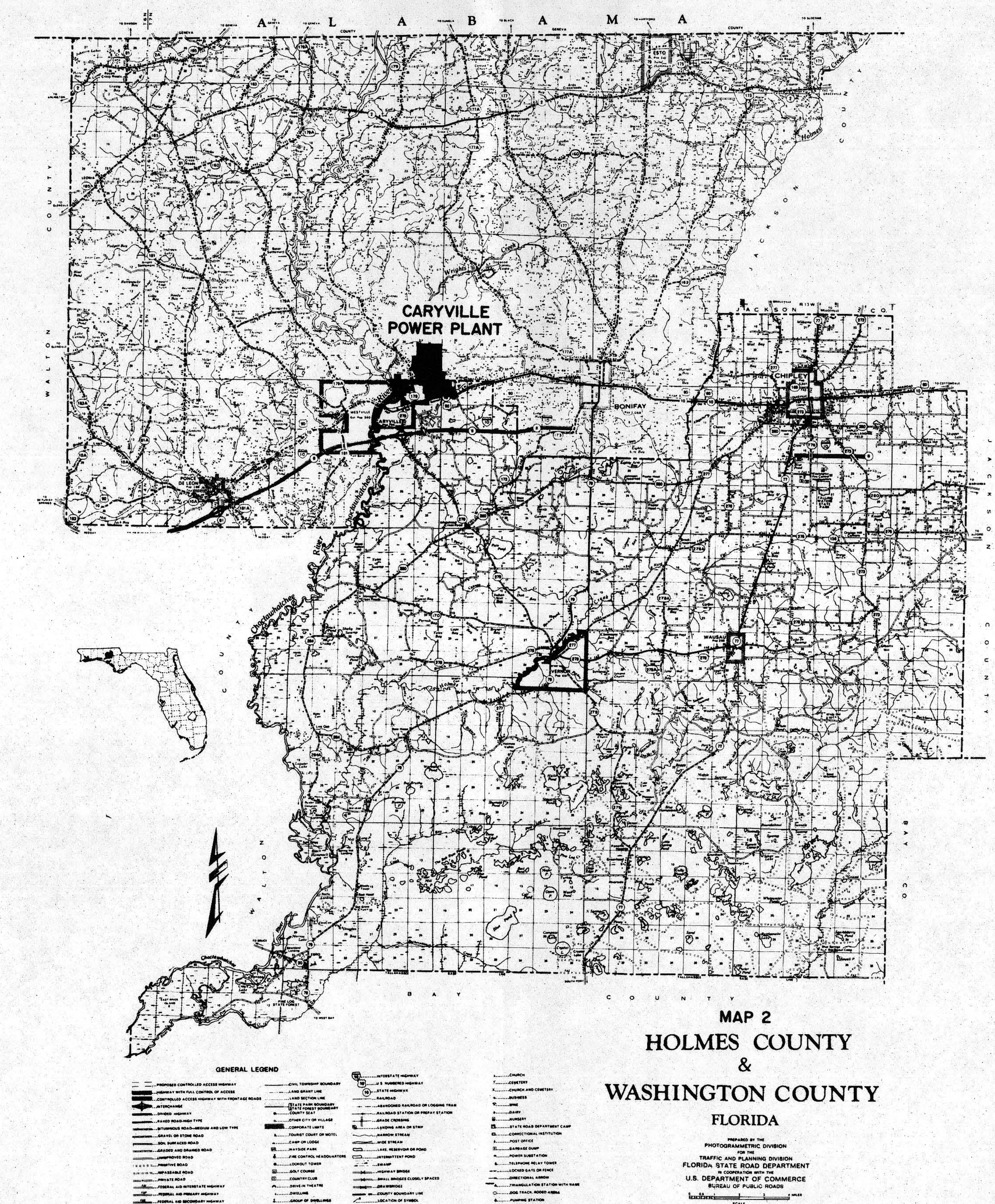
Table 1.1 below shows population trends for the two counties and their sub-areas.

As shown on Map 2, there are eight incorporated areas located within the two counties, ranging in size from 3,347 people (Chipley) to 125 people (Ebro), according to 1970 Census of Population. Bonifay and Chipley, the county seats of Holmes and Washington counties respectively, have the largest concentrations of population within the counties.

Table 1.1
POPULATION TRENDS, 1960-1970
HOLMES AND WASHINGTON COUNTIES

	1960	1970	1960-1970 Change No.	1960-1970 Change Per Cent
Holmes County				
Bonifay	2,222	2,068	- 154	- 6.9
Esto	148	210	62	41.9
Ponce de Leon	---	288	288	---
Unincorporated area	8,474	8,154	- 320	- 3.8
Total	10,844	10,720	- 124	- 1.1
Washington County				
Caryville	730	724	- 6	- 0.8
Chipley	3,159	3,347	188	6.0
Ebro	---	125	125	---
Vernon	624	691	67	10.7
Wausau	---	288	288	---
Unincorporated area	6,736	6,278	- 458	- 6.8
Total	11,249	11,453	204	1.8
TOTAL TWO-COUNTY AREA	22,093	22,173	80	0.4

Source: U.S. Bureau of Census, Census of Population 1970, Number of Inhabitants, Final Report PC(1)-A11, Florida, Table 10, pp. 22 and 26.



MAP 2

HOLMES COUNTY & WASHINGTON COUNTY FLORIDA

PREPARED BY THE
PHOTOGRAMMETRIC DIVISION
FOR THE
TRAFFIC AND PLANNING DIVISION
FLORIDA STATE ROAD DEPARTMENT
IN COOPERATION WITH THE
U.S. DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

SCALE

JANUARY, 1965

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Projected population for the two counties (Table 1-2) shows that Holmes County will increase by 2,400 people from 1975 to 2000, and Washington County will increase by 10,400 people. The total increase represents a 46.9 per cent increase over estimated 1975 population. Clearly, dramatic increases in population are not expected to occur.

Table 1-2

PROJECTED POPULATION, 1975-2000
HOLMES AND WASHINGTON COUNTIES

	1975	1980	1985	1990	2000
Holmes	12,000	12,500	13,100	13,800	14,400
Washington	13,600	15,800	17,700	19,500	23,200
Total	25,600	28,300	30,800	33,300	37,600

Source: 1973 Florida Statistical Abstract, edited by Ralph B. Thompson, Table 2.242, p. 25.

1.1.2 Population Characteristics

Population characteristics examined in this section consist of age distribution, racial composition, educational attainment, income distribution, and employment, each of which is discussed below. The provision of adequate community services, facilities, and housing is contingent on understanding these factors and planning facilities and services in response to them.

Age Distribution - Age distribution enables one to understand the relative importance (in terms of numbers) of various segments of the population, such as the numbers of school age children and the elderly (over 65). As found in the 1970 Census, the school age population (6 to 18 years old) for the two counties totalled 5,726 people. Although in numbers, Washington County has more people within school age, as a per cent of the total school age population, the two counties do not differ significantly.

Similarly, the number of elderly (65 and over) is the same for the two counties. Holmes county in 1970 had 1,549 elderly while Washington County had 1,506 elderly.*

Racial Composition - Racial composition varies considerably between Washington and Holmes counties. According to 1970 Census of Population data, blacks constitute a small proportion of the population in Holmes County (3.2 per cent), whereas in Washington County, they are over 20 per cent of the total population. Between 1960 and 1970, Holmes County lost 110 blacks while Washington gained 133 black people. The Vernon division experienced the largest gain (Table 1-3).

Table 1-3

NON-WHITE POPULATION TRENDS, 1960-1970
HOLMES AND WASHINGTON COUNTIES

	Population		Change 1960-70	
	1960	1970	Number	Per Cent
Holmes County				
Bonifay division	360	264	- 96	- 26.7
Esto-Noma division	57	42	- 15	- 26.3
Holmes West division	35	36	1	2.8
Total	452	342	-110	- 24.3
Washington County				
Chipley division	949	1,001	52	5.5
Caryville division	363	324	- 39	- 10.7
Vernon division	863	983	120	13.9
Total	2,175	2,308	133	6.1

3

Sources: U.S. Bureau of Census, Census of Population: 1970, General Population Characteristics, Final Report PC(1)-B-11, Florida, Table 33, pp. 151 and 153; and Census of Population: 1960, Table 25, pp. 79 and 82.

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*Population age groups aggregated from 1970 Census report, General Population Characteristics, pp. 163 and 173.

According to school enrollment data, black children represented 11.1 per cent of the total children enrolled in Washington County in 1975.*

Educational Attainment - For the State of Florida as a whole, the median school years completed for persons 25 years of age and over was 12.1 years, according to 1970 census statistics. In the Florida panhandle, however, educational attainment was generally much lower. In fact, Holmes and Washington counties were among the lowest ranked counties in the state in this regard with median school years completed of 8.9 years and 9.1 years respectively.

Table 1-4 gives census information on educational level reached by persons 25 years old and older for the two counties.

Table 1-4

YEARS OF SCHOOL COMPLETED FOR PERSONS 25 YEARS OLD AND OLDER, BY EDUCATIONAL LEVEL, BY SEX, 1970

	Holmes County, Persons 25 years old and over		Washington County, Persons 25 years old and over	
	Male	Female	Male	Female
No School Years Completed	72	141	68	68
Elementary (1-8) Completed	1,519	1,489	1,555	1,545
High School (9-12) Completed	1,222	1,417	1,104	1,427
College, 4 years or more	193	235	296	307
Total	3,006	3,282	3,023	3,347
Median School Years Completed	8.8	9.0	8.8	9.3
Per Cent High School Graduates	29.8	27.2	33.8	30.5

Source: U.S. Bureau of Census, Census of Population: 1970 General Social and Economic Characteristics, Florida, PC(1)-C-11, Table 120, p. 481-486.

*Blacks enrolled not reported for Holmes County.

2.2.1.b.(4) School Enrollment - The 1971-72 school enrollment is shown in Table 1-5. This table accounts for these students attending public school. As reported in the 1970 Census, 18 students in both counties were enrolled in private schools.

Table 1-5

SCHOOL ENROLLMENT FOR PUBLIC SCHOOLS*, 1971-1972

	Holmes	Washington	Total
Nursery**	---	12	12
Kindergarten	222	236	458
Elementary (1-6 grades)	1,601	1,731	3,332
High School (7-12 grades)	1,533	1,473	3,006
College	202	87	289
Total	3,558	3,539	7,097

*Includes those enrolled who are 3 to 34 years of age. 3

**U.S. Bureau of Census, Census of Population: 1970, General Social and Economic Characteristics, Table 120, p. 183 and 186.

Source: Florida Statistical Abstract, 1973, Table 4.142, pp. 111-114.

2.2.1.b.(5) Income Distribution - Both Washington and Holmes counties are relatively poor counties. This observation may be confirmed by examining the data on income distribution of families (Table 1-6). Over 50 percent of the families in both counties made less than $5,000 annually in 1969. Per capita income from Holmes Couty in 1971 was reported to be $2,328 and for Washington County, it was $2,225. For the state, per capita income in 1971 was $3,930; Holmes and Washington counties fell 40 percent and 43 percent below the state average, respectively.

Employment - The employment picture reflects income distribution. As shown in Chart 1, almost 65 percent of the total number of jobs in Holmes County are in manufacturing or retail trade. In Washington County, jobs are primarily in the manufacturing, contract construction, and retail trade sectors.

Table 1.6

FAMILY INCOME DISTRIBUTION TRENDS, 1959-1969

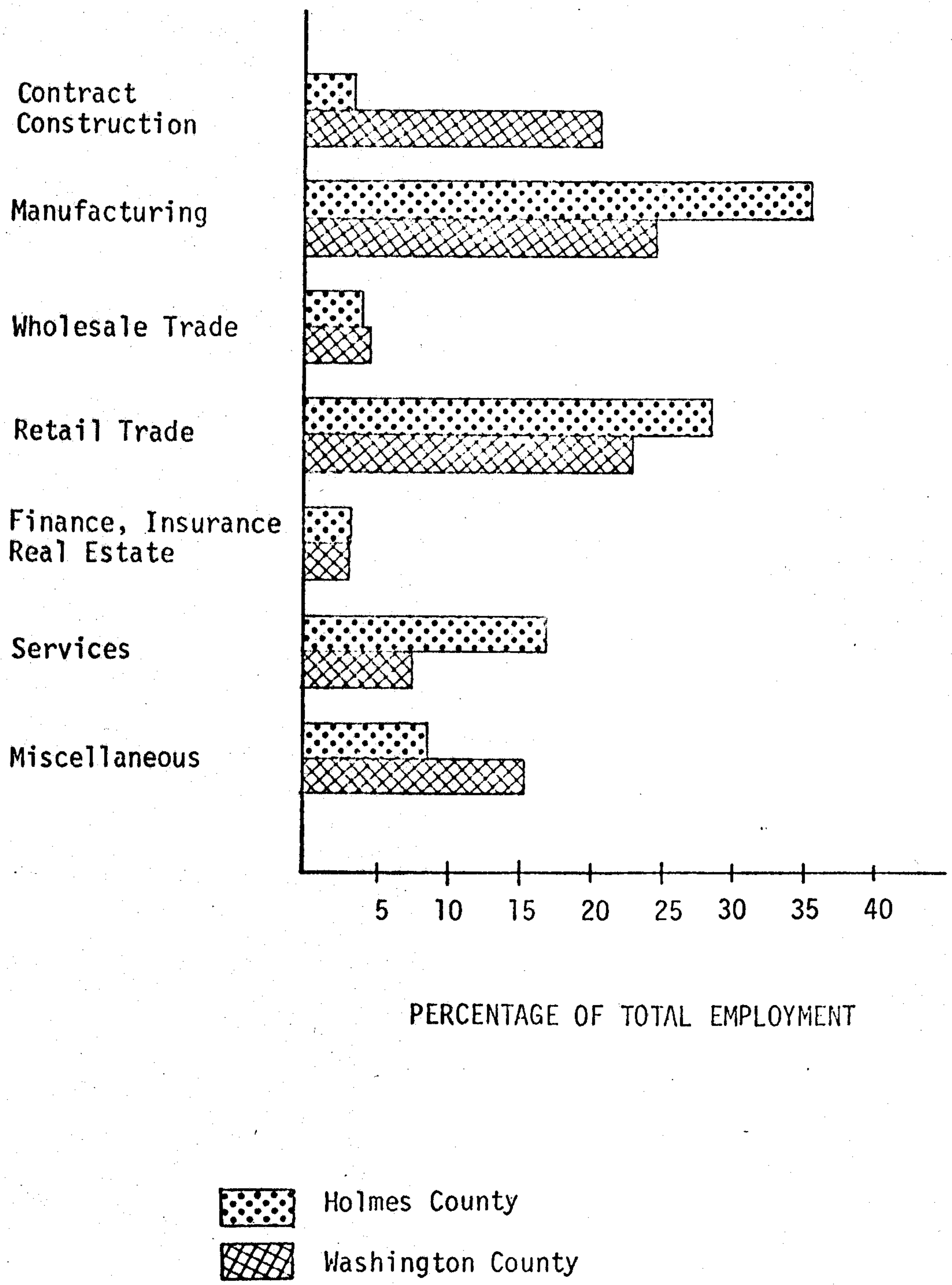
HOLMES AND WASHINGTON COUNTIES

	Holmes				Washington				1959-69 Change				
	1959		1969		1959		1969		Holmes		Washington		
	No.	% of Total	No.	% of Total	No.	% of Total	No.	% of Total.	No.	% of Change	No.	% of Change	
Under $3,000	1,891	66.4	961	32.4	1,520	55.4	969	32.0	- 930	- 49.2	- 551	- 36.2	
$3,000 - $4,999	548	19.2	588	19.8	668	24.4	620	20.4	40	7.3	- 48	- 7.2	3
$5,000 - $6,999	253	8.9	535	18.0	281	10.2	475	15.7	282	111.5	194	69.0	
$7,000 - $9,999	84	2.9	467	15.8	200	7.3	437	14.4	383	456.0	237	118.5	
Over $10,000	70	2.6	414	14.0	73	2.7	530	17.5	344	491.4	457	626.0	
Total	2,846	100.0	2,965	100.0	2,742	100.0	3,031	100.0					

Source: U.S. Bureau of Census, Census of Population: 1970 General, Social, and Economic Characteristics, Florida, PC(1)-C-11, Table 124, p. 510.

Chart 1

PROPORTION OF EMPLOYMENT IN INDUSTRIAL SECTORS,
HOLMES AND WASHINGTON COUNTIES, 1970



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Source: County Business Patterns, 1972, Table 2, pp. 72 and 125.

Note: This information is based on place of work, not place of residence.

Table 1-7 summarizes the characteristics of the civilian labor force in the two counties. Since 1960, there have been 1,530 workers added to Holmes County's labor force and 1,205 added to Washington County's. Holmes County's unemployment rate was 3.9 per cent and the unemployment rate for Washington County was almost twice as large as for Holmes County. Projections to the year 1990 of the civilian labor force were made in March, 1975, by the Northwest Florida Planning and Advisory Council. The Council estimated the two counties will gain approximately 170 employees per year between 1980 and 1990 (Table 1-8).

Table 1-7

CIVILIAN LABOR FORCE, WASHINGTON AND HOLMES COUNTIES, 1960-1974

	1960			1974		
	Civilian Labor Force	Employed	Per Cent Unemployed	Civilian Labor Force	Employed	Per Cent Unemployed
Holmes	3,108	2,916	6.2%	4,640	4,460	3.9%
Washington	3,195	3,026	5.3%	4,400	4,080	7.1
Total	6,303	5,942		9,040	8,540	

Source: U.S. Bureau of Census, Census of Population: 1960, General Social and Economic Characteristics, pp. 232-237. State of Florida, Department of Commerce, Division of Employment Security, Research and Statistics (March, 1974 figures), FDC Form 12AS-33A, Basic Labor Market Information By County.

Table 1-8

CIVILIAN LABOR FORCE PROJECTIONS, 1980-1990

County	1980	1985	1990
Holmes	4,000	4,500	5,000
Washington	5,000	5,300	5,700
Total	9,000	9,800	10,700

Source: Northwest Florida Planning and Advisory Council, March, 1975, as published in Population and Economic Analysis.

1.2 ECONOMICS

The purpose of this section is to present a general review of the economy of Holmes and Washington counties and to discuss probable future trends. This section begins with a discussion of employment, construction activity, and retail sales. Because of its importance, housing construction and problems related to housing quality and supply are discussed separately.

1.2.1 Employment

Historically, agriculture has been a major economic activity in terms of employment in Holmes and Washington counties. As is true throughout the Northwest Florida region, in the last decade, the number of farms has been decreasing while the average farm size has increased. Both counties have more livestock farms than other types. Typical crop farms are corn, peanuts, cotton, and soybeans. Poletimber, sawtimber, saplings, and seedlings make up the majority of the acreage in commercial forest land in the two counties. In 1969, over $100,000 in forestry products was sold in Holmes County and over $50,000 was sold in Washington County. 3

For nonagricultural industries, manufacturing, retail trade, and construction, respectively, had the largest numbers of employees.* Table 1-9 presents a summary of employment, by industry group and sex, for 1970, for the two counties. Labor force trends and employment patterns have changed significantly from 1960. As reported in Research and Analysis reports for both counties, 1970 employment, as a percentage of total 1970 population, has increased over the 1960 ratio. Similarly, 1970 employment, as a percentage of the working age and as a percentage of regional employment, has increased over 1960 ratios. Another important characteristic shows that females in both counties have increased as a percentage of the labor force. Major manufacturers of both counties reported that a large percentage of their employment is female. In Holmes County, for example, 50 per cent of the total employment of major manufacturers is female and in Washington County 30 per cent.

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*Industrial Development Analysis, Northwest Florida Development Council, p. 27.

In general, Holmes and Washington counties are predominantly rural, agricultural counties whose major manufacturers produce wearing apparel.

Table 1-9

1970 EMPLOYMENT BY INDUSTRY GROUP AND SEX

HOLMES AND WASHINGTON COUNTIES

	Male	Female	Total
Agriculture, Forestry, Fisheries, Mining	806	92	898
Construction	910	14	924
Manufacturing	717	537	1,254
Transportation, Commerce, Public Utilities	404	106	510
Wholesale Trade	119	27	146
Retail Trade	584	447	1,031
Finance, Insurance, Real Estate	89	68	157
Business, Repairs	90	6	96
Personal Services, Entertainment	112	318	430
Professional and Related	304	681	985
Public Administration	368	90	458
Total Employed	4,503	2,386	6,889

Source: U.S. Bureau of the Census, Census of Population: 1970, General Social, and Economic Characteristics, Final Report, PC(1)-C11, Florida, Table 123, pp. 501 and 504.

1.2.2 Construction Activity

Construction plays a significant employment role in both counties. According to the 1970 Census of Population, General Social and Economic Characteristics, in 1970, Holmes County had 396 persons employed in construction activities whereas Washington County had 528 persons so employed. This represents an increase over the 1960 construction employment for Holmes County and a slight loss

for Washington County. However, overall the two counties construction employment total increased by 44 employees between 1960 and 1970. The <u>Housing Study</u> for Holmes County suggests that a significant percentage of the recent construction activity may have been to improve the housing stock. The <u>Plan and Implementation</u> for Holmes County states:

> ...since 1970 the county has been averaging approximately 150 new single-family housing starts per year, with 52 units in the "under $10,000" category, 60 in the $10,000-$15,000 category, 30 in the $15,000-$20,000 category, and 8 in the "over $20,000" category.

Building permits are not issued in Washington County and no construction activity figures were reported for Holmes County in 1967.

1.2.3 Retail Sales

In the recent past, retail sales for both of the counties have increased significantly. From 1967 to 1972, Holmes County's retail sales increased over 120 per cent, and Washington County's retail sales increased over 94 per cent. Future retail sales have been projected by the Northwest Florida Planning 3
Advisory Council. Table 1-10 shows that Holmes County retail sales are expected to increase an average of $6.3 million during each five-year period, while Washington County's retail sales will increase $6.5 million between 1975-1980, $8. million between 1980-1985, and 10.5 million between 1985-1990. Holmes County's retail sales will more than double by 1990 and Washington County's sales will increase 4.5 times the 1975 amount.

1.2.4 Taxable Sales

Taxable sales have been examined for the five westernmost counties in the Florida Panhandle. As shown in Table 1-11, Holmes and Washington counties had by far the lowest taxable sales of those five counties. However, this does not tell the whole story. Taxable sales per account vary considerably within the region; the largest taxable sales per account are in Bay and Jackson counties. Bay County taxable sales are undoubtedly bolstered by the presence of Panama City and the Gulf Coast development. Jackson County has a large number of small cities within its boundaries, and their business districts would tend to attract nonretail sales.

Table 1-10

RETAIL SALES PROJECTIONS, 1975-1990

(million $)

County	1975	1980	1985	1990
Holmes	15.6	21.0	27.0	34.5
Washington	18.0	24.5	32.5	43.0
Total	33.6	45.5	59.5	77.5

Source: Northwest Florida Planning and Advisory Council.

Table 1-11

TAXABLE SALES BY COUNTY FOR FISCAL YEARS ENDING JUNE 30, 1971, AND 1972

	1971		1972	
County	Taxable Sales	Number of Accounts	Taxable Sales	Number of Accounts
Bay	$172,423,815	2,526	$191,715,389	2,380
Holmes	9,469,787	249	11,132,334	273
Jackson	45,980,062	792	55,506,684	893
Walton	17,324,461	480	20,784,920	470
Washington	9,207,153	269	11,268,470	278

Source: *Florida Statistical Abstract*, 1973.

1.2.5 Housing

Since 1970, the Deltona Corporation began construction of Sunny Hills, a retirement-oriented community located in Washington County. It is anticipated that this development will draw a population of approximately 10,000 people within ten years and that ultimately it will accommodate 60,000 persons. Lot sales began in June, 1971, and at the beginning of 1974, 55 per cent of the 34,000 potential lots had been sold. Although very few of the lots are as yet developed, housing construction should increase as the purchasers begin to reach

retirement age. This development meets and will continue to meet the specialized housing needs of retired families; however, it does not fulfill this need for all ranges of income.

One of the most severe problems facing the two counties, and a problem which will impact the proposed plant construction, is housing. Information obtained from local interviews and census information suggests housing of all types is in short supply. Local realtors report that people moving into the area have a difficult time finding vacant housing.

Studies done by the RMBR Planning/Design Group (see Tables 1-12 and 1-13) show that over 25 per cent of the year-round housing units in Holmes County and 24 per cent in Washington County lack some or all plumbing. This condition has improved, the reports state, but lack of plumbing facilities is still relatively high.

According to the 1970 Census of Housing, the median value of occupied housing units in Holmes and Washington counties is well below the Florida rural median ($11,600). The median value of owner-occupied units for Holmes County was $5,600 and for Washington County was $6,600, according to the data given in Tables 1-12 and 1-13. Contract rent was also well below the state's median. 3

Conclusions about the housing stock from the RMBR Planning/Design Group are the following:

- Both counties are deficient in low- and moderate-cost housing categories.
- Small dwelling units in terms of bedrooms are needed to serve one- and two-person households.
- Young families are leaving the area and older persons are moving in.
- Approximately eight per cent of the total housing stock is in mobile homes.
- Twenty-four per cent of the housing stock in Washington County was shown to be in need of repairs.

Table 1-12

SELECTED HOUSING DATA - WASHINGTON COUNTY AND CHIPLEY, 1970

	Washington County	Chipley	
Total Year-Round Housing Units	4,216	1,235	
Lacking Some or All Plumbing	1,003	207	
Percent	23.8	16.8	
Total Reported Occupied Units	3,620	1,116	
Owner-Occupied Units	2,879	759	
Percent of Total Occupied	79.5	68.0	
Median Value (based on sample)	$6,600	$7,400	3
Renter-Occupied Units	741	357	
Percent of Total Occupied	20.5	32.0	
Median Gross Rent (based on sample)	$ 51	$ 35	
Units Vacant for Sale Only or for Rent	136	67	
Other	460	52	

Sources: General Housing Characteristics, Tables 24, 24; Detailed Housing Characteristics, Tables 61, 62, Bureau of the Census, 1970.

Copied from Research and Analysis: Washington County, RMBR Planning/Design Group, 1974 -- Table 23 on page 85.

Table 1-13

SELECTED HOUSING DATA - HOLMES COUNTY AND BONIFAY, 1970

	Holmes County	Bonifay	
Total Year-Round Housing Units	4,073	831	
Lacking Some or All Plumbing	1,023	120	
Per Cent	25.11%	15.64%	
Total Reported Occupied Units	3,550	738	
Owner-Occupied Units	2,773	497	
Median Value	$5,600	$7,400	
Renter-Occupied Units	777	241	
Median Contract Rent	$ 32	$ 38	
Units Vacant For Sale Only or For Rent	188	48	
As a Percent of Total Year-Round Units	4.6%	5.8%	
One-Person Households	565	181	
As a Percent of Reported Occupied Units	15.9%	24.5%	3
Persons Per Household	3.0	2.8	

Sources: Housing unit figures from General Housing Characteristics, Florida, HC(1)-A11, U.S. Department of Commerce, Bureau of the Census, Tables 27 and 29, pp. 103 and 105. Data for other small communities in Holmes County are not available in census reports as they are below 1000 population. Calculations by RMBR/The Planning/Design Group.

Copied from Research and Analysis: Holmes County, RMBR Planning/Design Group, 1974 -- Table 20, page 65.

It is evident from the above statistics that there is a severe shortage of standard housing. Improvements to the housing stock and an increase in the choice of type of housing available will be a critical issue for the two counties.

1.3 LAND USE

This section describes the extent of land use planning for the two-county area and depicts projected land use as developed by the Northwest Florida Planning Advisory Council.

No continuous land use planning is known to exist within the two-county area. Land use plans were prepared for both counties by the RMBR Planning/Design Group, (Plan and Implementation, Holmes - 1974, Washington - 1974). Neither of these were officially adopted by the respective county governments. In addition, approved zoning ordinances do not exist for the two counties.

Map 3 is a composite of the future land use maps presented in studies previously mentioned. It was redrawn for clearer reproduction, but otherwise remains unchanged. Map 4 focuses on Caryville. This is also redrawn from the Washington County planning report and remains unchanged except for the insertion of the proposed fossil fuel plant.

1.4 ARCHEOLOGICAL, CULTURAL, HISTORICAL, AND RECREATIONAL RESOURCES

Various recreational resources were documented in the Plan and Implementation studies for the two counties. These reported the following:

> Major park/recreation facilities in Washington County at this time are provided either by state facilities or semi-public (institutional) facilities. These include Pine Log State Forest in the extreme southeast part of the county (partly in the town of Ebro); Falling Waters State Recreation Area south of Chipley; three Department of Transportation Wayside Parks, two of which (at Caryville on the Choctawhatchee River and at Vernon on Holmes Creek) have public boat ramps; Falling Waters Golf Course south of Chipley; Dogwood Acres Recreation Camp owned by the Presbytery of Florida; and the Boy Scout Camp near Econfina Creek in the extreme southeast part of the county. In addition, the county provides several additional boat ramps on the Choctawhatchee River and Holmes Creek and there are many privately-owned fishing camps utilized both by residents and by tourists. Falling Waters State Recreation Area should be expanded to conserve this valuable resource.
>
> All towns except Ebro have ball parks or playing fields, either on former or existing school sites or elsewhere. However, the types of activities for which these ball fields are suitable are limited. Chipley has in addition one city park, located in the south central part of the city. Local officials and citizens state there is need for additional park space at this facility and for additional parks in other portions of the city.*

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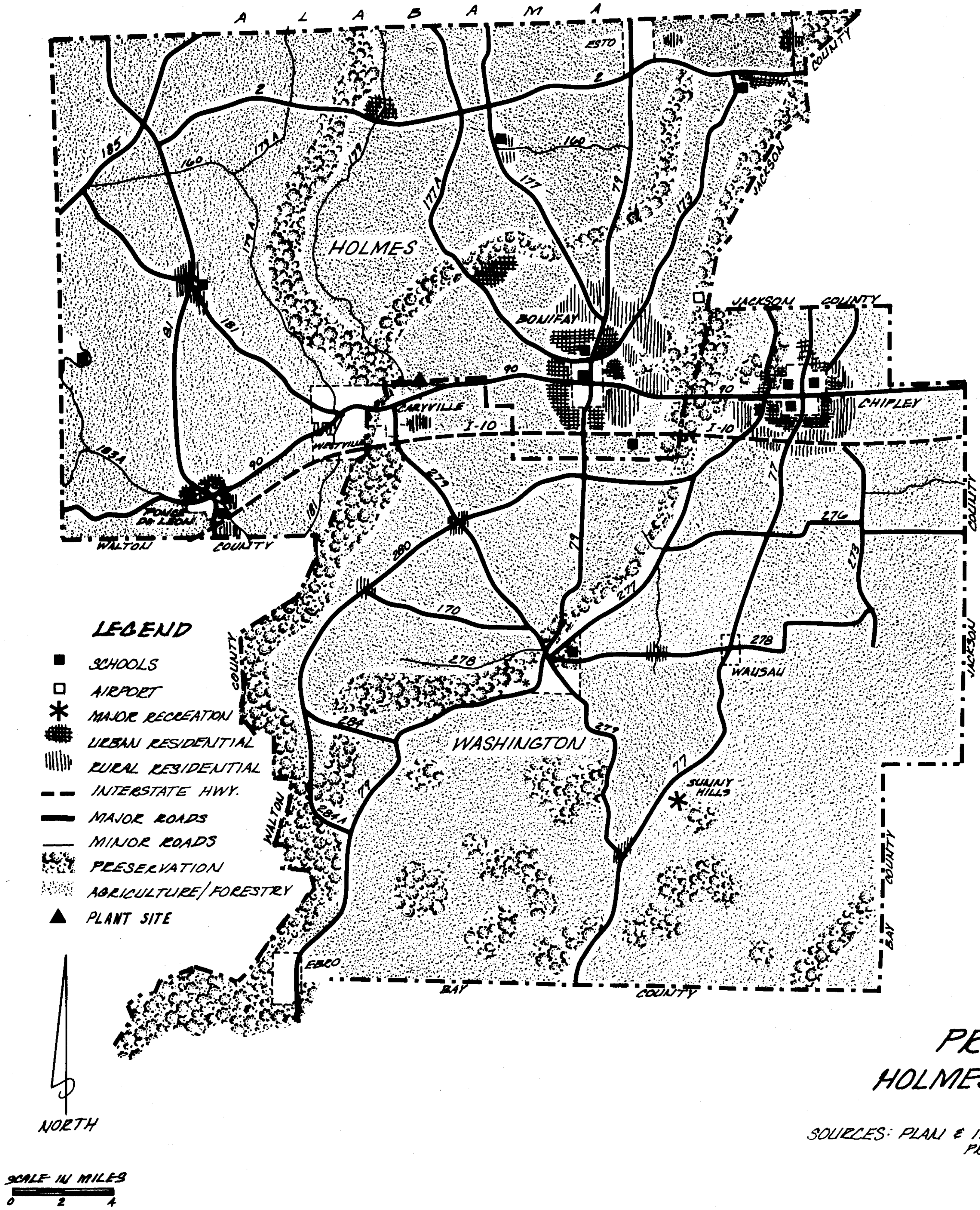
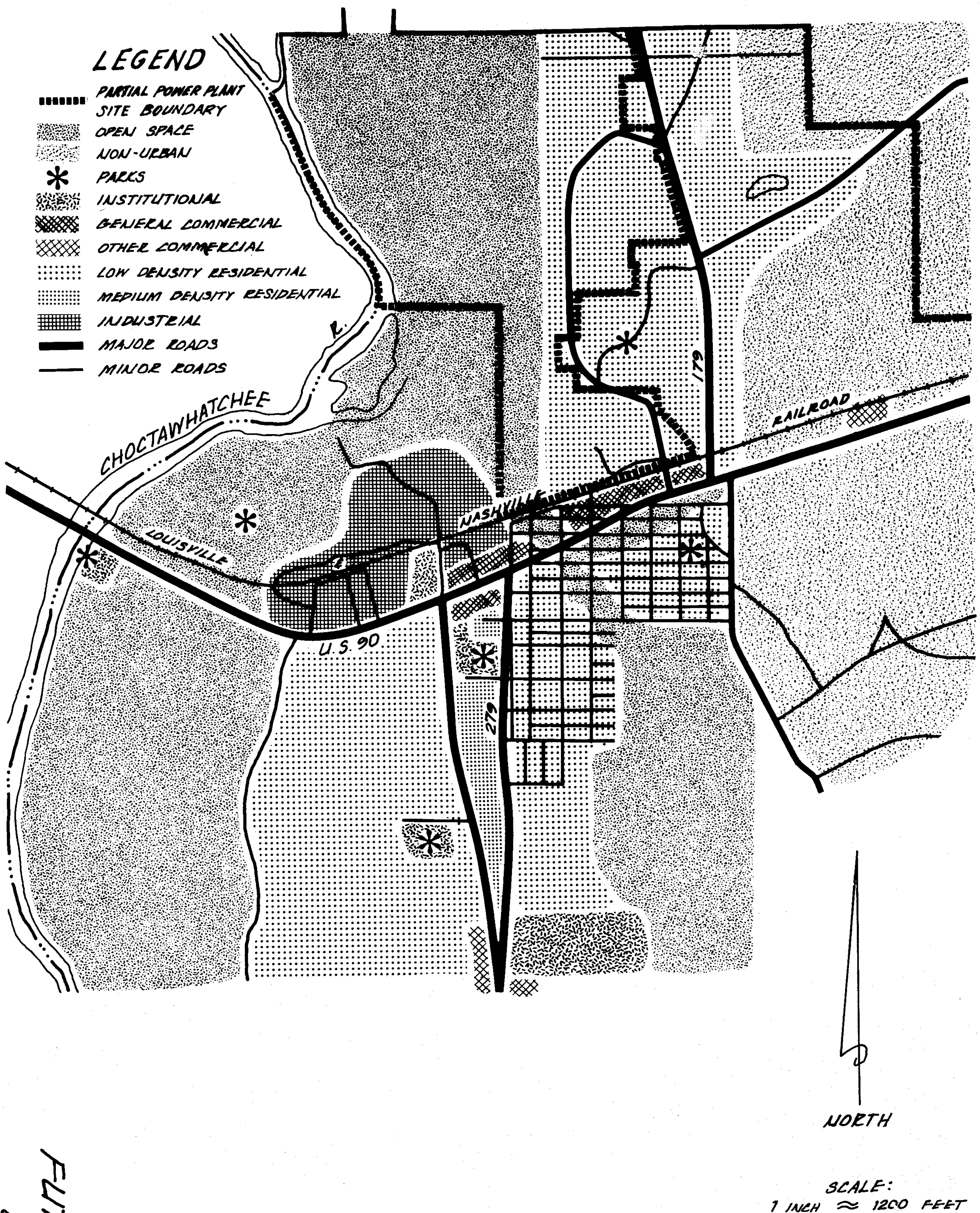
*Plan and Implementation: Washington County, RMBR Planning/Design Group, June, 1974, pp. 57-58.



MAP 3

PROPOSED LAND USE PLAN
HOLMES & WASHINGTON COUNTIES, FLORIDA

SOURCES: PLAN & IMPLEMENTATION: WASHINGTON COUNTY; PLAN & IMPLEMENTATION: HOLMES COUNTY
PREPARED BY THE R.M.B.R. PLANNING/DESIGN GROUP
MAP REDRAWN BY ERIC HILL ASSOCIATES, INC.



MAP 4

FUTURE LAND USE PLAN

CARYVILLE, FLORIDA

SOURCE: PLAN & IMPLEMENTATION: WASHINGTON CO.
PREPARED BY THE E.M.B.E. PLANNING/DESIGN GROUP
MAP REDRAWN BY ERIC HILL ASSOCIATES, INC.

Holmes County does not sponsor any recreation programs or own any park facilities. Fortunately, the County is rural and is blessed with an abundance of natural areas. This permits informal recreation opportunities on an individual basis. However, as the population increases, there will be a continuing need to provide a diversity of recreation-park facilities. Also, while some community-type lake facilities are now being used, there are good possibilities these areas will not always be available.

The cities, too, have no park facilities and the need for the neighborhood level are noticeable, especially in Bonifay.

The state provides the major facilities found in Holmes County and they are represented by the roadside parks and the Ponce de Leon Springs Recreational Area. Currently being completed, this facility is definitely Regional in character, but will serve multiple functions since it is located within the corporate limits of Ponce de Leon.*

Proposed recreational uses were also provided in the reports. For Washington County, the following recommendations were made:

Chipley: a small neighborhood park with facilities for pre-school children and adult resting areas, in each of the four quadrants of the city, near major concentrations of residences. 3

Caryville: Consideration should be given to provision of a combined town recreation facility near the Choctawhatchee River, and two small park areas in the residential neighborhoods. The area east of Cypress Slough, south of U.S. 90, already has a one-half block area donated for a neighborhood park; this should be developed, with the assistance of local residents. Similar areas should be located for future development in the southwest area of the town and in the northeast, as more dense development occurs. Some portion of the central ball-field area or adjacent lots might also be developed for quiet park activities.

Vernon: Land along the borders of Holmes Creek, as well as an area in the south part of the town, should be considered in the future for park development, with both total community service facilities and small quiet play/rest areas in mind. Local residents should be encouraged to work with the town government in provision of such facilities.

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*Plan and Implementation: Holmes County, RMBR Planning/Design Group, June, 1974, p. 46.

Wausau: Wooded land to the west of the existing playing field is available and is being considered for provision of town park facilities. Picnic areas, play areas for pre-school children and quiet resting and walking areas for adults should be included. Wausau has opportunities for nature study and bird-watching walks.

Ebro: Should plan for the future, making some reservation of vacant land now, in accordance with residential areas suggested in the Land Use Plan.

Sunny Hills: Park and recreation areas are indicated on the master plan for this community prepared by the Deltona Corporation, so no additional recommendations are made here.*

For Holmes County, the following recommendations were made:

Bonifay, according to the standards, should have approximately six acres in neighborhood parks in two facilities. One should be located in the northern half of the City and the other in the southern half. Opportunities for these parks may come about as new development occurs.

The community park situation varies in Holmes County because of the population level, large amounts of open land, the dispersal of population and the state recreation area at Ponce de Leon. From an analysis of existing conditions, and discussion with local officials, it appears that a need for publicly accessible lake sites for water-oriented activity does exist. Based on this, two sites for community-servicing facilities are suggested: one at Lake Cassiday, and the other at the lake on the Development Commission's property south of Bonifay. These two parks would respond to the greatest future population needs, in conjunction with the urban corridor through Holmes.**

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*Plan and Implementation: Washington County, RMBR Planning/Design Group, June, 1974, pp. 58-59.

**Plan and Implementation: Holmes County, RMBR Planning/Design Group, June, 1974, p. 46.

2.0 EFFECTS OF SITE PREPARATION AND PLANT CONSTRUCTION ON THE MAN-MADE ENVIRONMENT

The plant construction phase is expected to last approximately six years. The peak construction employment level, to occur in 1979-1980, is estimated at 1,800 workers. Figure 5 identifies the key time periods of plant construction, and enumerates expected employment levels for the construction phase.

The effects of full development of the site to 3000 MW have not been considered in this study due to lack of definite plans of expansion past the initial 1000 MW. As plans are made to expand the facility past the initial 1000 MW an evaluation of this impact will be provided.

2.1 DEMOGRAPHY

The construction force will consist of workers who currently reside within commuting distance of the plant site and of workers presently living elsewhere who will relocate to the general vicinity of the site for a period of from one to six years. 3

The effects on the man-made environment caused by the construction work force are related to three primary factors:

- -commutation characteristics: how many workers will commute to work daily and weekly, from where, and by what means?
- -magnitude of influx: how many workers and families will relocate to the vicinity of the plant site?
- -dispersal of influx: where will relocating workers and families reside?

2.1.1 Estimated Construction Work Force Requirements

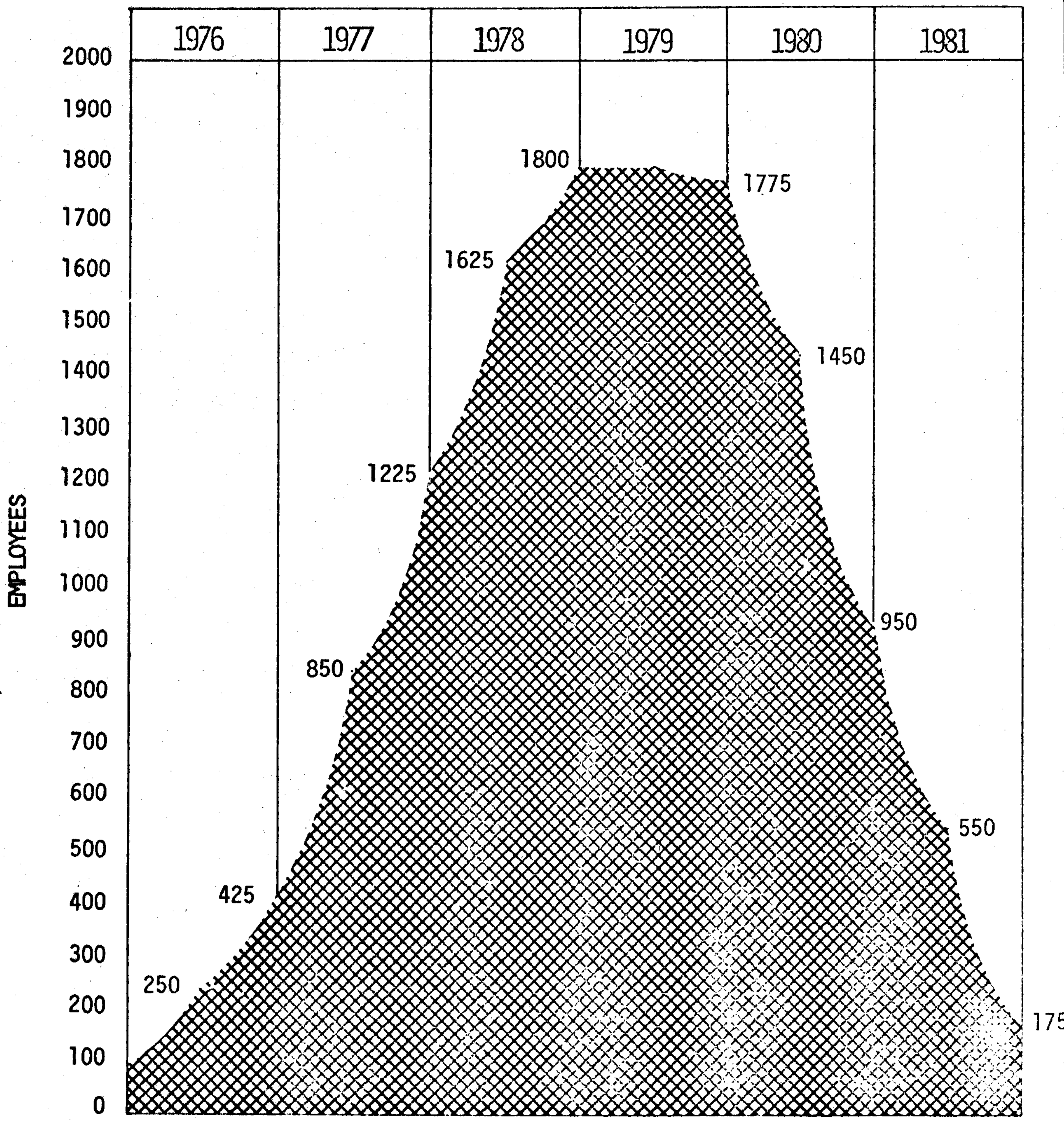
The paragraphs which follow develop estimates of the number of construction workers, by skill, who will temporarily move into the area, and where they will locate. Also estimated are the number of workers who will commute and from where. These estimates, and others which follow, are based on the following assumptions:

-construction activity in the Florida Panhandle area will not expand to a point that depletion of the supply of labor required to support normal levels of construction activity will occur.

-energy costs for travel will not exceed 200 percent of current costs. 3

-construction workers will continue to show a strong propensity for car-pooling and other cost reducing methods of travel to and from work.

FIGURE 5
SCHEDULE OF ESTIMATED WORK FORCE
IN SITE PREPARATION AND PLANT CONSTRUCTION
FOR PROPOSED CARYVILLE, FLORIDA, STEAM PLANT



Source: Gulf Power Company

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- construction workers will continue to be more rural than urban oriented in this part of the country.

- the construction phase will last approximately six years and peak at about 1,800 workers.

A variety of skills will be required during the construction phase. Some of these skills are more prevalent than others in the resident labor force. Therefore, to understand how many total workers are likely to move into the area to fill the construction jobs, it is necessary to first estimate the number of jobs of each skill that will be needed, and then to estimate the number of workers in each skill who reside within commuting distance of the plant site.

Table 2-1 provides an estimate of the number of workers needed for each skill type at peak construction period.

Table 2-1

ESTIMATED BREAKDOWN OF NEEDED PEAK CONSTRUCTION WORK FORCE BY SKILLS 3

Skills	Workers
Operating Engineers	100
Laborers	200
Electrical Workers	300
Carpenters	200
Ironworkers	200
Concrete Workers	50
Boilermakers	400
Pipefitters	310
Supervisory & Engineering	40
TOTAL	1,800

Source: Estimates by Gulf Power Company based on general knowledge of skilled labor needs for the construction phase of a fossil fuel steam generating plant.

2.1.2 Estimated Commutation Characteristics of Construction Workers

Given the breakdown of skills required for the jobs as shown in Table 2-1, a determination of the area from which the work force may be drawn was made. Sources used in this analysis include interviews with:

- local labor union leaders
- construction firms with experience in building power generating plants
- public planning agencies whose jurisdictions have been affected by similar construction projects
- power companies.

A list of persons interviewed and their organizations is given in reference (1). Interviews were conducted by phone. Each labor union representative was asked a similar, although unstructured, set of questions pertaining to labor resources for the project. All labor union respondents were knowledgeable of the proposed project. In addition to questions regarding the availability of labor in each skill type, respondents were asked about typical travel and family habits of the 3
labor force (i.e., how far will workers likely commute on a daily/weekly basis, how many relocating workers are apt to bring their families, where are they most likely to relocate, etc.?).

Interviews with public planning agencies and a national construction firm explored experiences in constructing a power plant or similar project in a relatively remote area. Effort was made to obtain information on actual effects (as opposed to anticipated effects) from the introduction of a large number of construction workers.

Interpretation was necessary to compensate for possible bias in the observations of labor leaders whose members are potential labor resources for plant construction. Interpretation was also necessary for public planning agencies' observations, where demographic and socioeconomic characteristics differed from those of the proposed plant site.

In addition to interviews, four impact studies for similar power plants were analyzed (See reference (2) for a list of these studies.) Three of these studies estimated effects anticipated prior to construction. The fourth was a case study exploring the effects of construction after it had occurred. However, measurable impacts on critical socioeconomic characteristics were not enumerated.

The results of the analysis of interviews and impact studies are given in Table 2.2. The salient point is that a relatively large number of potential plant construction workers already live within commuting distance of the plant site. Normal commuting distance is considered to be up to 45 miles from the site; it is estimated that 64 percent of the necessary 1,800-man peak construction force now resides in this area (Map 6 shows the various commutation ranges 3
discussed here). Another 14 percent of the workers currently live more than 45 miles away, but are expected to commute. The remaining 22 percent currently live elsewhere and are expected to relocate during the construction period to within 45 miles of the plant. Less than half of these in-migrating workers will bring their families with them.

There are two statistical scurces which tend to support the conculsions reached in Table 2.2. First, the total population residing within a 45-mile radius of the plant site in 1970, as Table 2-3 indicates, was more than a quarter of a million people. From this quarter million people, an estimated 1,155 commuting workers (64 percent of the total peak construction force) will be drawn.

Table 2-2

ESTIMATED COMMUTATION CHARACTERISTICS OF PEAK CONSTRUCTION FORCE BY SKILLS

Commutation Characteristic	Construction Skill										
	Operating Engineers	Laborers	Electrical Workers	Carpenters	Ironworkers	Concrete Workers	Boilermakers	Pipefitters	Supervisory/Engineering	Total	% of Total
Workers currently residing within 45 miles who will commute daily.	20 (20%)	160 (80%)	240 (80%)	160 (80%)	120 (60%)	30 (60%)	240 (60%)	186 (60%)	0 (0%)	1,156	64.2%
Workers currently residing more than 45 miles who will commute daily.	10 (10%)	10 (5%)	0 (0%)	20 (10%)	40 (20%)	10 (20%)	80 (20%)	62 (20%)	0 (0%)	232	12.9
Workers residing more than 45 miles who will temporarily relocate without families.	50 (50%)	10 (5%)	54 (18%)	10 (5%)	20 (10%)	5 (10%)	40 (10%)	31 (10%)	0 (0%)	220	12.2
Workers residing more than 45 miles who will temporarily relocate with families.	20 (20%)	20 (10%)	6 (2%)	10 (5%)	20 (10%)	5 (10%)	40 (10%)	31 (10%)	40 (100%)	192	10.7
TOTALS	100 (100%)	200 (100%)	300 (100%)	200 (100%)	200 (100%)	50 (100%)	400 (100%)	310 (100%)	40 (100%)	1,800	100.0%

Source: Eric Hill Associates, Inc.

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