

**SITE CERTIFICATION APPLICATION
AND
ENVIRONMENTAL ANALYSIS**

SEMINOLE PLANT UNITS NO. 1 & NO. 2

**SEMINOLE ELECTRIC COOPERATIVE,
INC.**

VOLUME I

SITE CERTIFICATION APPLICATION
AND
ENVIRONMENTAL ANALYSIS

FOR

SEMINOLE PLANT UNITS NO. 1 AND NO. 2

SEMINOLE ELECTRIC COOPERATIVE, INC.

TAMPA, FLORIDA

PREPARED BY

DAMES & MOORE

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August 4, 1978

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Administrator, Power Plant Siting
Bureau of Permitting
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Tallahassee, Florida 32301

Mr. William Dalton
Director - Southeast Area
U.S. Department of Agriculture
Rural Electrification Administration
Washington, D.C. 20250

Gentlemen:

Transmitted with this letter are copies of "Site Certification Application and Environmental Analysis for Seminole Plant Units No. 1 and No. 2".

In compliance with responsibilities under the National Environmental Policy Act, Florida Electric Power Plant Siting Act, and Executive Order 11991: Protection and Enhancement of Environmental Quality, Dames & Moore is pleased to submit a consolidated environmental assessment on behalf of Seminole Electric Cooperative, Inc. in the matter of the licensing of a proposed 1,200 megawatt coal-fired steam electric generating station in northeast Florida.

To coordinate the review of this document, all questions should be directed to:

Mr. Robert W. Claussen, Director of Engineering
Seminole Electric Cooperative, Inc.
2410 East Busch Boulevard
Tampa, Florida 33612
Telephone: (813) 933-7406

As appropriate, in response to questions, this document will be updated by amended pages with instructions to delete and replace original pages.

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Completion of the work necessary for the preparation of a document of this size and complexity is a significant accomplishment by many people. Contributions from people outside of Dames & Moore include staff members of Seminole Electric Cooperative, Inc. who provided information concerning their operations, and staff members of Burns and Roe, Inc., the project architect-engineer consultant, who provided information about the plant engineering systems. Guidance concerning the regulatory process provided by many regulatory agencies, both federal and state, are also acknowledged.

We are also indebted to Mr. James J. Miller of Cultural Resources Management, Inc. who conducted the cultural resources survey of the Putnam site. A special acknowledgement is made of the contributions of Mr. Kenneth W. Prest, Jr., President of The Environmental Licensing Group, Inc., who assisted in an untold number of ways throughout the project from development of the Plan of Study through assistance in preparation of the final document.

Internally, within Dames & Moore, scores of people have contributed to this effort. Their work and dedication have not gone unnoticed. Key personnel who have made significant contribution to the project are included herein.

The persons whose technical expertise have provided the substance of this document are as follows:

<u>Technical Specialty</u>	<u>Name</u>
Terrestrial Ecology	Derry Stockbridge Steve Cox
Aquatic Ecology	Wayne S. Lifton Thomas E. Simpson Charles J. Zimmerman
Surface Water Hydrology	William L. Hall
Ground Water Hydrology	F.L. Doyle
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Meteorology/Air Quality	James W. Little
Acoustics	Brown Yue
Land Use/Demography	Marvin Smith
Socioeconomics	Robert T. Mott
Transmission Line Study	William T. White

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Technical review was provided by the following individuals:

Biology	James B. Knauss
Surface Water Hydrology	Steve H. Blair
Ground Water Hydrology	Porter-C. Knowles
Geology/Soils	Charles P. Gupton
Meteorology/Air Quality	Robert G. Allen
Acoustics	Frederick M. Kessler
Land Use/Demography	William T. White
Socioeconomics	Harry M. Bridgeman
Transmission Line Study	John Matthews

Several key individuals were responsible for final document preparation including coordinating, editing, and production. They are:

Document Coordination	Vicki J. Anderten
Editing	Vicki J. Anderten Andrew Fabian
Word Processing	Pamela Garrett
Technical Illustration	James Corcoran

Dames & Moore appreciates the opportunity to have been able to work closely with Seminole Electric Cooperative, Inc., and participating state and federal agencies throughout the preparation of the document. We feel that the open interactions among participants from the early stages of the proposed project have resulted in a proposal founded on responsible decision consistent with the policy set out in Section 1500.2 of the proposed Council on Environmental Quality Regulations.

We look forward to your review and comments.

Respectfully submitted,

DAMES & MOORE

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Project Manager

Hubert B. Visscher

Hubert B. Visscher
Principal-In-Charge

VJA:TJD:HBV:tr
Enclosures

PERTINENT APPLICANT INFORMATION

Legal Name

Seminole Electric Cooperative, Inc.

Mailing Address

Suite 200, 2410 East Busch Boulevard
Tampa, Florida 33612

Address of Official Headquarters

Same as Above.

Business Entity

The applicant is a generation and transmission cooperative organized and existing as a corporation under the Laws of the State of Florida.

Name and Title of Chief Executive Officers

Vern Eveland, President
Harry Wright, Executive Vice-President and General Manager

Name, Title, Address, and Phone Number of Official Representative Responsible For Obtaining Certification and To Whom Questions Concerning the Application Should Be Addressed

Robert W. Claussen, Director of Engineering
Seminole Electric Cooperative, Inc.
2410 East Busch Boulevard
Tampa, Florida 33612
Telephone Number: (813) 933-7406

Professional Engineer Submitting Application

Robert W. Claussen, Florida Registration Number 20459

Site Location

The preferred site for Seminole Plant Units No. 1 and No. 2 is located in Putnam County, Florida.

Nearest Incorporated City

Palatka, Florida

Latitude and Longitude

The preferred site is located at 29°44'N latitude and 81°38'W longitude.

Coordinates

The Universal Transverse Mercator (UTM) coordinates are:

3289200 North

438800 East

Proposed Nameplate Generating Capacity

Seminole Plant Unit No. 1 will have a nameplate generating capacity of 600 megawatts (MW), and is scheduled for commercial operation in June 1983. Seminole Plant Unit No. 2 will have a nameplate generating capacity of 600 MW, and is scheduled for commercial operation in June 1985.

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1.0

NEED FOR POWER

CHAPTER 1.0

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CHAPTER 1.0

NEED FOR POWER

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1.0 NEED FOR POWER
(Prepared by Seminole Electric Cooperative, Inc.)

1.1 THE APPLICANT

Seminole Electric Cooperative, Inc. (Seminole) of Tampa, Florida, is thirty years old as a corporation, but only four years old as an active utility.

Seminole's purpose is to provide reliable electric power at the lowest possible cost to its eleven distribution member systems. This objective is accomplished by generating, transmitting, purchasing, selling, exchanging, etc., electric power and energy, and constructing, owning, leasing, etc., such facilities as required to meet Seminole's stated purpose.

1.1.1 Member Companies

Seminole's eleven distribution cooperative member systems serve almost 300,000 individual meter locations or an estimated 1,000,000 persons, with a system demand in an excess of 1,000 megawatts (MW). Seminole has only approximately 14 MW of self-generation.

The Seminole member cooperatives are as follows:

- Central Florida Electric Cooperative, Inc.
Chiefland, Florida
- Clay Electric Cooperative, Inc.
Keystone Heights, Florida
- Glades Electric Cooperative, Inc.
Moore Haven, Florida
- Lee County Electric Cooperative, Inc.
North Fort Myers, Florida
- Okefenoke Rural Electric Membership Corporation
Nahunta, Georgia
- Peace River Electric Cooperative, Inc.
Wauchula, Florida
- Sumter Electric Cooperative, Inc.
Sumterville, Florida

- Suwannee Valley Electric Cooperative, Inc.
Live Oak, Florida
- Talquin Electric Cooperative, Inc.
Quincy, Florida
- Tri-County Electric Cooperative, Inc.
Madison, Florida
- Withlacoochee River Electric Cooperative, Inc.
Dade City, Florida

These member systems serve in 47 of the 67 Florida counties, as shown on Figure 1.1-1.

1.1.2 Suppliers

Seminole receives power from six suppliers. Of these six, Florida Power Corporation and Florida Power & Light supply more than 90 percent of the purchased power. This power is purchased through rate tariffs filed with the Federal Energy Regulatory Commission. The remaining power suppliers to Seminole are Tampa Electric Company, Gainesville Regional Utilities Board, Jacksonville Electric Authority, and the Southeastern Electric Power Administration. These remaining power suppliers supply power and energy to Seminole by wholesale power contracts.

Seminole and its member cooperatives own and operate a combined total of approximately 650 miles of 138-, 115-, and 69-kV transmission line. Typically, much of this transmission is radial in nature, from a tap or breaker on the State bulk transmission grid to a member-owned substation. The majority of this transmission is in northeast Florida and belongs to Clay Electric Cooperative, Inc., or is in southwest Florida and belongs to Lee County Electric Cooperative, Inc. Seminole owns approximately 31 miles of 69-kV line from Cedar Key to Otter Creek, and then to Bronson, in Levy County, Florida. In addition to these two lines, Seminole has eight transmission projects, 69 and 115 kV, in various states of design and construction, for a total of approximately 75 miles. These lines will be operated and maintained by the Seminole member served by the line. The transmission required for the proposed two 600-MW, coal-fired units is discussed in Chapter 10.0 of this document.

1.1.3 Operations and Financing

Seminole's Executive Vice President and General Manager implements the policies adopted by the Board of Trustees of Seminole. Seminole's Board of Trustees consists of two voting delegates from each member cooperative, one of whom must be the General Manager, and the other a Trustee. An alternate from each member cooperative also sits on the Board as a non-voting member.

Seminole's staff is responsible to the Executive Vice President and General Manager. Functional responsibilities are broken down into the following areas:

- Engineering
- Project
- Finance and Accounting
- Procurement
- Member and Public Information Services

At this time, Seminole employs twenty-eight professional and non-professional personnel.

Seminole obtains its long-term funds for capital projects primarily by securing guaranteed loans from the Federal Finance Bank. The guaranteed loan is not funded by Federal tax money. These loans are administered by the Rural Electrification Administration and guaranteed to be repaid by the Government if the Mortgagee defaults. These guaranteed loans are similar in form to FHA loans for homes. The interest rate obtained is very similar to an AAA rated First Mortgage Bond sold by a private utility.

Seminole does have other means of financing. In addition to local bank lines of credit, Seminole can obtain funds from the Cooperative Finance Corporation, the Bank for Cooperatives, and from the sales of pollution control bonds in the private bond market.

Seminole operates under By-Laws of Seminole Electric Cooperative, Inc., originally adopted by the membership, December 4, 1974. The members of Seminole entered into a wholesale power contract with Seminole in May and June of 1975. The contract basically indicates that the

member desires to purchase electric power and energy from Seminole and that Seminole agrees to provide such power and energy either by self-generation or purchase. The term of this contract is for not less than 45 years. After 45 years the contract is automatically renewed unless either party provides at least a three year written notice to the other party of its intention to terminate the contract.

Seminole does coordinate the planning needs of the members as well as those member needs with other utilities. Seminole is an active member of the Florida Coordinating Group (FCG) and actively participates on such committees as the Executive Committee, Technical Advisory Group, System Planning Committee, Operating Committee, etc.

Seminole is a generation and transmission cooperative and one of fifty-three such cooperatives in the country. Seminole has a responsibility by contract to provide the power and energy to the distribution system members' points of connection. The distribution system member in turn has the responsibility of delivering that power and energy to its members through a system owned and operated by the distribution system cooperative. It is through the member system that the power ultimately gets to its consumers. In the case of the distribution cooperative, the ultimate consumer elects its Board of Trustees and controls its own system. Seminole, in turn, is controlled by a Board of Trustees elected by its member systems. The investor-owned power systems and many municipally-owned power systems that also serve the same functions, i.e., generation-transmission and distribution, are not totally controlled by the ultimate consumer. The Seminole member distribution cooperatives, Seminole as a generation-transmission cooperative, and the municipals do not pay Federal or State income tax due to their non-profit status. Of course, the investor-owned utilities are subject to Federal and State income tax. The cooperatives, distribution and generation-transmission, and the investor-owned systems pay all other taxes as opposed to the municipal systems, who do not pay such other taxes as property taxes, etc. It should be noted that municipal systems do make a contribution generally, to the "general fund," and this contribution may be used to offset the need for increased taxes.

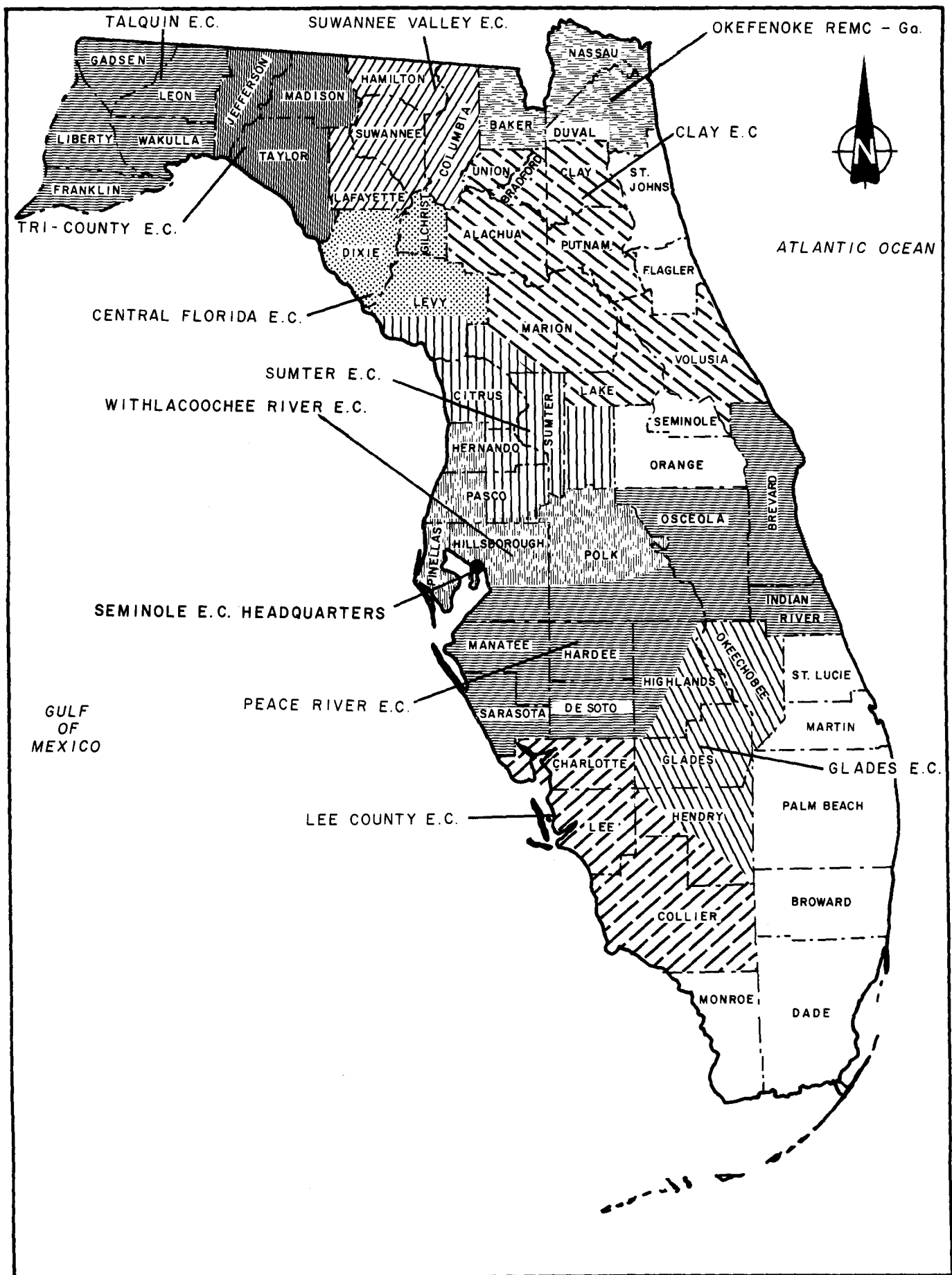


Figure 1.1-1. Seminole Electric Cooperative, Inc., Cooperative Member Systems and Office Headquarters.

1.2 SYSTEM PLANNING

1.2.1 General

Seminole planning process calls first for the development of a load forecast, identified by the Rural Electrification Administration as a Power Requirements Study, which develops the expected demand and energy requirements of each of Seminole's member systems, which in turn, defines the overall load requirements for the Seminole system. The term "system" is underlined due to the fact that Seminole member systems are not directly tied together by a transmission system owned by Seminole, but are in fact radial systems which tap the State of Florida's bulk power supply system owned primarily by the privately owned utilities. Due to the fact the Seminole system is dependent on other systems' transmission, it requires close coordination with these systems. The future will see some changes to the cooperative transmission system due to the proposed plant in Putnam County which will require 230-kV transmission lines to be tied into the bulk power grid in Florida. However, it is not Seminole's intent to duplicate facilities but to jointly plan transmission facilities with the other utilities in Florida, either through direct study with a given utility or through the Florida Coordinating Group.

The second step in the Seminole planning process is to address the future needs of the member systems. The member systems define their needs, new points of delivery, etc., through their own planning studies. Seminole in turn reviews these needs and determines the best method of serving them after considering those needs from a single system point of view. The criteria used for these studies is basically the same as defined in Section V of the FCG System Planning Committee Handbook, where practicable.

The third step in the planning process is actually performed in parallel with step two. This third step requires the review of the way in which Seminole will continue to meet its responsibility under the power contract, that is, how it will provide adequate power and energy

to its members at the least possible cost and in a reliable manner. This third step requires the review of power resources available to Seminole along with the expected cost from each of these power resources. Due to the fact that power resources include purchasing from others by contract or from a tariff offered by another utility, a considerable amount of work is required in developing the expected cost from these power resource alternatives, since rate making assumptions, construction programs, forecasts, etc., are required before the cost can be estimated. Along with other power resource alternatives such as self-generation, simulations of various scenarios are investigated.

These simulations are performed using reserve criteria of the power supplier in which load is anticipated to be served by a Seminole-owned power resource. Pricing of power purchases from other systems is based on the cost developed from the assumptions discussed earlier but is based also on the type of purchase power required, i.e., base, intermediate, peaking, reserves, etc.

The load forecast for Seminole was developed by taking into consideration two basic forecasting methods. The first method is based on analytical trend analysis of prior historic growth patterns. The time frame selected is analyzed in order to evaluate the sensitivity to historic growth patterns based on various years of history. The second method is a "grass roots" approach. Each member of Seminole develops a forecast by customer class based on customer growth and customer usage parameters. The results of the customer class forecast are summed to obtain the total energy requirements and expected customers. The total demand for each member is then developed based upon the expected load factor and upon an analysis of historic and anticipated future customer use characteristics. The key factors analyzed by member system personnel included population growth, anticipated economic development, customer income, the effect on usage due to cost of electricity, and the weather. The cooperatives have seen a continual migration from the urban areas to the rural areas in ever increasing numbers. Those moving to the rural areas are building larger homes and installing electrical equipment such

as air conditioning, heat pumps, resistance heating, etc. In addition to the impact of the migration from urban to rural areas, the cooperatives are also being impacted by the influx from outside the State. These trends seem to be reflected in the Projections of Florida Population for 1978 - 2020, Division of Population Studies, Bureau of Economic and Business Research, College of Business Administration, University of Florida. A composite of the individual system analysis has been reviewed by Seminole and the basic assumptions for the Seminole Forecast of Power Demand are the aggregate of each of the member system assumptions. The results of this load forecast have been reviewed and approved by the Rural Electrification Administration of the United States Department of Agriculture.

1.2.2 Peak Demand

Seminole has been a summer peaking system (the prior summer peak exceeds the following winter peak) until 1975 at which time it became a winter peaking system. The determination of the peaking season is correlated very closely with the weather conditions for that year. Winter peak demand was usually caused by an unseasonably cold period of short duration. While this has a great effect on this demand, little or no increase in kilowatt-hour (kWh) usage has been noticed. It is felt that the trend towards a winter peaking system has greatly contributed to the decreasing annual load factor. It is believed that the future peaking season will also be dependent upon the prevailing weather factors and will probably shift from year to year. It should be noted that when the individual projected peak demands of the member cooperatives were collected, no diversity factor was applied to any system before a summation. Seminole member systems are located in 47 of the 67 counties of Florida, and stretch from the Georgia border south through Fort Myers, Florida. Based on studies by the Florida Coordinating Group, it was noted that little diversity existed between utility systems within peninsula Florida. We believe that this basically correlates with the Seminole system and is why, for a given period, the individual systems' peaks were summed to obtain the Seminole peak.

When the total kWh purchased for Seminole member cooperatives was collected for the historical years 1967 through 1977, it was found that Seminole grew at an annual compound growth rate of 15.1 percent for this period. For the year 1977, the growth rate was 11.2 percent over 1976. The projected annual kWh compound growth rate for the period year end 1977 to year end 1982 is 10.6 percent and 10.4 percent for the period year end 1972 through 1992.

When the total kW purchased for Seminole member cooperatives was collected for the historical years 1967 through 1977, it was found that Seminole grew at an annual compound growth rate of 17.58 percent for the winter peak and 16.06 percent for the summer peak. The projected 1977-1987 annual compound growth rate for the winter peak is 10.20 percent and 10.99 percent for the summer peak.

Table 1.2-1 sets forth the history and forecast of seasonal peak demand and annual energy requirements and is followed by Table 1.2-2, which provides a two-year forecast of peak demand and energy requirements by month for 1978 and 1979. Figure 1.2-1 is a graph of the history and forecast of energy use from 1967 through 1986.

1.2.3 Forecast Update

Seminole reviews its load forecast after its winter and summer peaks. The review process involves an analysis of the differences between the forecast and actual demand and energy figures. After the analysis is complete, the forecast is modified if required.

1.2.4 Conservation and Load Management

Seminole Electric Cooperative occupies a somewhat unusual position compared to other Florida utilities in relation to conservation and load management. As a generation and transmission cooperative, we have control over service only up to the point where the energy enters the system of a distribution cooperative. These distribution cooperatives, eleven in number, established Seminole as an alternative energy resource to be under their control. It was a joint effort to help meet their need for electric power, which formerly came only as wholesale purchases from other utilities, about 90% of them investor owned. They have now banded together to assure themselves economical and reliable power supplies.

Conservation and load management efforts under these circumstances require coordinated and cooperative planning between Seminole as energy supplier and each system member as a distributor. Such coordination presents special challenges. But, it also creates beneficial opportunities. Multiple conservation programs and approaches can be introduced, tested and evaluated by various cooperative members. The results can then be documented and shared throughout the system. The improved information and planning interchange created by this Seminole "link" has in itself become a significant factor in progress towards sound conservation programs and load management research.

One example of this effect involves an energy conservation survey commissioned by Seminole. The interviews covered a comprehensive range of conservation and load management possibilities. They included questions about energy conservation programs, program staffing, home weatherization promotion and assistance, conservation information efforts, incentive rates, master metering, system load analysis, load control research and load management programs with commercial, industrial or other large customers. The findings provided valuable information on the general status of conservation efforts by various Seminole cooperatives. And, since the survey results were also communicated to all system members, this data from numerous sources provided comparative guidelines, measurements and incentives for future program development by them.

Seminole system members already have compiled an impressive record in instituting and expanding conservation programs. As a group, they are involved in extensive and diverse efforts, as indicated by some of the areas listed below:

I. Program administration

- A. Assigning of qualified personnel with responsibility for directing and coordinating conservation efforts.
- B. Establishment of conservation program concepts, objectives, research and control.

II. Energy consumer conservation information

- A. Bill stuffers, publication articles, releases from news media.
- B. Conservation posters, displays and demonstrations.
- C. Local meetings, seminars, workshops, including films, speakers and printed materials.

III. Conservation assistance and education

- A. Programs for home weatherization and insulation.
- B. Consultation services on insulation weatherization materials and installation.
- C. Informational guides on insulation terminology, resistance values and economic benefits.
- D. Supplying consumers with appliance efficiency ratings and definition of terms.
- E. Promotion of "energy efficient homes" design and recognition programs through builders.

IV. Load Management

- A. Rate analysis for load management applications.
- B. System load analysis to determine major peak contributors.
- C. Research into load control devices and management techniques.
- D. Comparative studies of load management approaches and advantages.
- E. Planning for elimination of master metering.
- F. Utilization of major media (letters, publications, news outlets) to alert members about measures needed to cut usage during peak demand periods.

Seminole has adopted an energy conservation policy approved by its Board of Trustees. It includes provisions for the promotion of conservation activities and energy awareness among member systems. It also calls

for energy management, conservation and education programs directed at these cooperatives. Research is now underway into system-wide energy conservation and load management techniques most suitable within the system and member cooperative relationship.

Seminole also has participated on other levels in energy conservation and load management efforts. On a national basis, Seminole is a contributing member of the National Rural Electric Cooperatives Association (NRECA). This organization provides information, educational and supportive programs for cooperatives throughout the country, including Seminole and all its member systems. A typical function of this type occurred last year when NRECA conducted a load management seminar, attended by a Seminole Staff member.

Seminole also belongs to a statewide group, the Florida Rural Electric Cooperative Association (FRECA). FRECA provides broad support programs in the area of conservation. In January of 1979, for example, FRECA held a state home energy audit seminar for the training of cooperative personnel with responsibilities in this area. Representatives from the Seminole system attended this seminar.

Another important FRECA accomplishment has been the development of an Energy Efficient Home program. It sets standards for home builders to reduce energy consumption by about 30% compared to usage in a normally constructed home. Seminole's member cooperatives have instituted this program.

Only homes meeting the standards receive certification as "Energy Efficient." Three sets of criteria are involved in the efficiency evaluation: 1) general illegibility requirements, 2) specific minimum prerequisites, and 3) a score of 100 points or more on a checklist of energy-saving features. The "checklist and builders certification sheet" provides the basis for this evaluation. The certification is made after an inspection by a utility representative verifies the qualifications and a score of 100

or more points. If the home passes this inspection, the cooperative posts at the location a sign which reads, "This Residence Qualifies As An Energy Efficient Home". The builder is also furnished with a certificate for presentation to the home buyer at closing.

Another major Seminole affiliation has been the Florida Electric Power Coordinating Group (FCG), a consortium of all state utilities - investor-owned, municipal and cooperative. This group has gained recognition as a national leader in the development of coordinated policy, power brokerage and joint system programs. Seminole has representatives on various FCG committees, including the Energy Conservation Committee. The Energy Conservation Committee in January submitted to the Governor of Florida a comprehensive energy conservation plan for residential consumer service. It incorporates a broad range of progressive energy conservation provisions. It provides for home energy audits, insulation and home weatherization assistance by utilities, research programs for conservation incentives and load management techniques, and broad consumer information and education programs through a variety of media. This document earned Florida utilities the distinction of being the first in the United States to file a conservation plan as required under the draft National Energy Act. The FCG committee is now in the process of developing similar conservation plans for state adoption in the commercial and industrial customer areas. In addition, a representative of one Seminole system member is included in the program of featured speakers on load management for a March, 1979, FCG system planning seminar.

One consequence of the FCG-drafted residential conservation plan will be energy audits by Seminole cooperative members. These audits, provided to requesting home owners, will involve checks by cooperative representatives to determine possible energy conservation measures, costs and savings. The program also includes assistance from the cooperative in selecting qualified contractors to perform selected work and in arranging for financing.

Even now, under a separate program, one of Seminole's members is participating in an Federal Housing Administration (FHA) plan for home weatherization loans for lower income households. The cooperative acts as an agent for the qualified homeowner - helping determine insulation needs, recommending contractors, inspecting completed jobs, obtaining the necessary financing and handling paperwork and administrative details. The cooperative also services these loans, for up to \$1500 over five years, by billing the borrower monthly and forwarding payments to the FHA. All funds come from the FHA.

This same cooperative began this year to provide loans of its own for up to \$300 over three years to help home owners for the cost of installation and weatherization. The cooperative provides similar consultation and assistance for this program as for the FHA loans.

Another area receiving extensive study relates to special circumstances within the Seminole system, as mentioned previously. At present, almost all the electric power for our distribution cooperatives comes by wholesale purchases from investor-owned utilities. The rates for these purchases are established by the utility supplier, based on factors that do not provide credit for load management equipment by the wholesale purchaser. In effect, the benefits of any cooperative efforts to reduce peaks will be distributed among all rate payers at the time of a rate increase. Under these circumstances, other wholesale purchasers can realize benefits resulting from load management by our cooperatives.

The impact of these factors on load management efforts is of very serious concern at this time. When Seminole begins providing substantial amounts of electric power and supplies an increasing proportion of member system needs, this impact will be lessened but not eliminated. A system of credits within the wholesale rate structure must be developed by the outside suppliers to create appropriate incentives and proper equity for load management on the part of our cooperatives. Seminole is now in the process of developing and proposing such a system.

It should be noted that, despite the problem discussed above, one of Seminole's members already has developed a test program for load management. Others also have similar programs under consideration. Seminole and its members are interested in evaluating potential alternatives to peak load control even if the proper mechanisms for rate credit do not now exist.

The advanced load management effort by a Seminole member involves residential service. The research is designed to determine potential for load reduction during peak demand periods. Some 500 different pieces of equipment at homes of volunteers participating in the program are hooked into load control system. The equipment includes the major residential energy consumers - water heaters, air conditions and electric heat. Individual switches can be controlled at load center to connect or disconnect each electrical appliance. The entire system is automated and under computer control. The switching devices disconnect loads in a programmed pattern of predetermined load levels. Water heaters will be dropped first - because of their heat storage capability prevents any residential inconvenience for several hours. If the electric demand continues to climb, a percentage yet to be determined of air conditioning or heating load can be cycled off on a five minute rotating basis. As demand drops to the pre-set levels, loads are returned to service in reverse order. The switching activity and effects are constantly monitored and recorded. The resulting data will be used to direct future load management efforts.

With respect to the impact on the Power Requirements Study, Seminole and its members took conservation and load management effects into account. The real impact, however, on future load and energy requirements cannot be fully evaluated at this time. A test program now underway and others to be initiated later will be closely evaluated. The potential for partially meeting power requirements through conservation and load management can then be assessed more accurately.

Table 1.2-1

History and Forecast of Seasonal Peak Demand and Annual Energy Requirements

(1)	(2)		(3)	(4)	(5)	(6)	(7)		(8)
	Summer Peak Demand						Winter Peak Demand		
	Net MW						Net MW		
<u>Year</u>	<u>Interruptible</u>	<u>Total</u>	<u>Net Energy</u>	<u>Factor</u>	<u>Year</u>	<u>Interruptible</u>	<u>Total</u>		
			<u>For Load - GWH</u>	<u>(%)</u>					
1968	0	220	1020.4	52.9	1968-69	0	230		
1969	0	268	1210.5	51.6	1969-70	0	305		
1970	0	320	1441.2	51.4	1970-71	0	351		
1971	0	365	1676.6	52.4	1971-72	0	371		
1972	0	466	2000.9	49.0	1972-73	0	519		
1973	0	556	2462.0	50.5	1973-74	0	589		
1974	0	602	2598.4	49.3	1974-75	0	650		
1975	0	628	2818.9	51.2	1975-76	0	802		
1976	0	702	3104.8	50.5	1976-77	0	952		
1977	0	767	3452.0	51.4	1977-78	0	1030		
1978	0	883	3807.4	49.2	1978-79	0	1104		
1979	0	982	4216.4	49.0	1979-80	0	1228		
1980	0	1093	4669.4	48.8	1980-81	0	1366		
1981	0	1206	5171.0	48.9	1981-82	0	1507		
1982	0	1330	5706.6	48.9	1982-83	0	1663		
1983	0	1468	6297.6	48.9	1983-84	0	1835		
1984	0	1620	6949.8	48.9	1984-85	0	2025		
1985	0	1788	7669.6	48.9	1985-86	0	2235		
1986	0	1973	8464.0	48.9	1986-87	0	2466		
1987	0	2177	9340.6	48.9	1987-88	0	2721		

Table 1.2-2

Two-Year Forecast of Peak Demand
and Energy Requirements by Month

(1) <u>Year</u>	(2) <u>Month</u>	(3) <u>Peak Demand - Net MW</u>		(5) <u>Net Energy For Load - GWH</u>
		<u>Interruptible</u>	<u>Total</u>	
1978	Jan	0	992	381
	Feb	0	927	320
	Mar	0	737	251
	Apr	0	647	267
	May	0	640	267
	Jun	0	722	286
	Jul	0	844	354
	Aug	0	883	358
	Sep	0	832	358
	Oct	0	785	381
	Nov	0	817	267
	Dec	0	941	317
	TOTAL			3807
1979	Jan	0	1104	422
	Feb	0	1031	354
	Mar	0	820	279
	Apr	0	720	295
	May	0	712	295
	Jun	0	804	316
	Jul	0	940	392
	Aug	0	982	396
	Sep	0	926	396
	Oct	0	873	422
	Nov	0	910	295
	Dec	0	1048	354
	TOTAL			4216

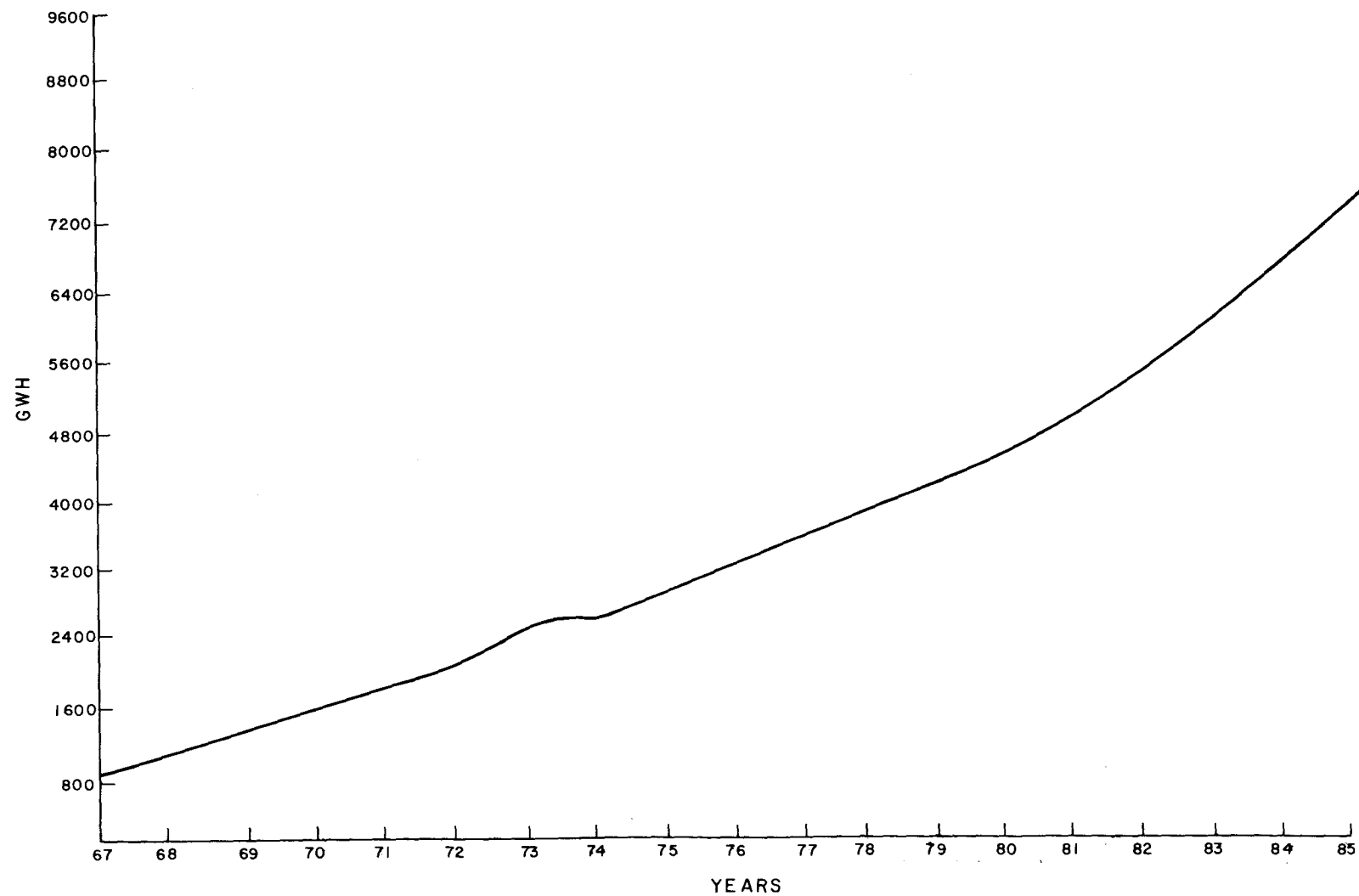


Figure 1.2-1. History of Forecast of Energy Use. (Gigawatt Hours).

1.3 POWER SUPPLY ALTERNATIVES

In July of 1973, Seminole began its present efforts at developing its own future power supply by initiating an investigation of possible power supply programs. Since that time, considerable activity has taken place in the direction of defining the power supply program to be sought. In January, 1975, Florida Power Corporation offered for sale 10 percent of Crystal River Unit #3 Nuclear Unit as well as capacity from other units under construction. On July 31, 1975, Seminole purchased 1.6994 percent ownership in Crystal River Unit #3. This capacity represents approximately 1.3 percent of the 1977/78 winter peak of 1030 megawatts (MW).

In 1976 the Seminole staff prepared a power supply plan with an objective of supplying reliable electric power at the lowest possible cost to its members by:

1. Substituting lower-cost Seminole capital for higher-cost investor company capital to be used in the construction of generating stations and transmission lines.
2. Eliminating income taxes as a cost by substituting cooperative non-profit ownership for investor-owned ownership of generation and transmission facilities.

The power supply plan reviewed fuel choices available, discussed the advantages and disadvantages of each, and concluded that basically, the only viable fuel sources available to Seminole would be coal and nuclear.

Because of the lead time required for construction of power plants, alternatives available to Seminole until mid-1983 were joint ownership in units under construction and those scheduled for commercial operation prior to the middle of 1983. Alternatives available to Seminole subsequent to mid-1983 were joint ownership and/or total ownership of

generating units. The Seminole staff was directed by a Resolution passed by the Seminole Board of Trustees on July 8, 1976, to investigate the possibilities of joint ownership in existing projects consisting of the following:

1. Tampa Electric Company 425-MW, coal-fired unit scheduled for commercial operation in 1981. (Commercial date now changed to March, 1985, per a response to the Federal Power Commission Order 383-4, dated April 1, 1978.)
2. Florida Power Corporation scheduled 600-MW, coal-fired unit scheduled for commercial operation in 1981. (Commercial date now changed to October, 1982, per a response to the Federal Power Commission Order 383-4, dated April 1, 1978.)
3. Joint participation in the Florida Power & Light Company St. Lucie II Nuclear Unit scheduled for commercial operation in 1981. (Commercial date now changed to 1983, per a response to the Federal Power Commission Order 383-4, dated April 1, 1978.)
4. Joint participation in the proposed 1140-MW nuclear units to be built at South Dade.
5. Joint participation in a nuclear plant to be located in Central Florida.

Seminole was also directed to investigate the feasibility of constructing its own generating plant subsequent to 1982.

The Seminole staff began investigating the possibilities of joint ownership.

Tampa Electric company (TECO) was approached by Seminole concerning the possibility of increasing the unit size of their proposed 1981, 425-MW, coal-fired unit to a 600-MW range with a 200-MW ownership share for Seminole and the balance of ownership with TECO. For their own business reasons, TECO declined the offer.

Seminole and Florida Power Corporation (FPC) have studied two scenarios per a letter agreement of December, 1976, concerning joint ownership by Seminole in Crystal River Unit #4 and Unit #5 with unit power sales to FPC from two 600-MW coal-fired units owned by Seminole. FPC is considering unit power purchases from the proposed Seminole Unit No. 1 scheduled for commercial operation in June, 1983, and Seminole Unit No. 2 scheduled for commercial operation in June, 1985. However, FPC has decided not to offer joint ownership in Crystal River Unit #4. FPC is still considering the joint ownership of Crystal River Unit #5.

Seminole has reached agreement with Florida Power & Light Company (FP&L) for a 6-percent entitlement share (48 MW) of St. Lucie Unit #2 Nuclear Unit (802 MW). Negotiations are proceeding on a participation agreement and the associated back-up services and transmission services. St. Lucie Unit #2 is scheduled for commercial operation in May, 1983.

Seminole expressed an interest to FP&L in the proposed 1140-MW nuclear units to be constructed at a site called "South Dade." FP&L refused to offer an ownership share to Seminole. Seminole entered into an antitrust action against FP&L along with other parties who had also been denied an ownership share in the South Dade units. In 1977, FP&L announced that the South Dade units would not be built as proposed due to changes in their load forecast which indicated that FP&L would not need the units as initially planned. There has been no indication as to when the South Dade project may be reactivated, but Seminole will again indicate an interest, if and when the project is activated.

Seminole participated in discussions of a nuclear plant that was proposed to be located in Central Florida. Seminole was a member of a Steering Committee formed by a group of interested utilities and continued to participate until it became obvious that the intent of certain utilities was not to actively work toward the goal of jointly constructing a nuclear power plant.

In addition to the possibilities in joint ownership investigated by the Seminole staff under direction from the Seminole Board of Trustees, Seminole has investigated the possibility of joint ownership in Deerhaven Unit #2 proposed for commercial operation in 1981 with the Gainesville Regional Utilities Board. Due to the cost involved, this project did not appear feasible for Seminole. Seminole has also discussed the possibility of joint ownership of coal and nuclear projects in the 1980's with Orlando Utilities Commission, and also considered the possibility of rejuvenating the Jackson Bluff Hydro Electric project (approximately 9-MW capacity) on Lake Talquin, northwest of the City of Tallahassee.

Seminole has also offered to Jacksonville Electric Authority (JEA) and FP&L unit power from the proposed Seminole Units No. 1 and No. 2, but as of the date of preparation of this document, no interest has been expressed by FP&L. Jacksonville Electric Authority has expressed, by letter, an interest in a unit power purchase of up to 250 MW from 1983 thru 1985.

Studies have been made for Seminole to determine the most economical and reliable means of providing power necessary to meet the requirements of the member cooperatives. The studies included the following alternatives:

1. Purchase of all power requirements.
2. Self-generation by unit facility owned by Seminole.
3. Joint ownership of generating unit(s).
4. Sale and purchase of generating capacity.
5. Combination of the above alternatives.

These studies have concluded that:

1. A combination of purchase power and generation owned by Seminole is the optimum way to meet the power requirements of the member cooperatives.
2. It is more economical for Seminole to enter into a joint ownership arrangement for incremental capacities in large base units than entering into generation with a number of small units.

3. It appears economical for Seminole to add to its system up to 700 MW of nuclear capacity within the next decade. However, this amount is not attainable due to the practical consideration of Seminole not being lead agent for a nuclear project.
4. The Seminole power supply program should include ownership of two 600-MW units, scheduled for commercial operation in June, 1983, and 1985, with associated unit power sales.

Based on studies made to date, Seminole's planned and prospective generating facility additions are as shown on Table 1.3-1, and are also shown on Table 1.3-2 and Table 1.3-3, which reflect the forecast of capacity, summer and winter peak demand in MW, and expected scheduled maintenance during the summer and winter peak periods respectively. Figure 1.3-1 and Figure 1.3-2 reflect Table 1.3-2 and Table 1.3-3 graphically.

Unit power sales from Seminole Units No. 1 and No. 2 are being offered to interested utilities. The maximum anticipated unit power sales available from Seminole Units No. 1 and No. 2, are shown on Table 1.3-4. Unit power sales are being offered to improve the economics of installing two 600-MW units on the Seminole system and are intended to integrate the retained capacity into the Seminole system in the most economical fashion.

Table 1.3-1

Planned and Prospective Generating Facility Additions and Changes

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
<u>Plant Name</u>	<u>Unit No.</u>	<u>Location</u>	<u>Type</u>	<u>Fuel</u>		<u>Const. Start Mo/Yr.</u>	<u>Com'l In-Service Mo/Yr.^a</u>	<u>Gen Max Nameplate KW</u>	<u>Net Capability</u>	
				<u>Pri</u>	<u>Alt</u>				<u>Summer MW</u>	<u>Winter MW</u>
St. Lucie	2	St. Lucie	N	N	-	-	7/83	-	48.1 ^b	48.1 ^b
Seminole ^c	1	Palatka	F	C	C	12/79	6/83	671,000	600	600
Seminole ^c	2	Palatka	F	C	C	12/81	6/85	671,000	600	600

^aThis column is to be used for dates of retirements and changes.

^bAn entitlement amount has been agreed to by the parties, a participation agreement and generation support services agreement is being negotiated at this time.

^cA sell back arrangement of capacity from each unit for a period of ten years is now under discussion.

Table 1.3-2

Forecast of Capacity, Demand, and Scheduled Maintenance
At Time of Summer Peak^a

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Year	Total Installed Capacity MW	Firm Capacity Import MW	Total Available Capacity MW	Peak Demand MW	Margin Before Maint.		Sched. Maint. MW	Margin After Maint.	
					MW	% of PK.		MW	% of PK.
1978	13.8	Will vary as needed to provide a minimum of 15% re- serve above system peak	-	883		15	0		15
1979	13.8		-	982		15	0		15
1980	13.8		-	1093		15	0		15
1981	13.8		-	1206		15	0		15
1982	13.8		-	1330		15	0		15
1983	61.9		-	1468		15	0		15
1984	661.9		-	1620		15	0		15
1985	661.9		-	1788		15	0		15
1986	1261.9		-	1973		15	0		15
1987	1261.9		-	2177		15	0		15

^aCapacity additions and changes must be made by May 31 to be considered in effect at the time of the Summer peak. All values are Summer Net MW.

Table 1.3-3

Forecast of Capacity, Demand, and Scheduled Maintenance
At Time of Winter Peak^a

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Year	Total Installed Capacity MW	Firm Capacity Import MW	Total Available Capacity MW	Peak Demand MW	Margin Before Maint.		Sched. Maint. MW	Margin After Maint.	
					MW	% of PK.		MW	% of PK.
1978-79	13.8	Will vary as needed to provide a minimum of 15% re- serve above system peak	-	1104		15	0		15
1979-80	13.8		-	1228		15	0		15
1980-81	13.8		-	1366		15	0		15
1981-82	13.8		-	1507		15	0		15
1982-83	13.8		-	1663		15	0		15
1983-84	661.9		-	1835		15	0		15
1984-85	661.9		-	2025		15	0		15
1985-86	1261.9		-	2235		15	0		15
1986-87	1261.9		-	2466		15	0		15
1987-88	1261.9		-	2721		15	0		15

^aCapacity additions and changes must be made by November 30 to be considered in effect at the time of the Winter peak. All values are Winter Net MW.

Table 1.3-4

Seminole Electric Cooperative, Inc.
Maximum Anticipated Unit Power Sales
Available From Seminole Unit 1 and Unit 2

<u>YEAR</u>	<u>SEMINOLE UNIT NO. 1</u>	<u>SEMINOLE UNIT NO. 2</u>
1983	400	-
1984	400	-
1985	400	400
1986	300	400
1987	300	400
1988	300	300
1989	200	300
1990	200	300
1991	100	200
1992	100	200
1993	-	100
1994	-	100

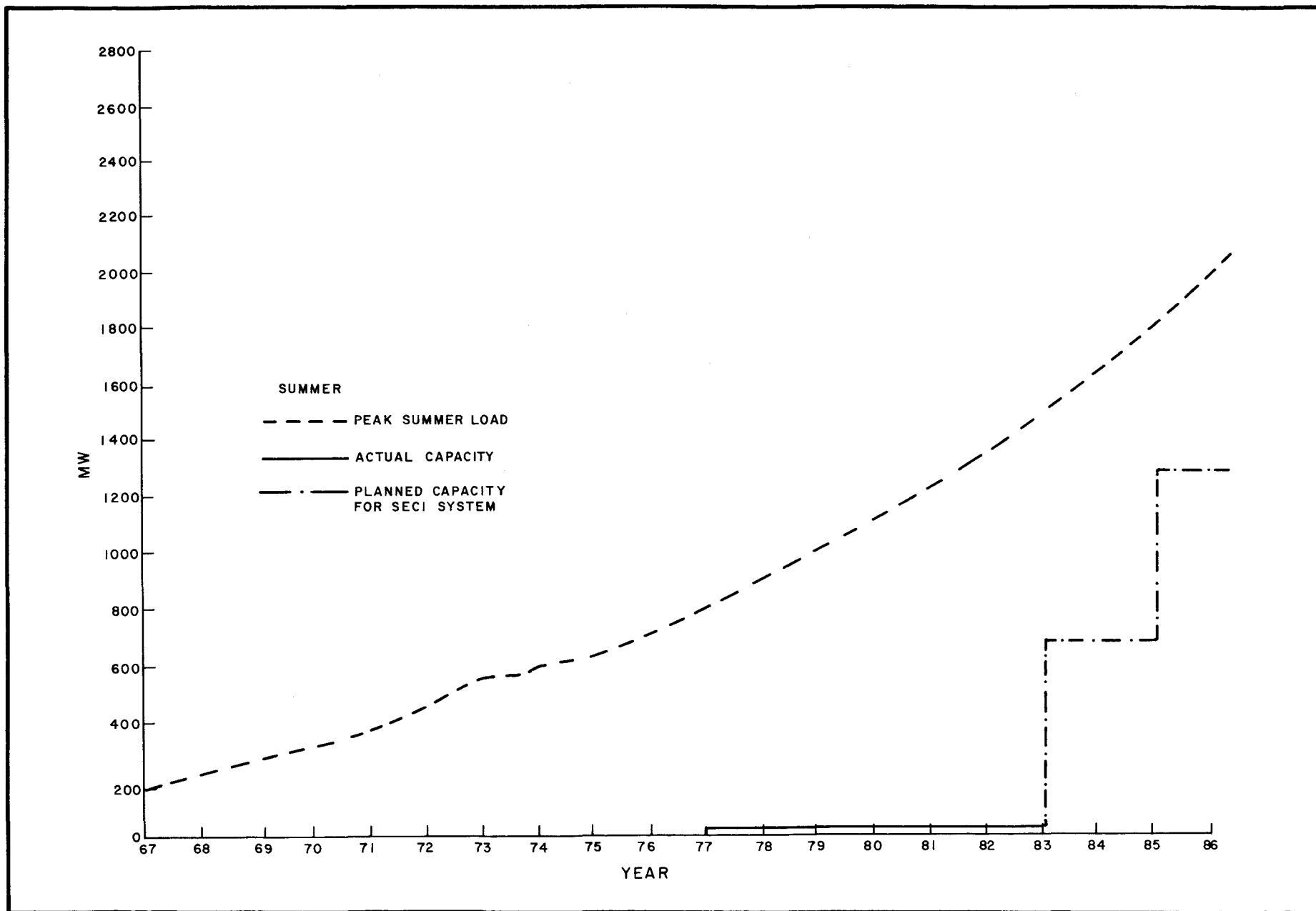


Figure 1.3-1. SECI History and Forecast of Load and Capacity Additions --Summer.

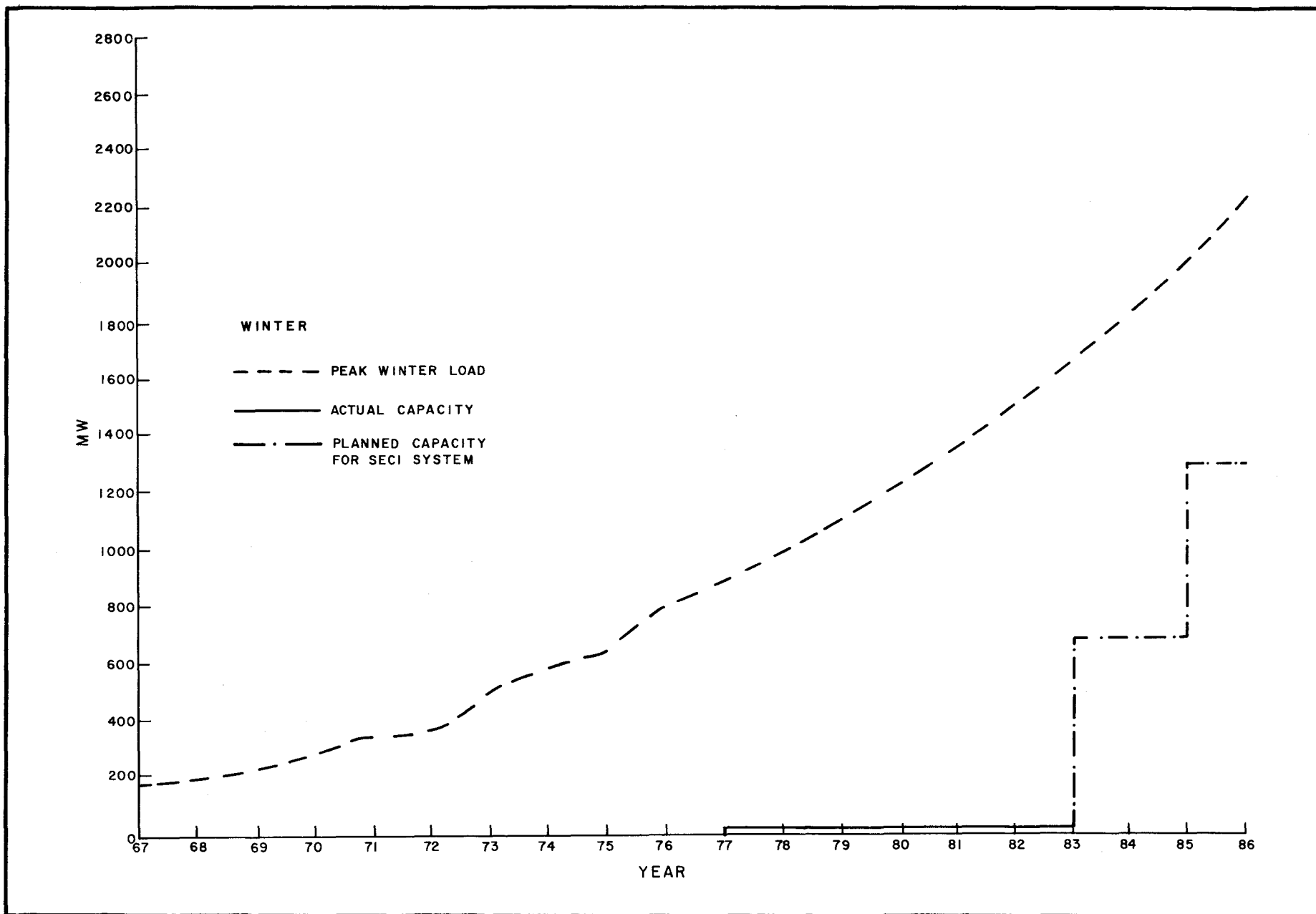


Figure 1.3-2. SECI History and Forecast of Load and Capacity Additions --Winter.

1.4 CONSEQUENCES OF DELAY OR NO ACTION

Seminole is concerned about its ability to adequately provide power and energy to its members in the future, due to the fact that more than 90 percent of its power requirements are purchased under a rate tariff and not under a purchase power contract. Only a year ago, when a combination of frigid weather and mechanical problems crippled the State's largest electric utility, we learned that the remaining generating facilities could not carry the electric load that people placed on the system. We had our first cold weather blackout. Radio and TV stations were silent, schools were urged to close, thousands of citizens rose to an icy chill. In February there was an emergency alert by Florida Power Corporation, and although no customers were disconnected, we were very close to that point. This illustrates vividly the thin margin between supply of, and demand for electric power in Florida at this time. Private electric utilities in the State are projecting low growth, as low as 5 percent per year, even though this is only half of their recent historic average growth rate. This compares to Seminole's growth rate of slightly better than 10 percent per year. At the present time, about half the generation in the State is oil; roughly 20 percent is nuclear, and 20 percent coal; the balance is natural gas and a very small amount of hydroelectric. Even if the low projection of growth rate by the private utilities is correct, and they are able to build generating units on the schedule that they have projected - how secure is the State's power supply? Our oil supply depends primarily on the OPEC nations. There are problems with two of the major nuclear units located at Turkey Point. It appears that both of these units have to shut down for an extended period for repair of steam generator tubes. The nuclear plant at Crystal River is now out of operation and under repair. It appears that it may be as much as nine months before this unit again is capable of producing energy. FPC is at this time experiencing environmental permitting problems with the new oil units at Anclote. Seminole, now buying most of its power wholesale from various companies, does not feel very secure in the power supply it is now receiving, even if everything goes as planned by its vendor companies.

Let's suppose it does not go by plan, and the growth rate for electric demand for these companies is 10 percent instead of 5 percent. Let's say that they do not bring the scheduled generating units in on time, as has been normal in the last five years; or what if there is another oil embargo; or what if the nuclear units cannot be repaired or repairs take much longer than anticipated? If any of these things should happen, we would have a critical power shortage in Florida. As a wholesale purchaser of power from these companies, we are very nervous about a decision the power supplier would have to make "Which customers are to be without service - the wholesale or the retail, or a combination?" Therefore, it is our opinion that delay of Seminole's two proposed 600-MW, coal-fired units would compound the already questionable power availability situation and greatly increase Florida's exposure to power shortages.

In addition to the overall impact of potential power shortages, no action on Seminole's proposed project would have a substantial financial impact on Seminole and its members. Over the initial 12-1/2 years of operation, the anticipated savings associated with this project will be close to \$300,000,000. No action on this project would have substantial economic consequences and would place Seminole in a very questionable position with respect to its ability to provide adequate power and energy to its members.

1.5 NEED FOR POWER

The facts, simply stated, are that Seminole had a system demand of 1030 MW in February 1978, with 13.8 MW of self-generation. If Seminole grows at the rate discussed earlier, by the time the first Seminole 600-MW unit goes into commercial operation in June 1983, the expected '83/'84 winter peak demand will be 1835 MW, and the expected installed capacity will be 661.9 MW, assuming Seminole purchases 48.1 MW of St. Lucie Unit #2. By commercial operation of Seminole Unit No. 2 in June 1985, Seminole's '85/'86 winter peak demand will have grown to 2235 MW, and the expected installed capacity will be 1261.9 MW. If Seminole grows at one-half the predicted growth rate, the demand will be 1384 MW for the '83/'84 winter peak compared to an installed capacity of 661.9 MW. At one-half the growth rate, the '85/'86 winter peak will grow to 1532 MW compared with an installed capacity of 1261.9 MW. Either way, there can be no question about the need for power.

2.0

THE STATION SITE

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2.0 THE STATION SITE

2.1 LOCATION

The preferred site for the Seminole Units No. 1 and No. 2 is located in the northeast part of Putnam County, Florida, about 5 miles north of the City of Palatka (see Figure 2.1-1). The geographic coordinates of the center of the site are 29° 44' north latitude and 81° 38' west longitude. The site property (Figure 2.1-2) covers 1,976 acres.

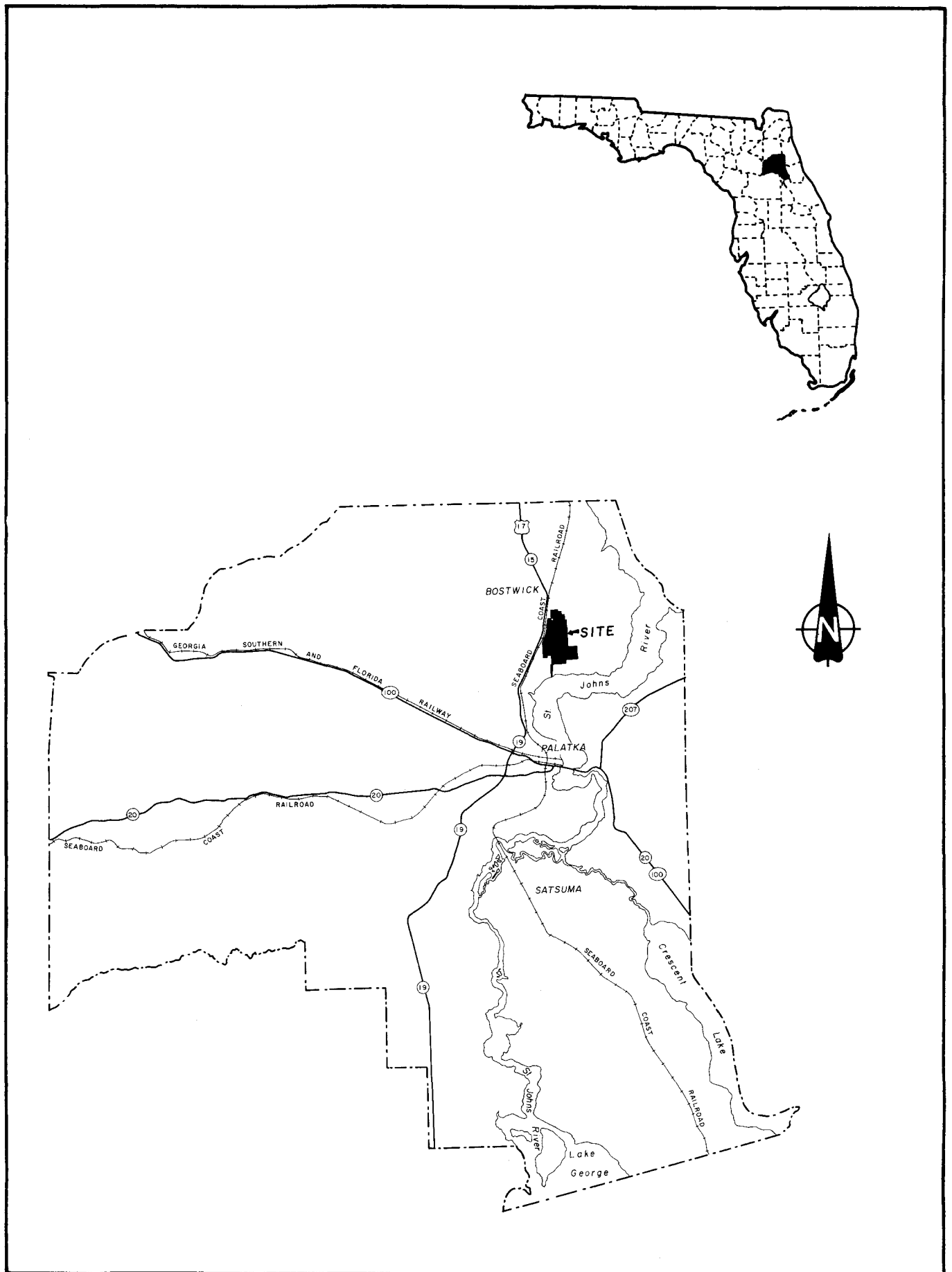


Figure 2.1-1. Site Location Map.

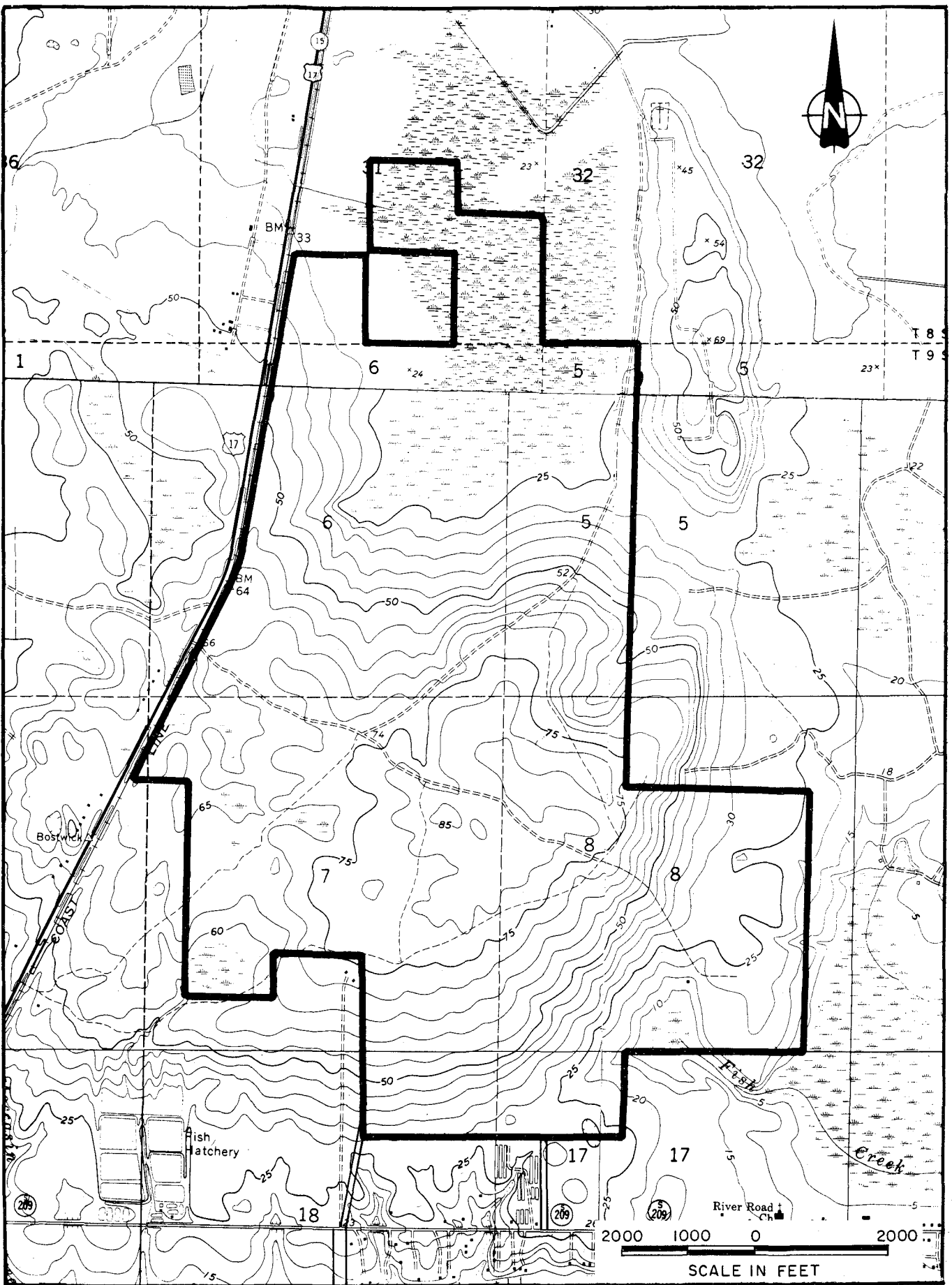


Figure 2.1-2. Putnam Site Property Boundaries.

2.2 GEOLOGY AND SOILS

2.2.1 General

The Florida peninsula is the partially emerged portion of a large plateau that extends from the main mass of the North American Continent. The peninsula is considered by a number of geologists (King P.B., 1950; King E.R., 1959; Murray 1961 and 1963) to be an extension of the Appalachian and/or Ouachita structural belts, but definite relationships are as yet undetermined (Chen, 1965).

Although Florida has undergone a fairly complex geomorphologic history, the present-day landforms in the vicinity of the site are relatively simple, being dominated by the St. Johns River and a series of marine terraces. A description of these and their origins is presented in Section 2.2.3.

Stratigraphy is discussed in general terms in Section 2.2.4. The sequence, composition, characteristics, and continuity of the upper materials pertinent to the site from a groundwater and construction-development standpoint are addressed in greater detail in Sections 2.2.7 and 2.3.2.1.

The more important events of three geologic eras are introduced in the present discussions:

- ° Paleozoic Era: Two categories of Paleozoic rocks are distinguished and their boundary delineated by the "Applin Line." Defined by Applin, (1951) as the contact zone between the deep-seated, unmetamorphosed Paleozoic sedimentary rocks to the northwest and Paleozoic crystalline rocks to the southeast; it trends northeasterly just east of the Putnam Site.
- ° Mesozoic Era: The Mesozoic witnessed a major depositional phase which carried on into the Cenozoic and, in southern Florida, resulted in the accumulation of more than 18,000 feet of marine sediment, mainly carbonates. In the northern areas, in which the oceans subsided more slowly, a thinner section of mixed carbonates and terrigenous elastic sediments were deposited in shallower marine and coastal environments.

- ° Cenozoic Era: The formations of interest in the vicinity of the site include the Eocene limestones, which constitute the potable extent of the Floridan Aquifer, the Miocene Hawthorn Formation, which acts as an aquiclude for the Aquifer, and the post-Hawthorn to recent sand silts, silty sands, and clean sands which comprise the water table aquifer and which will become the foundation materials for the proposed station.

The Peninsular Arch, which trends south-southeast just west of the site, is one of the major regional subsurface structures. The arch slopes gently to the southeast. Formed in Paleozoic rock, it remained a topographic high until late Cretaceous time and continued to influence deposition in the Cenozoic Era. The Ocala uplift, the fault immediately west of the site, and other structural features are discussed in greater detail in Section 2.2.5.

The Florida peninsula and adjacent continental shelves have been tectonically stable throughout the Mesozoic and Cenozoic Eras (Rainwater, 1971). Moreover, the peninsula is one of the most seismically stable areas of the United States (Algermissen, 1969). Earthquake history is discussed further in Section 2.2.6, while soils and geotechnical conditions pertinent to an environmental assessment are outlined in Section 2.2.7.

2.2.2 Method of Investigation

The geologic investigation was undertaken in essentially two discrete phases: a preliminary study and a more detailed site-specific investigation.

The purpose of the first phase, a preliminary study, was to establish whether any geotechnical "fatal flaw" nature existed at the proposed site. The scope of work for this phase consisted of a preliminary review of the published literature, onsite studies which included three subsurface borings sampled to depths on the order of 100 feet below grade, and the analysis of site specific data within the framework of existing regional information. Favorable findings of this study established the basis for proceeding with more detailed work.

Based on a Modified Mercalli isoseismal map presented in Figure 2.2-12, it is estimated that the Charleston shocks could be projected to the site with an intensity of MM VI. A projection of the New Madrid earthquakes would be MM V or less at the site indicated in Figure 2.2-13. Effects at the Putnam Site were, therefore, not extensive.

Another area that could conceivably exert a seismic influence in the Florida peninsula is the Caribbean Seismic Belt. The most active area in this region is in and around Cuba. The fact that the strongest earthquakes in Cuba are a considerable distance from the site, and that they have not been stronger than intensity MM VIII, makes them of little consequence to the Putnam Site.

In summary, historic evidence indicates that the Putnam Site has been exposed in only a small way to seismically induced ground motions generated within Florida or in adjacent regions.

2.2.7 Soils and Geotechnical Conditions

Surface and Surficial Conditions

The central portion of the site includes approximately 150 acres of relatively level ground above 75 feet MSL, while the highest elevation attained is approximately 85 feet MSL (Figure 2.2-14). The steepest gradients from this high ground are toward the southeast and northeast. The northern extension of the property includes a swamp lowland bounded by the 25-foot contour, the lowest elevation on site. The St. Johns River is within a mile of the site and meanders east and then north so that it is both south and east of the site.

With the exception of the northern lowland (which shows a surficial cover of organic silt to a depth of approximately 4 feet) and the restricted depressions on the higher ground (which showed abundant organic material to a depth of 3 feet below surface), the property is underlain by a well drained, loose, sandy cover.

The water table is subject to precipitation fluctuations. Measurements to date have ranged from about 2 feet below surface (in upland depressions) to approximately 15 feet below surface. The northern lowland is damp even in relatively dry weather and is reported to be waterlogged in very wet weather (see Section 2.3.2).

Sinkhole and/or Cavernous Conditions

Studies undertaken to date suggest that the area surrounding the site is relatively free of major sinkhole or extensive solution-related activity, this being associated more with areas of western and southeastern Putnam County. However, since the general region is characterized in many places by typical karst features, this matter was given considerable attention.

The only surface expressions of possible sinkholes on the property were isolated circular and semi-circular shallow depressions in the southwestern portion of the site. A boring (No. 2-1, Figure 2.2-14) was located in the most obvious of these features. The correlation of subsurface layers revealed by the boring with the general lithologic profile of the site (Figure 2.2-15) indicates that these lows are not associated with sinkhole expression at depth, but are rather natural drainage features.

Because of the substantial thickness of overburden and its potential ability to support heavy foundations, the limestones have not been extensively sampled.

Engineering Nature of Subsurface Materials

The generalized profile consists of approximately 200 feet of unconsolidated sediments (over the high areas of the site property) underlain by a considerable thickness of limestones. This overburden layer showed a "draped" effect over the area sampled. Although the surface elevation of borings differed by some 30 feet, the thicknesses of the

upper sediment layers intersected remained essentially constant. This would, in all probability, not extend as such into the lower-lying areas of the site, and the depressed (+25 feet MSL) northern extension of the property may be expected to be underlain by a somewhat lesser thickness of sand.

Over the area sampled, the overburden shows three broad geotechnically distinguishable and horizontally continuous layers (Figure 2.2-15): a clean medium dense to dense sand to a depth of 40 feet below surface; a transitional zone of increasing fines consisting of interbedded lenses of clean sand and silty or clayey sand between 40 and 100 feet below surface; and finally a very dense or very stiff to hard, relatively impervious layer, the Hawthorn Formation, between 100 and 200 feet below surface (~130 feet MSL). The detailed geotechnical characteristics of these layers are described in Appendix E.

Appendix E also includes data such as subsurface boring logs and laboratory test results, conclusions regarding potential ability to support foundation loads, and suggestions pertinent to an environmentally optimum layout of major plant facilities.

Conclusions

Some of the more salient conclusions regarding soils and geotechnical conditions are:

1. A preliminary evaluation suggests that, due to the magnitude of seismic events that could affect Florida, foundation stability will not be affected by the loss of shear strength due to liquefaction of the fine sand material at the site.
2. Based on studies to date, it is the opinion of Dames & Moore that, with the possible exception of the stacks (the resistance to the high overturning moments due to wind loading were not investigated), structures in the power station complex may be supported on shallow foundations at economical bearing pressures.

3. Since the ground water table onsite is relatively high and the upper sands are relatively permeable, major earthwork requiring dewatering should be kept to a minimum.
4. Other conclusions are incorporated in Section 9.3.1 Environmental Site Layout Guidelines.

APPENDIX E

GEOLOGY/SOILS

E.1 INTRODUCTION

The objective of this Appendix is to provide a broad geotechnical description of the materials underlying the Putnam Site and to present sufficient data to support this description. Although a preliminary evaluation is made of the suitability of these materials for potential foundation support, it may be emphasized that the level of effort expended was aimed at addressing those issues of relevance to an environmental analysis, and consequently should not be misconstrued as being sufficiently definitive to permit an initiation of foundation design.

It is also stressed that although the general geology of the region was taken into account in analyzing local subsurface conditions, the geologic setting of the site is not addressed in this Appendix, and the reader is referred for this information to Section 2.2 in the main body of the text.

The main emphasis of this work relates to the following:

1. the engineering nature of subsurface materials, in particular with respect to variation both vertically and horizontally of unconsolidated materials; any anticipated foundation problems and the relative suitability of existing subsurface conditions for the proposed facilities,
2. the identification of any mitigating measures that could be implemented to either reduce environmental impacts, or improve, from a geotechnical standpoint, the design layout of major plant facilities.

E.2 GEOTECHNICAL PROGRAM

The description of the subsurface conditions of the site is based on 5 exploratory test borings ranging in depth from approximately 100 to 200 feet below existing grade and by a number of hand auger holes to a maximum depth of 8 feet.

Samples were taken at intervals of 5 feet to 100 feet and at either 5 or 10 feet between 100 feet and 200 feet below surface, and all unconsolidated materials were described in terms of the Unified Soil Classification System (Figure E-1). Standard Penetration tests furnished the bulk of samples for identification and provided the main source of quantitative data. The laboratory program consisted predominantly of index-type testing including Atterberg limit tests, moisture and density determinations, and particle size analyses. These assisted in the engineering classification of materials. A few relatively undisturbed samples were taken at selected locations for more sophisticated testing (triaxial compression, direct shear, and consolidation tests).

Boring logs presenting the data collected during the program described above are included in Figures E-2 through E-9. Legend is shown on Figure E-10.

Boring 2-1 was located in a shallow semi-circular depression to assess the depression's possible association with collapsed cavern activity at depth. No such association was found. Further, an aerial photograph analysis showed no sinkhole-related features in the immediate vicinity of the site.

E.3 DESCRIPTION OF SOILS

The surficial soil characteristics of the site are shown in a surface soil map prepared by the U. S. Soil Conservation Service (1973) (Figure E-11). Beneath surficial deposits, the area sampled showed three broad geotechnically distinguishable and horizontally continuous layers (Figure 2.2-15). The geotechnical characteristics of these layers are described below:

1. Layer 1 consists of a clean fine to medium sand extending over most of the high ground of the site, to a depth of approximately 40 feet below surface. Based on typical standard penetration test 'N' values, this sand may be described for the most part as "medium dense" to "dense."

The gradational characteristics of the layer are shown in Figure E-12. Sieve analysis showed a silt and clay size fraction of up to 15 percent. Based on typical gradational characteristics, the coefficient of permeability of these sands is estimated to be on the order of 10^{-3} cm/sec. A preliminary evaluation of a field pumping test, however, suggests a somewhat higher value of 2×10^{-2} cm/sec.

The natural moisture content of samples tested ranged from about 14 percent to 25 percent (with corresponding natural dry densities of 121 and 99 pcf). Laboratory direct shear tests on samples taken from 11 feet and 22 feet below surface in Boring 2-1 showed shear strengths of 900 and 1550 psf under normal pressures of 1000 and 2000 psf, respectively. Shear strengths, in general, may be expected to increase with depth or with increasing confining pressures.

This sand layer constitutes an upper, unconfined, or water table aquifer, with the water table existing at about 8 feet below surface at the time of drilling.

2. Layer 2 is an interbedded layer extending typically between about 40 feet and 100 feet below surface. This layer is distinguished from the clean sands overlying it, by its increasing content of fines and from the layer underlying it, by that layer being more cohesive in makeup.

The unit characteristically contains interbedded silty and clayey sands and clean sands with 'N' values on the order of 15 to 50 and, as with the overlying clean sand above, may again be best described as "medium dense" to "dense." As is apparent from the logs, however, anomalies do exist in the form of low blow count materials, (less than 10 blows per foot) generally between 60 and 80 feet below surface. These few areas of low

blow count material should be looked at in more detail in the foundation investigation, but may well be the result of a "quick" condition which can exist at the tip of the split spoon during driving, rather than an indication of "very loose/soft" material.

Based on limited classification tests, this layer appears to consist predominantly of granular (non-plastic) materials. With the exception of a clay lens at approximately 50 feet below surface (Figure E-5) the soils comprising Layer 2 tended to show a fine fraction (material passing the number 200 seive) of up to 25 percent (Figure E-13). The natural moisture content ranged from 22 to 41 percent (with corresponding dry densities of 104 and 80 pcf, respectively).

3. Layer 3, the lowest overburden layer identified, extends from approximately 100 feet below surface to the top of the limestone intersected at approximately 200 feet. This unit is characterized by interbedded layers containing an overall higher percentage of fines, a notable lack of clean sands and significant thicknesses of cohesive materials. Materials within unit 3 were described typically as hard sandy clays grading with lenses of clayey and silty sands, clayey silts and occasionally with hard inorganic clays. 'N' values of these materials ranged from about 30 to approximately 100 suggesting consistencies of "very stiff" to "hard" for cohesive soils and "medium dense" to "dense" for granular soils.

Once again the individual beds within this unit appear to be lenticular and gradational in a lateral direction.

Sieve analyses from Layer 3 typically show approximately 50 percent of material finer than the number 200 sieve (Figure E-14). These materials may be expected to show an average coefficient of permeability on the order of 10^{-8} cm/sec and are therefore relatively impermeable. Tests showed the natural

water content to range from 35 to 57 percent with corresponding dry densities of 86 pcf and 68 pcf, respectively. The high 'N' values throughout the thickness of this layer should correspond with high unconfined compressive strengths in the clay zones.

Unit 3 corresponds with the Miocene Hawthorn Formation discussed in Section 2.2.4. It constitutes the major confining layer or aquiclude to the underlying limestones which comprise the Floridan Aquifer. Its effectiveness as an aquiclude demonstrates, on a large scale, its overall low permeability.

Deep borings on site show the top of the Eocene limestone dipping to the northwest as approximately 50 feet per mile. This corresponds with the direction of the near-regional trend. It is, however, somewhat steeper than average dips over the area depicted in Figure 2.2-6. In addition, a microscopic examination of the limestone sampled suggests that the uppermost limestones underlying the site belong to the Crystal River Formation. This means that the contact between the Crystal River Formation and the Williston Formation extends slightly to the south of the contact shown in Figure 2.2-6.

E.4 FOUNDATION SUITABILITY

Liquefaction Potential

An assessment of liquefaction potential is not a requirement for the licensing of a steam-electric generating plant. However, good engineering practice dictates that any condition which might reasonably be expected to affect the stability of the foundation materials should be examined. Thus, the liquefaction potential of the soils at the site has been reviewed, using the simplified Seed & Idriss approach.

This approach, first presented in Seed & Idriss (1971) was updated and modified slightly as more data became available (Seed, 1976). This is an empirical method based on field observations of the performance of sites at which liquefaction has, or has not occurred during previous

earthquakes. Briefly, the procedure is to compare blow counts from the standard penetration tests, which have been corrected to an effective overburden pressure of 1 ton/sq. ft., with an empirical relationship of corrected blow count for which liquefaction may occur. This empirical relationship is a function of peak ground acceleration and earthquake magnitude.

As described in Section 2.2.6, the Florida peninsula is one of the least seismically active regions in the United States. For the purpose of the analysis of liquefaction potential, a conservative peak ground acceleration of 0.1g was assumed.

The variation of blow count with depth is shown in Figure E-15. This plot shows overall high values, a few low values and a general scatter of results. Figure E-16, a plot of 'N' values against elevation, shows a similar trend, with the scatter of results indicating neither high nor low value material showing lateral continuity.

Since Boring 1 is nearest to the probable location of major foundation bearing structures, the standard penetration values from this bore hole were corrected to allow for effective overburden pressure, and plotted against depth below surface (Figure E-17). The fact that corrected blow counts to a depth of 50 feet (the range of depth for which the empirical relationship is valid) plotted outside of the zone where liquefaction is likely to take place, shows that liquefaction will not occur. Consequently, it is Dames & Moore's opinion that foundation stability will not be affected by the loss of shear strength due to liquefaction of the fine sand material at the site due to a 0.1g peak ground acceleration.

Foundation Assessment

The type of foundation most appropriate for a given structure depends upon several factors: (1) the function of the structure and its size; (2) the type and magnitude of the imposed load; (3) the subsurface conditions; (4) the tolerance of the structure to differential settlements; and (5) relative costs of foundation types.

Using preliminary information provided by Burns and Roe, Inc. as to the anticipated size and loading conditions of the structures in the power plant complex, the generalized soil profile, and the basic engineering properties determined during the field and laboratory program discussed previously, the suitability of different foundation types was assessed for the support of these structures.

Based on present knowledge, it is Dames & Moore's opinion that, with perhaps one exception to be discussed later in this section, the structures in the power plant complex may be supported on shallow foundations at economical bearing pressures and that construction may be undertaken with minimal dewatering.

For a given soil profile, the anticipated performance of a particular building foundation type and size is evaluated by considering both bearing capacity and settlement. In almost all cases, the allowable contact pressure is governed by settlement considerations rather than bearing capacity. A preliminary evaluation of the foundation conditions of this site indicates this to be the case; that is, the design allowable bearing pressure will be a function of the allowable settlement. The permissible contact stress will depend also on the size of the foundation, but will probably range from 6.0 kips/sq. ft. to 10.0 kips/sq. ft.

The settlement of the structures may be divided into two categories; namely, elastic settlement and consolidation settlement. The distinction between these two components of the total settlement is important because the elastic settlement is essentially "built out" during the construction process, while the consolidation settlement can be expected to continue after the plant is operational. For a given soil profile, the magnitude of both types of settlement increases with increasing contact pressure, and for equal contact pressure with increasing foundation size.

It is anticipated that the more heavily loaded structures in the plant complex will undergo elastic settlements on the order of 2 to 4 inches. It is again emphasized that this settlement will take place

during construction and should not affect the integrity of structures. Consolidation settlement under the major structures on the order of one inch or less may be expected. This is within the tolerance of all but the most sensitive structures.

Depending on the preferred plant grade and final foundation design elevations, it may be necessary to densify the surficial soils (upper 5 to 8 feet) to reduce the contribution of this upper material to the total settlement. This may be accomplished by in situ compaction or by excavation and replacement with compacted fill. Densification may also be required to a slightly greater depth under foundations which are subject to vibration; for instance, the turbine mat.

On the basis of this preliminary assessment, there is one loading condition for which a shallow foundation may not be adequate, or, if adequate, not economical. It is very possible that piles may be necessary to provide uplift resistance sufficient to withstand the high overturning moments due to wind loading on the stacks.

Alternate Foundation Types

The information presented in this section is based on the relatively small body of data available at this time. If subsequent analyses of field and laboratory data gathered for the actual foundation design indicated conditions less suitable than those encountered in this set of borings, other foundation types may have to be considered. Such alternative foundations include piles (friction or end bearing), caissons, or, perhaps, some form of soil stabilization in conjunction with deep foundations. It is emphasized that deeper foundations do have several inherent drawbacks, including, for example, the need for engineering data at proportionally greater depths. Also, if the centroid of loads in pile groups is in, or quite close to, the limestone (causing an increase in stress in the limestone), the question of possible solution features in the rock mass becomes a significant consideration.

Table 2.2-1

GEOLOGIC AND HYDROGEOLOGIC CHARACTERISTICS OF STRATIGRAPHIC UNITS

Geologic age	Stratigraphic unit		Approximate thickness (feet)		General lithologic character		Water-bearing properties
Recent and Pleistocene	Western Putnam Co.	Remainder of area	Western Putnam Co.	Remainder of area	Western Putnam Co.	Remainder of area	
Pliocene(?)		Pleistocene and Recent deposits	40	20-140	Poorly sorted fine to very coarse sand, kaolin, and sandy clays	Fine to medium sand, shell and green calcareous silty clay lenses	Nonartesian aquifer: zones of relatively high average permeability, generally supplies small to moderate amounts of water to rural domestic wells and municipal wells tapping coquina or medium to coarse sand beds; yields vary locally depending upon texture and extent of deposits.
Miocene	Post-Illaworth to Recent deposits	Late Miocene or Pliocene deposits	140 to	20-100			Nonartesian and secondary artesian aquifers: zones of relatively low average permeability locally yield small amounts of nonartesian water to wells tapping medium to fine grained sands in the Pleistocene and Recent deposits. Late Miocene or Pliocene deposits and in the Illaworth Formation; locally yield moderate amounts of artesian water to wells tapping shell bed in the late Miocene or Pliocene deposits and sand and limestone lenses in the Illaworth Formation.
	Illaworth Formation		0-120		Gray to bluish-green, plastic phosphatic, sandy clay; and thin beds of sand and sandy limestone		Impermeable clays and marls in both the Late Miocene or Pliocene deposits and in the Illaworth Formation confines the artesian water in the Eocene Limestones and in the thin, lenticular sand, shell, and limestone beds above the Eocene Limestone.
	Crystal River Formation		0-120		White to cream, chalky, massive fossiliferous, marine, limestone		Floridan aquifer: yields large quantities of water to wells; utilized as the primary source of ground water in the project area. The formations that comprise the Ocala Group are similar in lithology and hydrologic properties and are considered to be a single hydrologic unit.
	Williston Formation		0-50		Tan to buff, granular, marine limestone		
Eocene	Ocala Group ¹						Yields large amounts of water from soft, porous zones but dense, indurated zones restrict permeability so that generally yields are not as large as from overlying Ocala Group.
	Ingis Formation		55(-) - 110		Tan to buff, coarsely granular to mealy, marine limestone; contains thin beds of dolomite and zones of foraminiferal coquina		
	Avon Park Limestone		150-245		White to reddish-brown, hard, dense limestone and dolomite; contains restricted zones of soft, porous, and locally chalky limestone; formation more completely dolomitized west of St. Johns River		
	Lake City Limestone		225+		Alternating beds of brown to buff, porous limestone; brown to white, massive limestone; bluish-gray to tan, dense, crystalline dolomite		

AFTER: B. J. BERMES, G. W. LEVE, AND G. R. TARVER 1963

Table 2.2-2

SIGNIFICANT EARTHQUAKES THAT HAVE AFFECTED THE FLORIDA PENINSULA

<u>Year</u>	<u>Date</u>	<u>Time</u>	<u>Intensity</u>	<u>Location</u>	<u>N. Lat.*</u>	<u>W. Long*</u>	<u>Felt Area (Sq. Miles)</u>
1811	Dec. 16	02:00	XII	New Madrid, Mo.	36.6	89.6	2,000,000
1812	Jan. 23	-	XII	New Madrid, Mo.	36.6	89.6	-
	Feb. 07	-	XII	New Madrid, Mo.	36.6	89.6	-
1868	Mar. 26	-	VI-VII**	Havana, Cuba	23.1	82.4	-
1879	Jan. 12	23:45 23:55	VI	Northern Florida	29.6	82.0	25,000
1880	Jan. 27	22:33	VIII	Vuelto Abajo, Cuba	22.8	80.8	65,000
	Jan. 23	04:00					
1886	Aug. 31	21:51 21:59	IX-X	Charleston, S. C.	32.9	80.0	2,000,000
1900	Oct. 31	11:15	V	Jacksonville, Florida	30.4	81.7	Local
1930	Jul. 19	13:53	IV**	Ft. Myers-Everglades, Florida	25.8	81.4	Local
1942	Jan. 19	14:05	IV**	Ft. Myers-Everglades, Florida	25.9	81.0	-
1945	Dec. 22	11:25	I-III	Miami-Hollywood, Fla.	25.9	80.1	Local
1973	Oct. 27	02:22	V	Orlando, Florida	28.7	81.0	25,000
1975	Dec. 04	06:57	III-IV	Near Daytona Beach	29.2	81.0	Local

* Approximate epicentral location

** Seismic origin questionable

References: Earthquake Information
Bulletin, 1971

Coffman and Von Hake, 1973

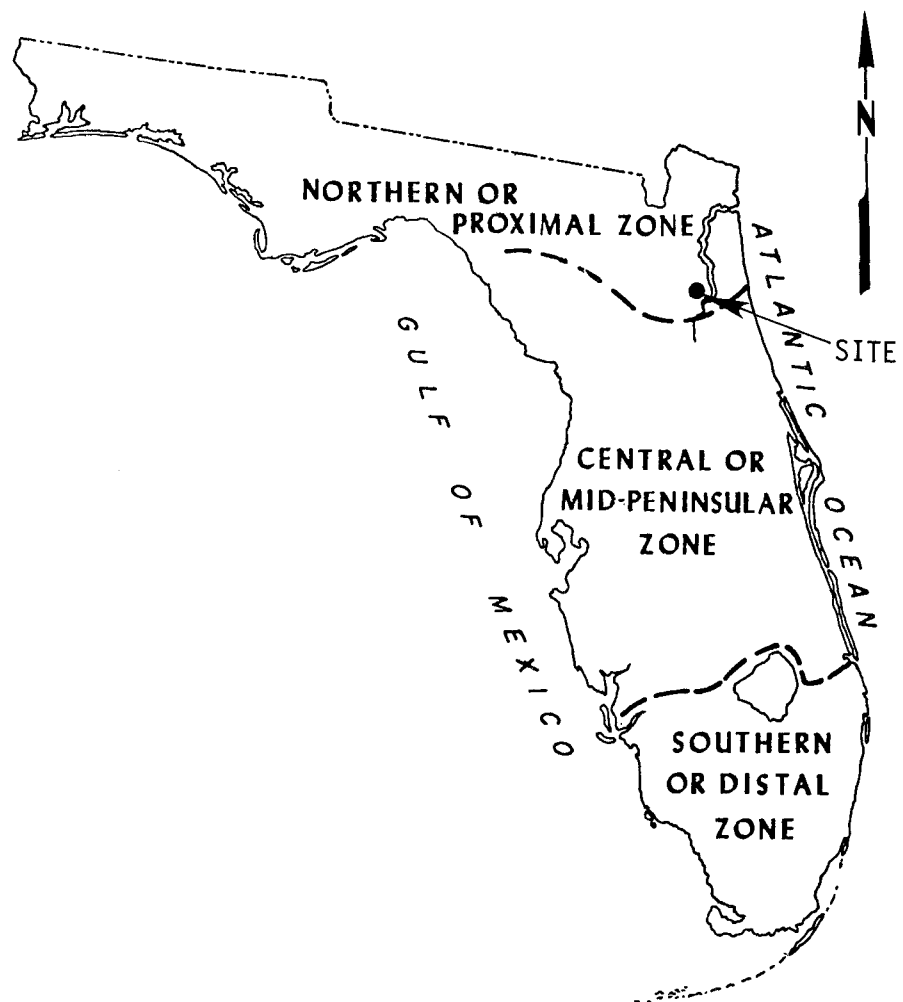
Table 2.2-3

MODIFIED MERCALLI INTENSITY (DAMAGE) SCALE
(Abridged)

- I. Not felt except by a very few under especially favorable circumstances. (I Rossi-Forel Scale.)
- II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II Rossi-Forel Scale.)
- III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated. (III Rossi-Forel Scale.)
- IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. (IV to V Rossi-Forel Scale.)
- V. Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel Scale.)
- VI. Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel Scale.)
- VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars. (VIII Rossi-Forel Scale.)
- VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed. (VIII+ to IX-Rossi-Forel Scale.)
- IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken. (IX+ Rossi-Forel Scale.)
- X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel Scale.)
- XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
- XII. Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown upward into the air.

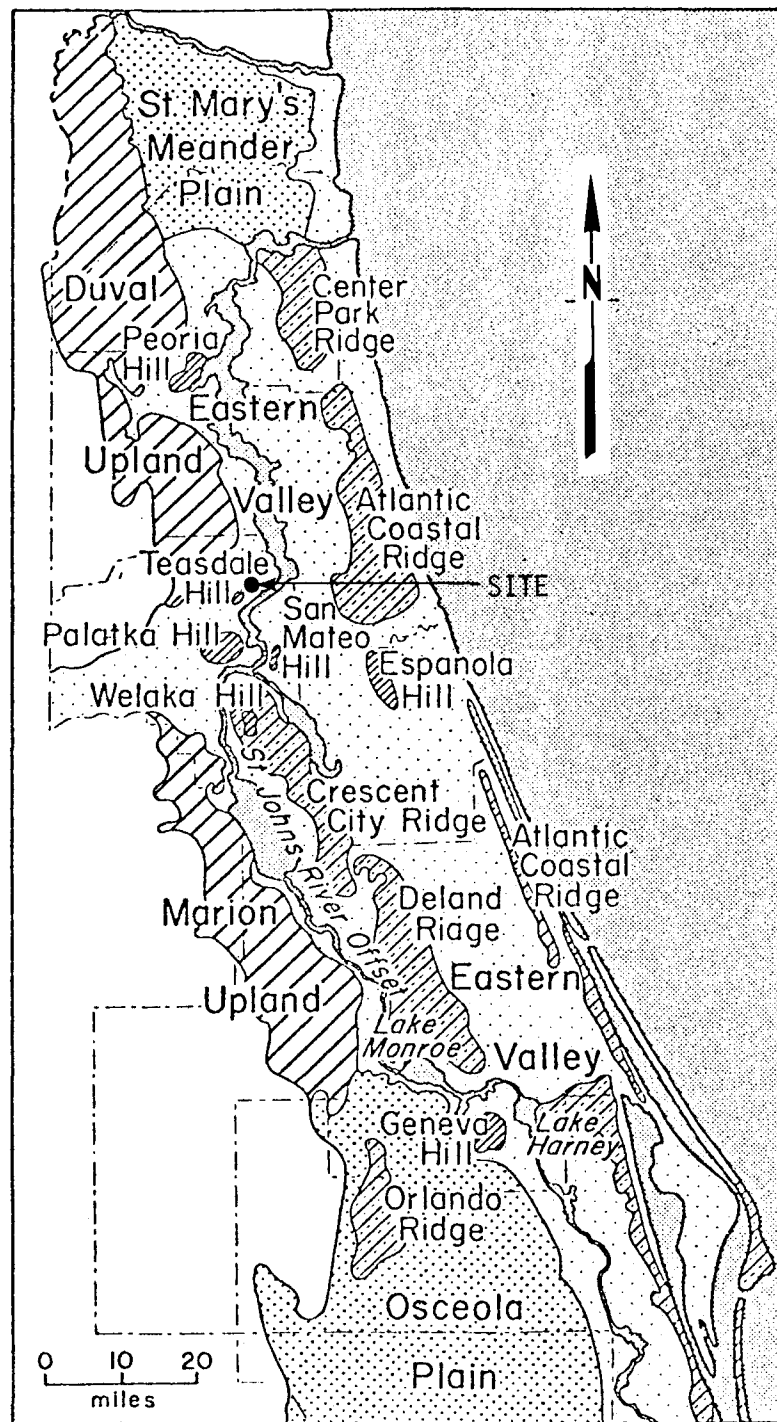
Image Quality

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



AFTER: WHITE, 1970

Figure 2.2-1. Major Transpeninsular Physiographic Divisions.



AFTER: PURI AND VERNON, 1964

Figure 2.2-2. Landforms in the Region of the St. Johns River.

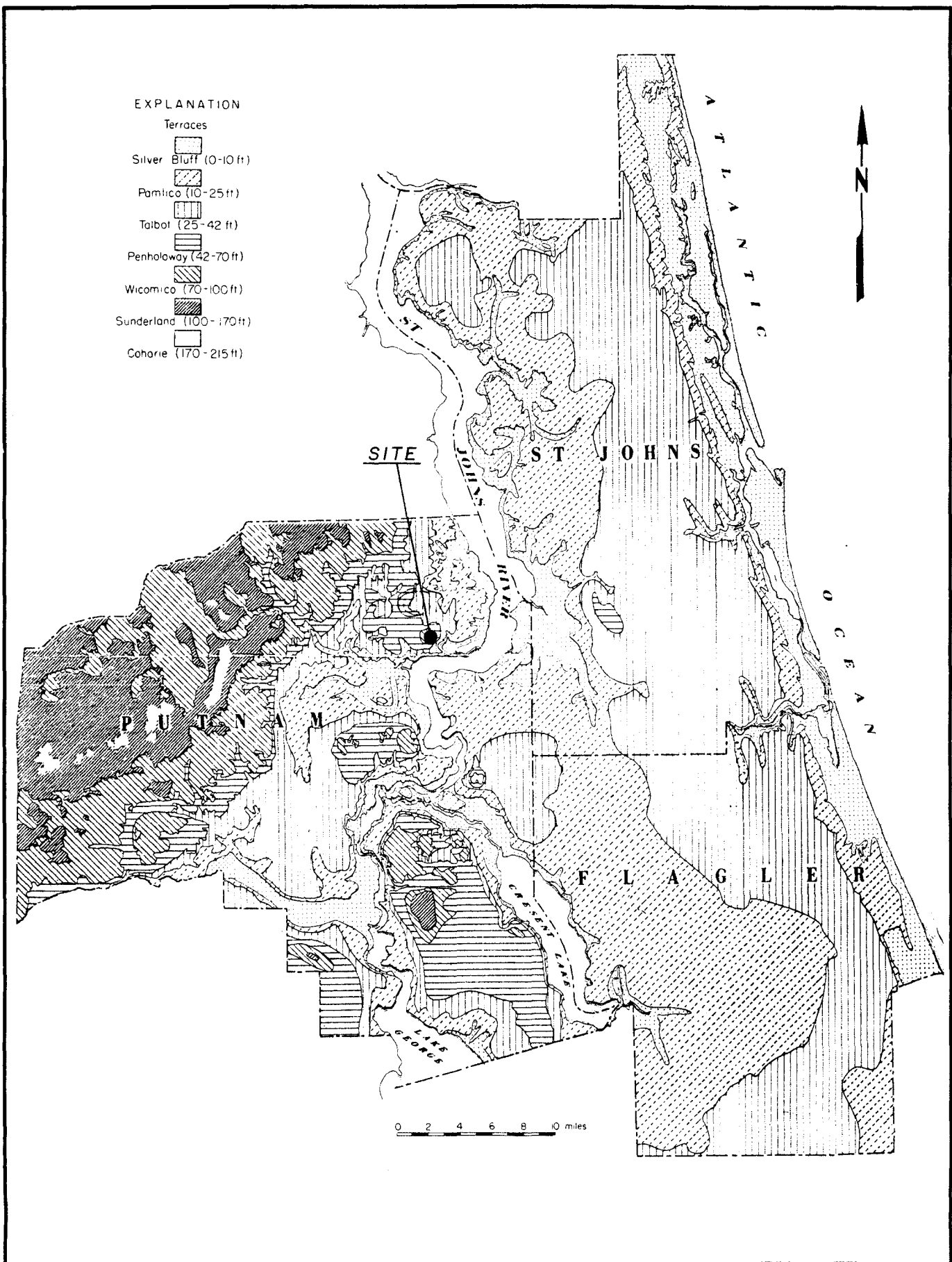
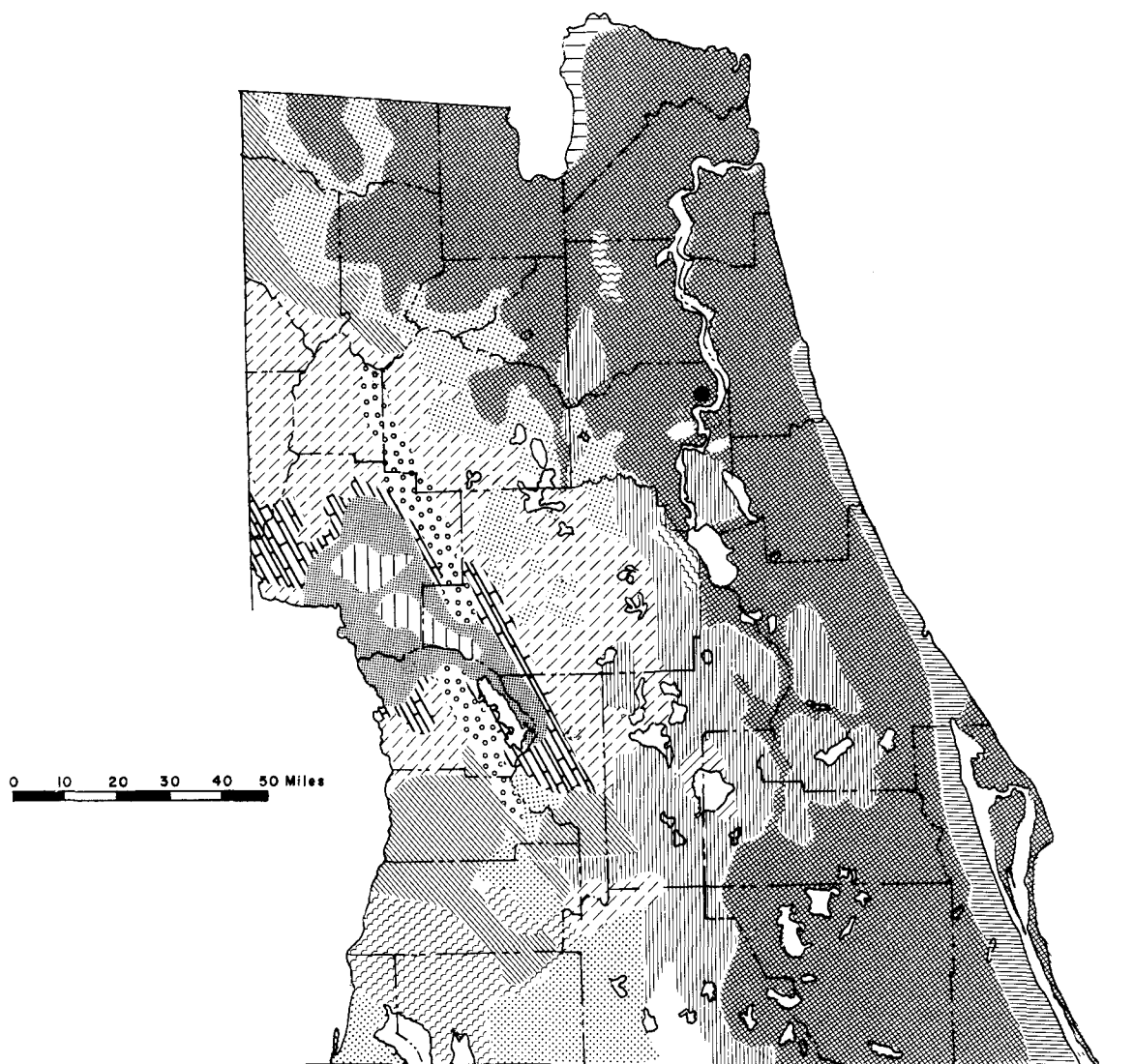


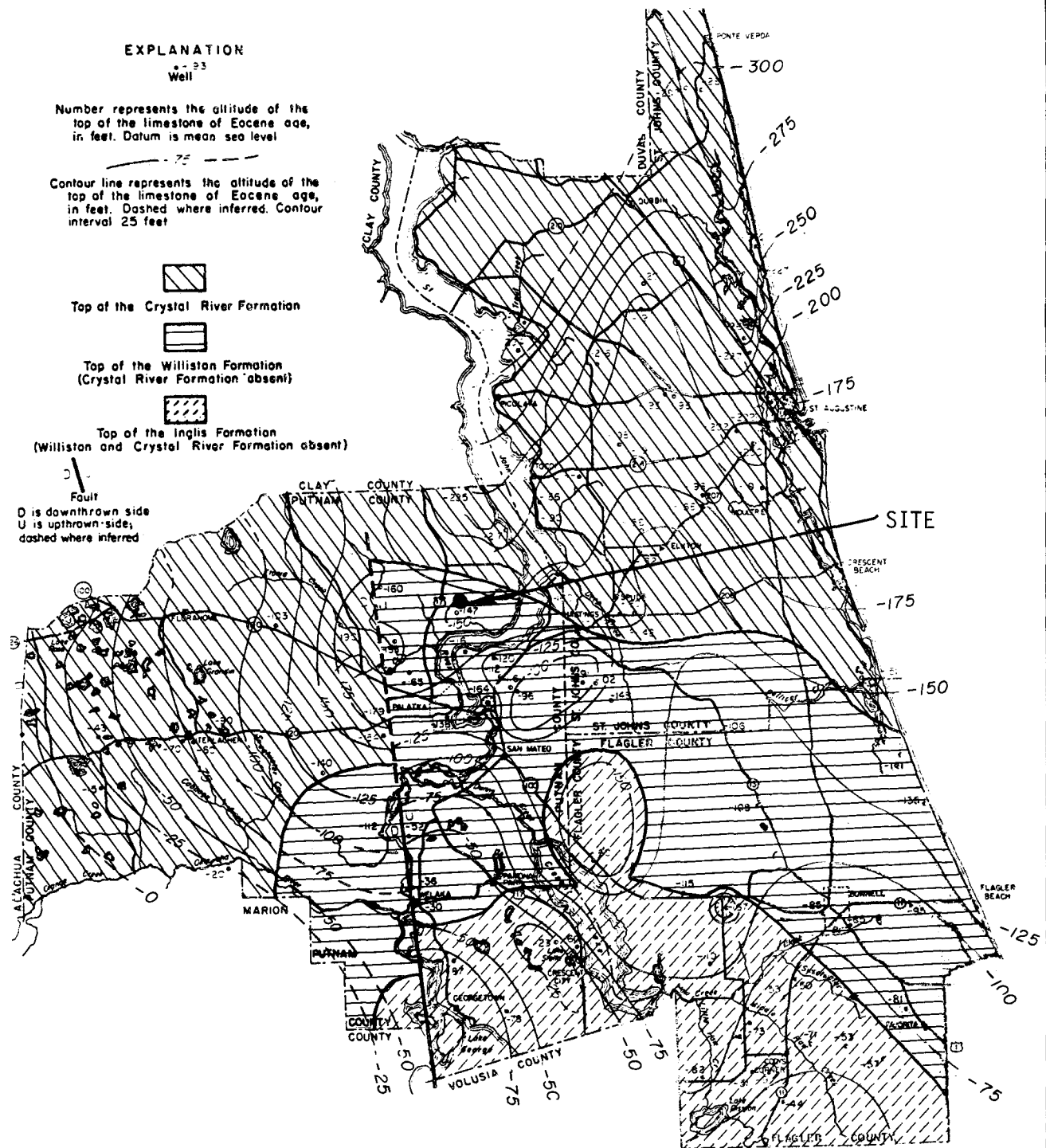
Figure 2.2-3. Regional Delineation of Marine Terraces.



SERIES	STAGE	FORMATION & MEMBER
RECENT AND PLEISTOCENE		SEVERAL LOWER MARINE AND ESTUARINE TERRACE DEPOSITS
		LAKE FLIRT MARL
PLEISTOCENE		ANASTASIA FORMATION
		FORT THOMPSON FORMATION
MIOCENE	CHOCTA- WHATCHEE	"CHARLTON" FORMATION
		JACKSON BLUFF FORMATION
		ALACHUA FORMATION
		FORT PRESTON FORMATION
		HAWTHORN FORMATION
	TAMPA	ST. MARKS FORMATION
OLIGOCENE		SUWANNEE LIMESTONE
EOCENE	JACKSON	CRYSTAL RIVER FORMATION
		WILLISTON FORMATION
		INGLIS FORMATION
	CLAIBORNE	AVON PARK LIMESTONE

AFTER: VERNON and PURI, 1964

Figure 2.2-4. Geologic Map of Northeast Florida.



AFTER: BERMES, LEVE AND TARVER, 1963

Figure 2.2-6. Contours to Top of Eocene.

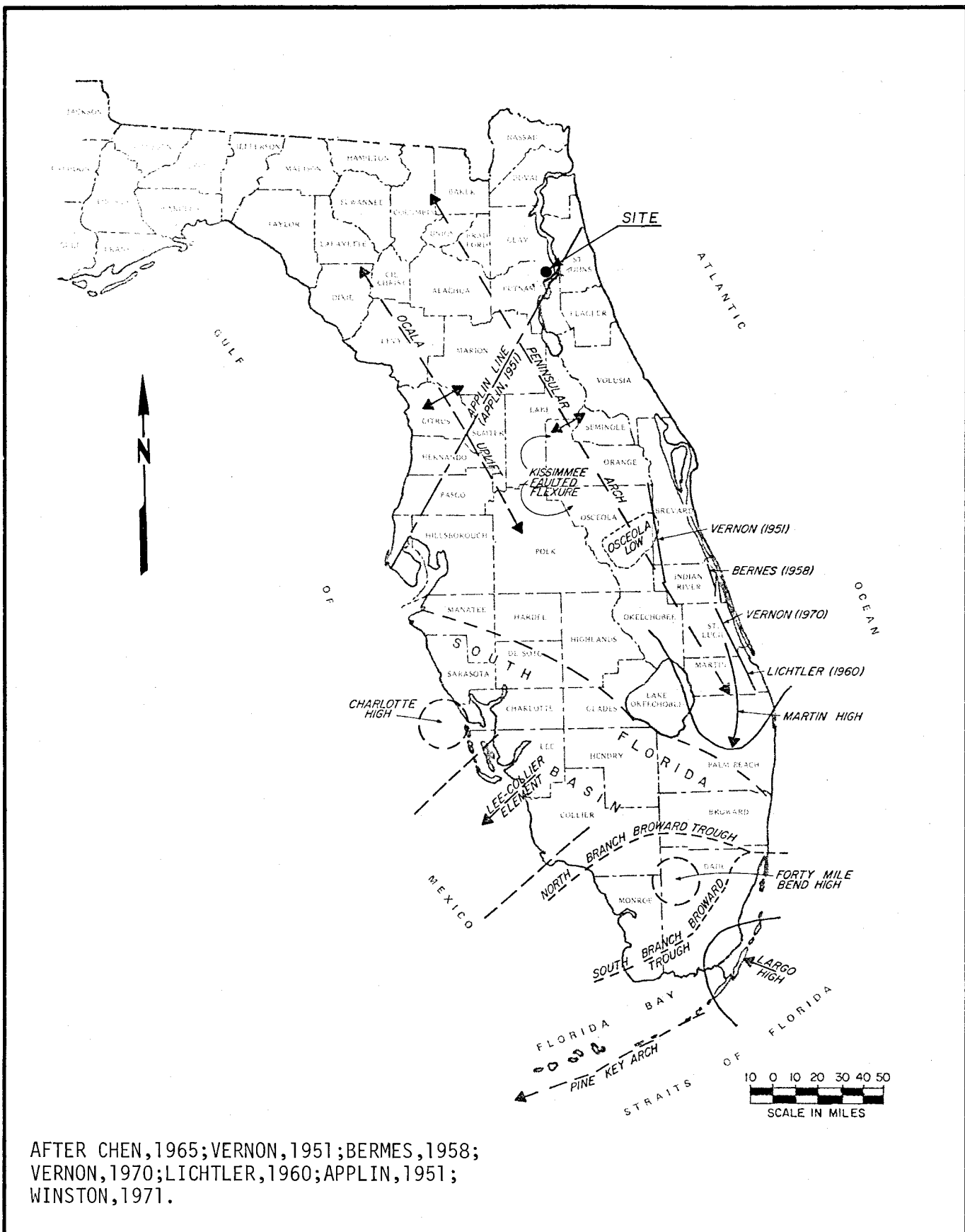
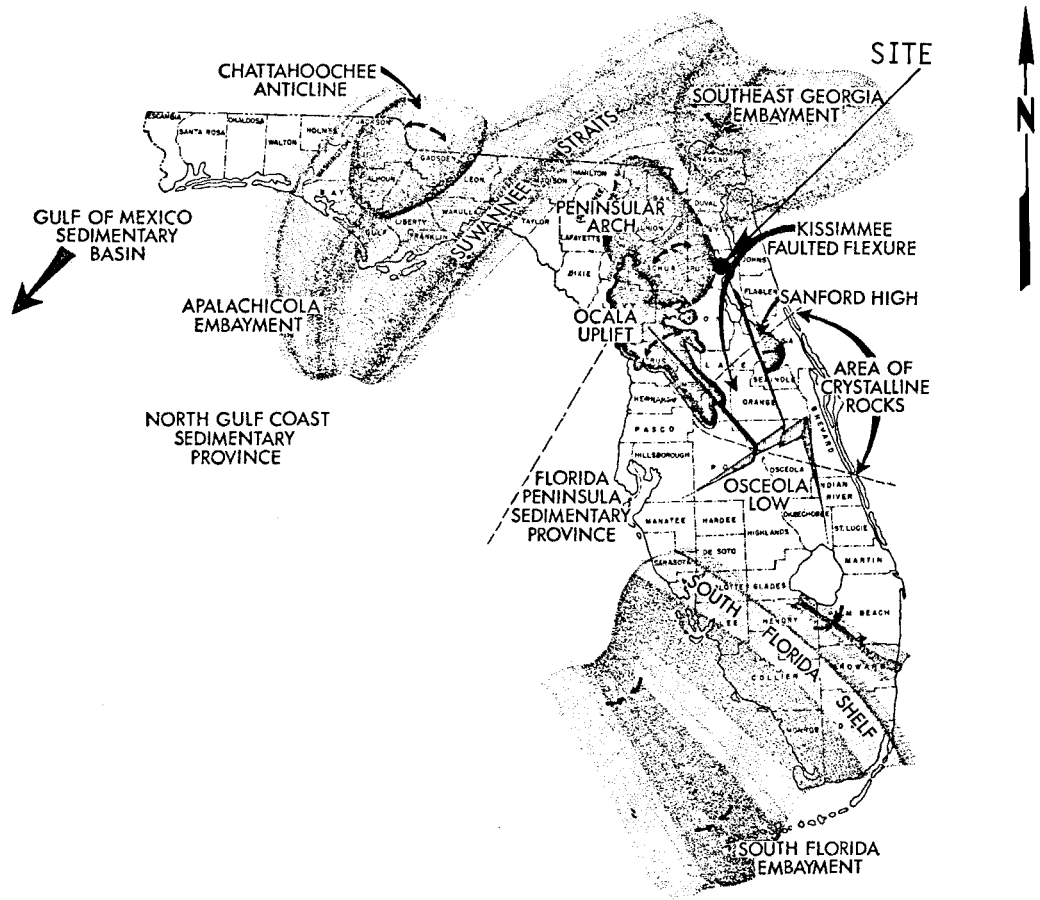


Figure 2.2-7. Regional Geologic Structure.



AFTER: PURI AND VERNON, 1964

Figure 2.2-8. Regional Geologic Structure.

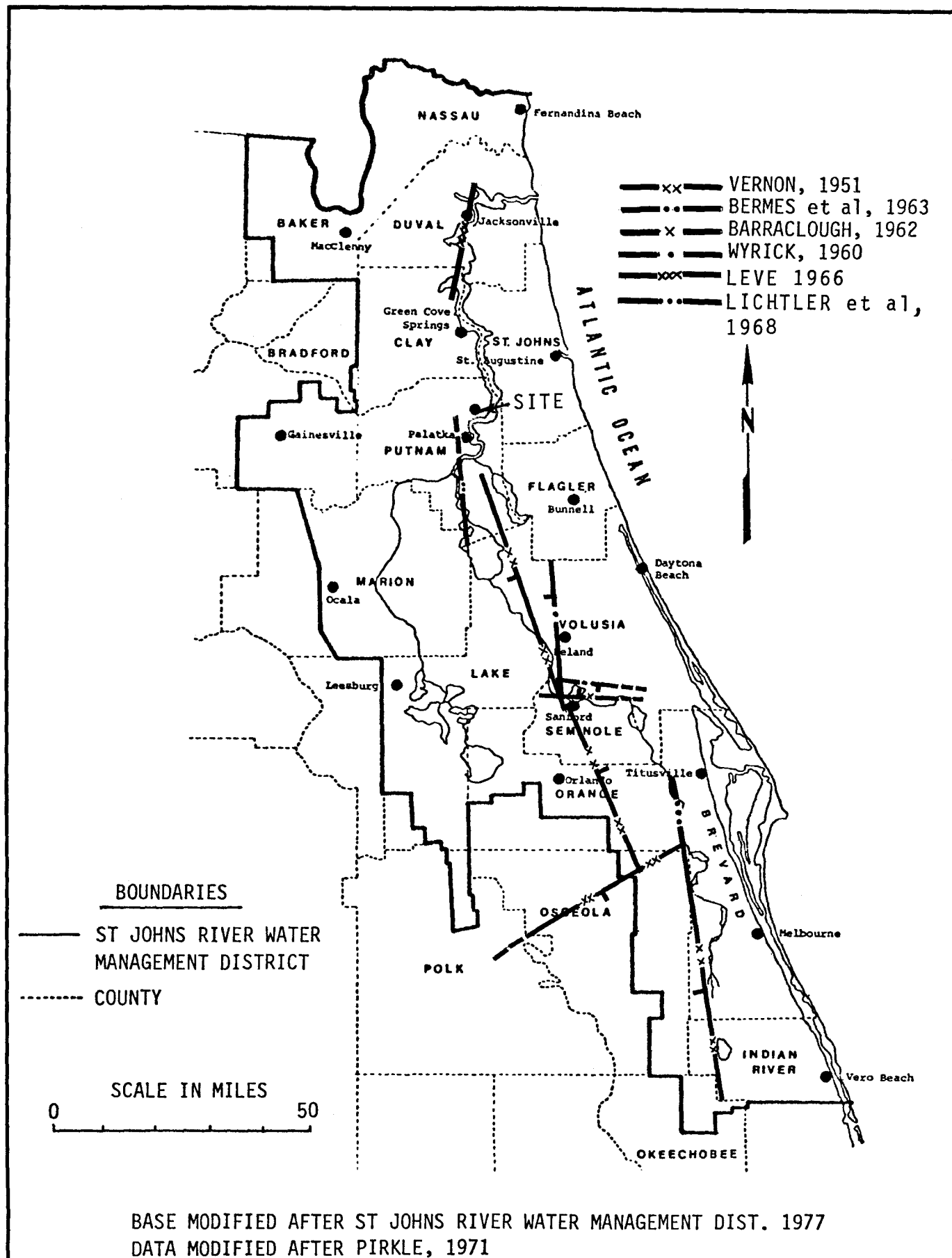
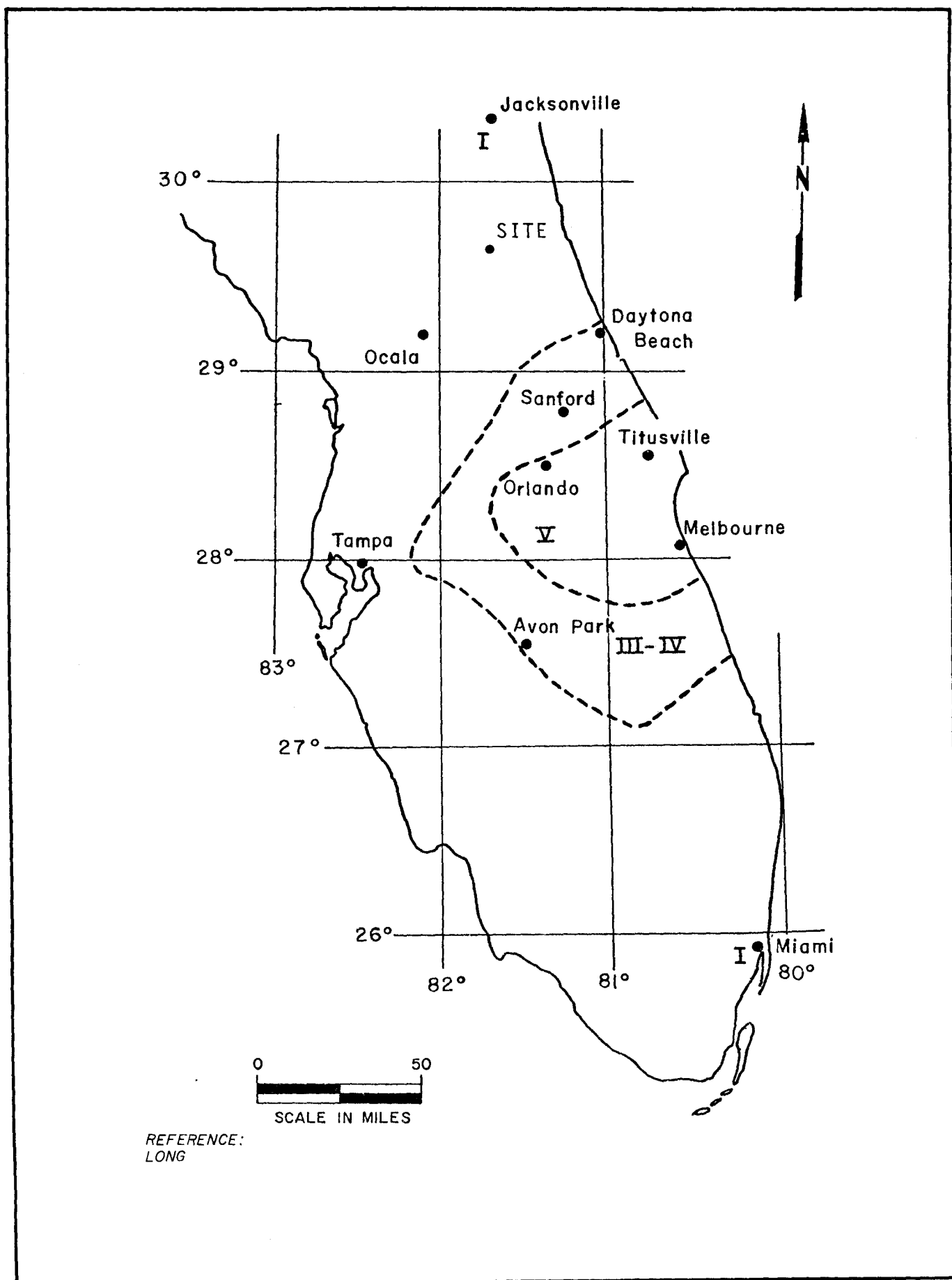


Figure 2.2-9. Some Reported Faults Along the St. Johns River



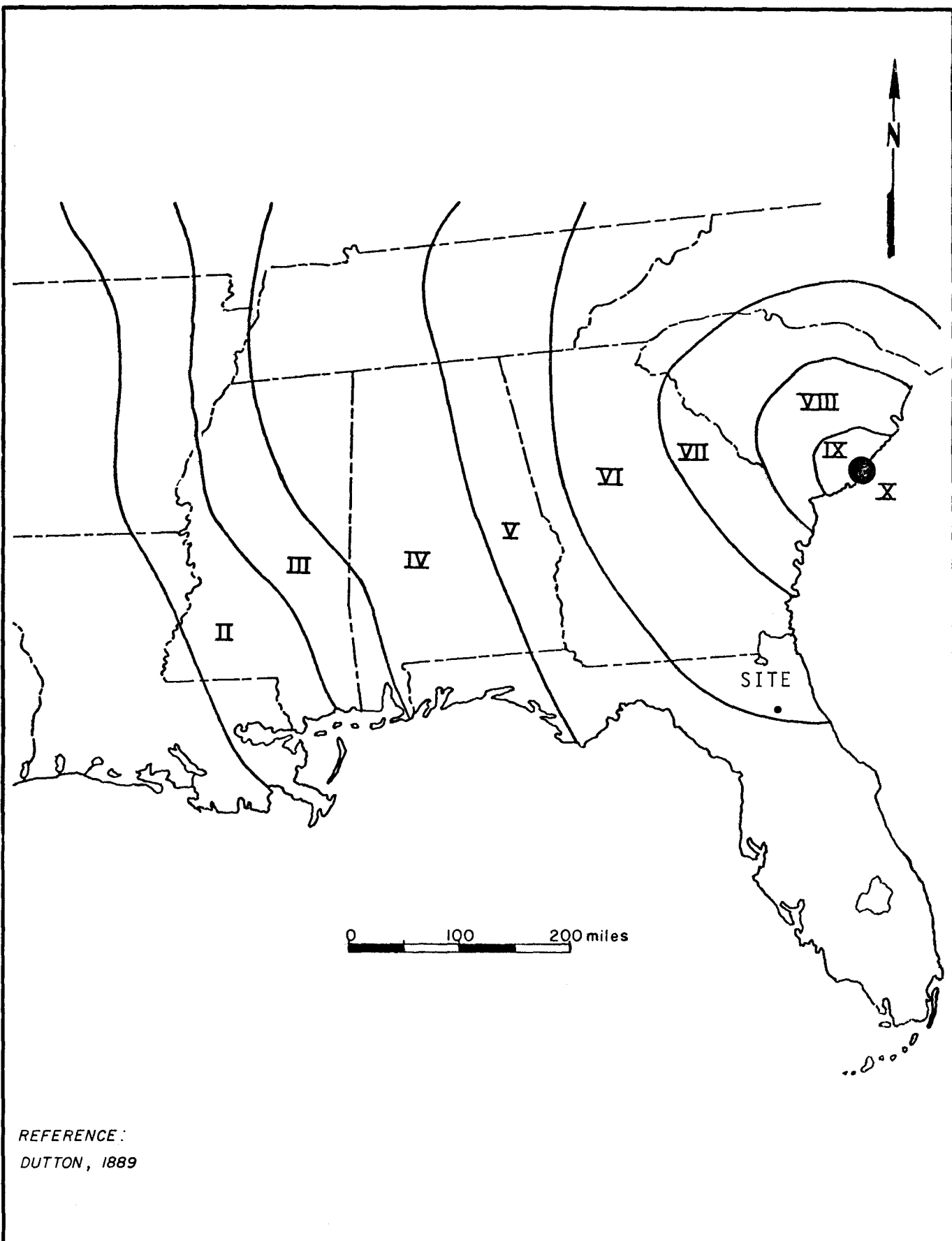


Figure 2.2-12. Modified Mercalli Isoseismal Map of the Charleston S.C. Earthquake August 31, 1886

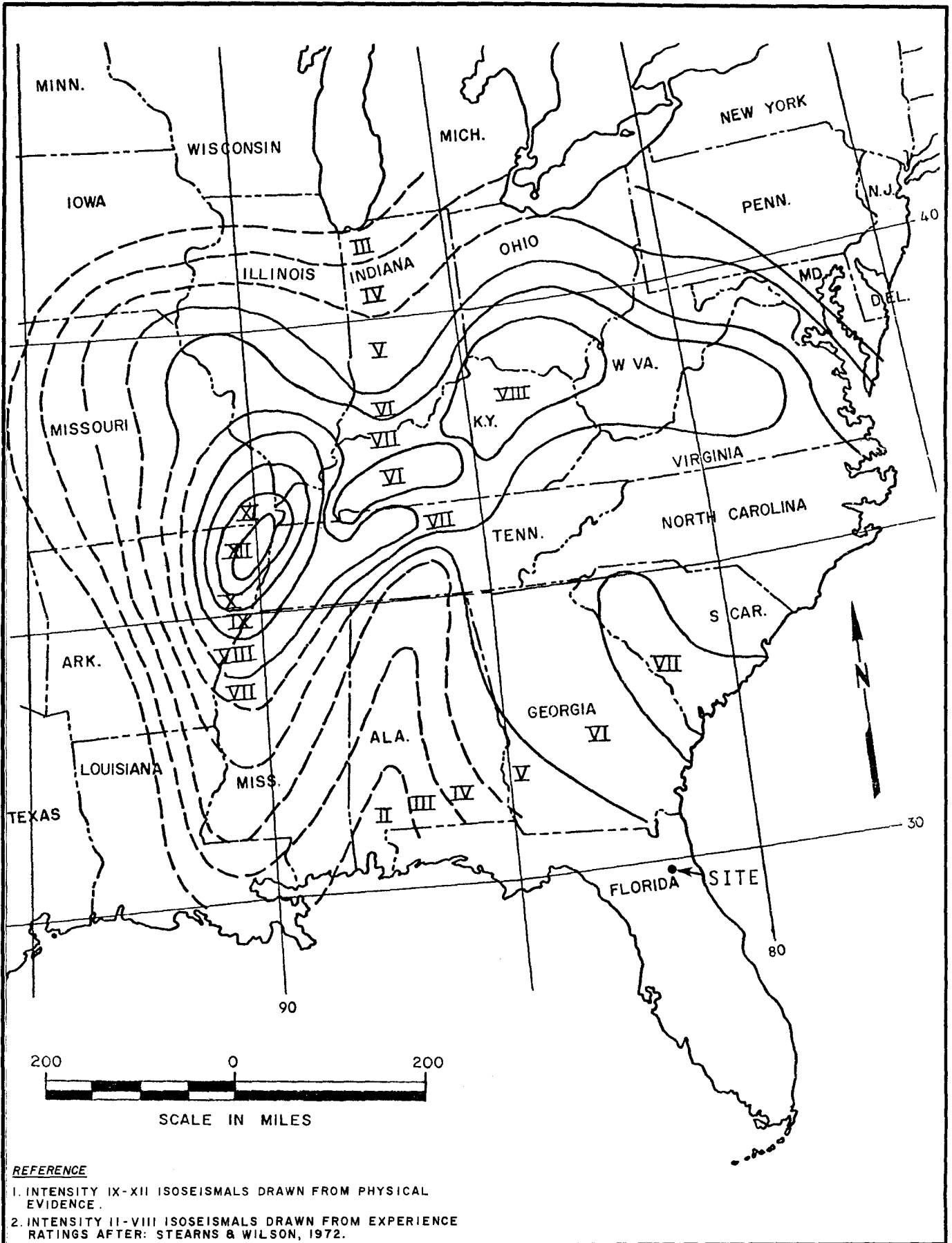


Figure 2.2-13. Modified Mercalli Isoseismal Map of New Madrid Earthquakes of 1811-1812.

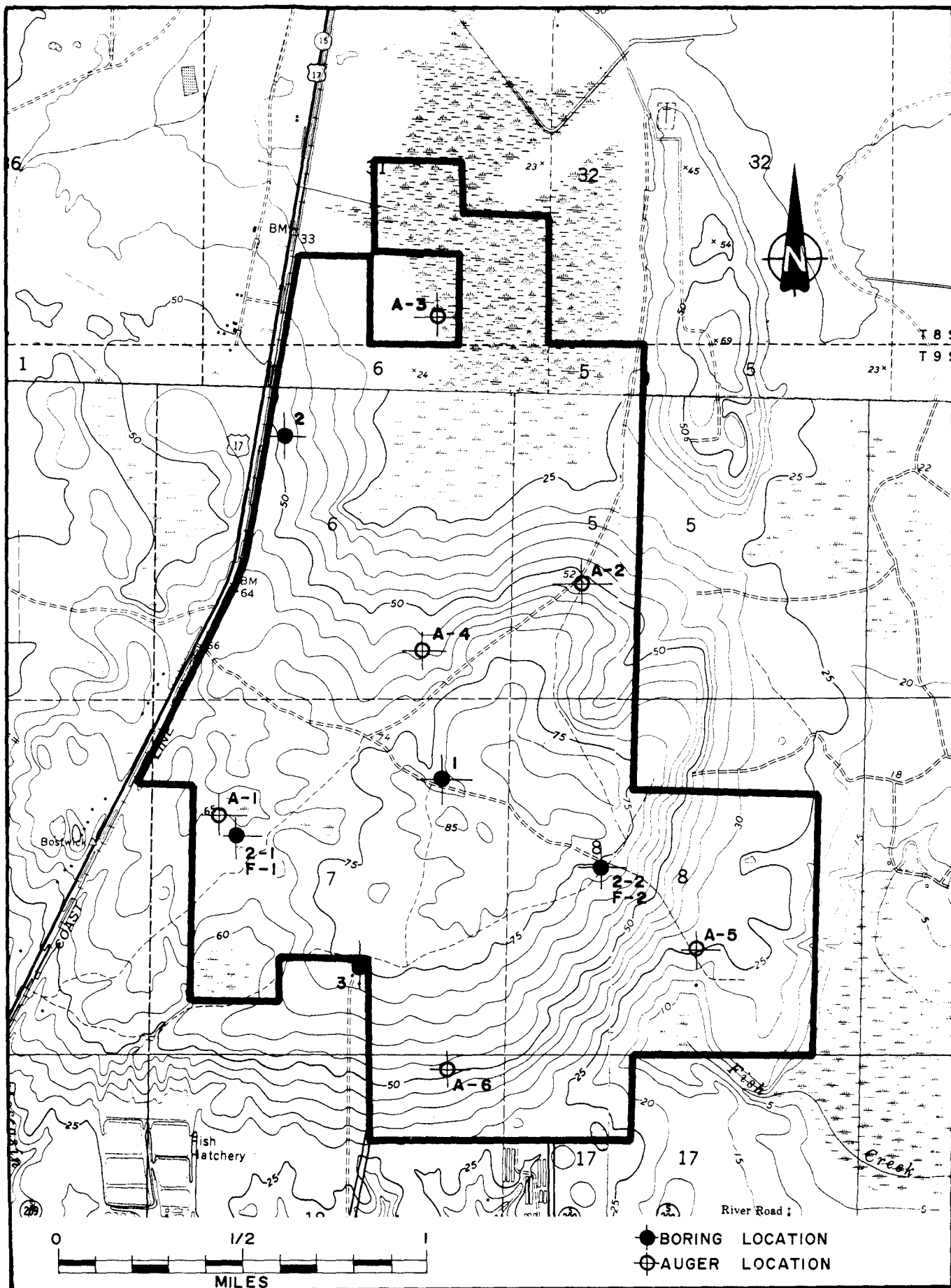
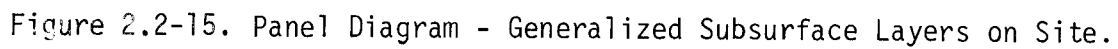


Figure 2.2-14. Soil Boring Location Map.



2.3 HYDROLOGY

2.3.1 Surface Water

2.3.1.1 St. Johns River

Regional Environment

The St. Johns River, with its 300-mile length and 9,430 square mile basin, is the largest watershed entirely within the State of Florida (Figure 2.3-1). The river rises in a poorly drained swamp in northwestern St. Lucie County, and becomes a discernible channel in southern Brevard County. Downstream of Brevard County, channel widenings give rise to eight lakes: Sawgrass, Washington, Winder, Poinsett, Puzzle, Hardey, Monroe, and George. At Palatka, the river widens to form a virtually continuous estuary with minor tributary bays. It is characterized generally by many extremely deep and wide segments, low stream velocities and flow reversals. The low velocities and flow reversals are products of an average hydraulic gradient of only 0.15 feet per mile and a backwater effect from tidal and wind action (Reynolds, 1974). Combined wind and tidal effects influence river levels and flow a maximum of 161 miles upstream from the mouth. Although there are normal seasonal flow variations, the large drainage basin and average annual rainfall in excess of 50 inches, coupled with artesian flow and springs produces an estimated average freshwater discharge of 6,000 cubic feet per second (cfs) into the Atlantic Ocean at Jacksonville (United States Geological Survey [USGS], 1977).

Normal tidal ranges affect river flow up to Deland, Florida; thus this 140-mile river reach may be considered an estuary. However, as indicated by the water quality data base, a salinity wedge has not been observed at Palatka. Therefore, in the Palatka area, the river can be considered to be a freshwater estuary. The water surface area of the estuary reach of the river and its adjoining lakes is 246 square miles. Mean tidal ranges vary from 1.2 feet at Jacksonville and Palatka to 0.5 feet at Welakea to less than 0.5 feet from Lake George to Deland (USGS, 1977).

Local Environment

The proposed steam-electric generating station will be located near the northwest bank of the St. Johns River, approximately 73 miles from the mouth of the river and five miles downstream of Palatka, Florida. The river reach on which the site is located is commonly known as the Lower St. Johns River reach, which extends 100 miles from the Oklawaha River to the Atlantic Ocean. In the vicinity of the site the St. Johns River is approximately 6,000 feet wide; its depth varies from a few feet to a maximum of about 15 feet with an average depth on the order of 10 feet.

Flow records have been collected for the Lower St. Johns River by the USGS at Palatka and Jacksonville. Strong tidal action at both stations limits the accuracy of mean daily flow computations. The total flow volume for each day must be computed from recorded river stage and velocity measurements. Upstream flow is subtracted from downstream flow to determine net daily freshwater discharge to the ocean. Freshwater discharge is only a small part of the daily water movement (USGS, 1977).

The gaging station located near Palatka was installed in January 1968 and discontinued in February 1976. The published discharge records are computed using continuous stage and velocity records obtained from a recording deflection meter and represent the net of much larger upstream and downstream discharges. The maximum downstream and upstream flows of record are, respectively, 31,311 cubic feet per second (cfs) on November 5, 1970, and 20,400 cfs on March 24, 1968. Average freshwater discharge at Palatka has been computed as 7,613 cfs with a mean tidal range of 1.2 feet based upon eight years of published records (USGS, 1977). Average velocities are on the order of 0.2 foot per second (fps), with a maximum on the order of 1.0 fps.

Although the long-term average daily flow at Palatka (1.07 cfs per square mile) compares closely with flows at other stations on the St. Johns River (Appendix C, Table C-1), the tremendous storage capacity of the estuary prohibits meaningful substantiation of the daily Palatka station records through comparison of daily records from more reliable upstream stations. In addition, as shown in Appendix C, Table C-2, little correlation is evident between the gaging station in Jacksonville and the Palatka station.

The only additional source of streamflow data on the St. Johns River in the project vicinity is the USGS Rice Creek gaging station at U.S. Route 17, with stage records from 1959 to 1972. At this station, located approximately 4,000 feet from the St. Johns River, Rice Creek is a St. Johns backwater, experiencing rapid response to stage fluctuations in the river. The stage records from this station may be used to approximate stages on the St. Johns, thereby increasing the available data for river stages to seventeen consecutive years. The data from these two stations are discussed in Appendix C, Section C.1.1.

Low Flows

In order to quantify the water supply potential and waste assimilation capacity of a stream, a design flow regime must be selected. Usually, a statistical frequency analysis may be performed to derive low flows and return periods having various probabilities of occurrence. In addition to the low flow frequency (or return period), the duration of the low flow must also be specified.

The St. Johns River in the site vicinity normally experiences tide-induced flow reversals twice daily. Consequently, there are instantaneous zero discharges at moments of flow reversal and periods of negative (upstream) flow. The river functions similar to a reservoir with inflow from both the ocean and the drainage basin being stored through variations in stage. Therefore, even during periods of near zero flow or negative flow, there may be an increase in the volume of water in

the estuary if the stage is increasing. Conversely, during periods of high downstream flow there may be a decrease in the volume of water in the estuary if the stage is decreasing. As a result, flow rates in the St. Johns at Palatka do not reflect its water supply potential, and the usual statistical low flow analysis is meaningless.

Additionally, the water supply potential in the St. Johns estuary is directly related to the volume of freshwater in storage which is controlled by the combined effects of freshwater runoff and stages in the Atlantic Ocean. Mean daily freshwater runoff into the estuary is 7,613 cfs. During periods of low freshwater runoff, large volumes of freshwater are maintained by stages on the Atlantic Ocean. Withdrawal of water from the St. Johns, therefore, would be compensated by this ability to maintain a large reservoir of freshwater during periods of low freshwater runoff.

Waste Assimilative Capacity

The waste assimilation capacity of the estuary is dependent on its dilution and dispersion characteristics during a design flow regime. In Florida, the usual design flow regime for waste assimilation on streams not subject to tide-induced flow reversals is normally taken as the seven-consecutive-day, one-in-ten year (7-day Q_{10}) minimum discharge (Oven, 1978). Since the St. Johns River is subject to tidal effects, this flow condition may not be computed for reasons previously stated. As discussed in Appendix C, the worst flow condition at the site in terms of effluent dispersion and dilution occurs when a minimum volume of water is discharged pass the site in either the upstream or downstream direction. As a seven-day duration is normally utilized for river design flow conditions, the available USGS flow records at Palatka were examined for the seven-consecutive-day period with the minimum cumulative upstream or downstream flow. This flow condition, hereinafter referred to as the seven-consecutive-day average daily minimum absolute flow (7-day MAF) represents the 7-day period of record in which there was the least amount of flushing action in the estuary from either upstream or downstream flows.

As stated above, the design flow is usually taken as the once-in-ten-year minimum discharge. The short streamflow record of only eight

years at Palatka prohibits a meaningful frequency analysis for a 10-year design flow. However, during the 7-day MAF of record from September 2, to September 8, 1971, there was volumetric flux upstream of only 2522 acre-feet. This represents an average flow rate of 180 cfs or a net rate of movement of the water body of less than 0.004 fps. Because this closely approximates oscillatory movement in the estuary, and a completely oscillatory tidal cycle represents the minimum amount of flushing possible, the 7-day MAF was utilized in the analysis as a suitable design flow.

High Stages

As discussed earlier, stage records are available from the St. Johns Palatka station and Rice Creek station for a total of 17 years. The highest stage of record was 5.5 feet mean sea level (MSL) which occurred in September 1964 as a result of Hurricane Dora. This is the only hurricane to move inland from the east over extreme northeastern Florida in over 90 years of record (National Oceanic and Atmospheric Administration [NOAA], 1976). The strong, long duration onshore winds produced unusually high tides on the Atlantic coast from 5 to 8 feet or more above normal. The storm surge up the St. Johns River was further aggravated by increased freshwater flow caused by the storm's total rainfall, in excess of 10 inches over the northern portion of the St. Johns Basin.

Apart from Hurricane Dora, most tropical storms reaching this latitude have tended either to move parallel to the coastline well out to sea, or to lose much of their force by moving overland before reaching this area. As a result, most of the extreme stage events are the result of late summer and fall storms along the northeast Florida coast (NOAA, 1976), and are marked by winds of 20 to 30 miles per hour and steady drizzle. The greatest stage at Palatka resulting from such a storm was 3.8 feet MSL, on September 30, 1968. A summary of the annual flood stages near the site is provided in Appendix C, Table C-3.

As Hurricane Dora was the most severe hurricane in over 90 years of record in the general region of the site and produced the highest stages in the seventeen years of state records near Palatka, it was assumed to be a suitable design hurricane for use in determining hurricane surge elevations in the site vicinity.

The Department of Housing and Urban Development (HUD) has developed a Flood Hazard Boundary Map (Flood Insurance Administration, 1978) for Putnam County. The areal extent of the Flood Hazard Areas and 1964 hurricane flood stages are shown in Figure 2.3-2.

2.3.1.2 Local Tributaries and Site Hydrologic Characteristics

Tributaries

Tributaries draining the general site area are shown in Figure 2.3-3 and Figure C-6. Their drainage areas are summarized in Appendix C, Table C-6. The major tributaries in the general site vicinity are Rice Creek, draining 353 square miles southwest of the site, and Cedar Creek draining 18 square miles northeast of the site. Of tributaries in the site vicinity, discharge records are only available for Rice Creek. Two USGS stations are presently in operation in this basin, one on Rice Creek near Springside and one on a tributary, Etonia Creek, at Bardin, Florida. A third station, discussed in Section 2.3.1.1, operated at the

U.S. Route 17 Rice Creek bridge from 1959 until 1972. The discharge records from this station are quite poor as the flow is affected by St. Johns River stages and effluent discharges from the Hudson Pulp and Paper Company (USGS, 1974).

Although records on Rice Creek at the U.S. Route 17 bridge indicate periods of zero discharge, such flows are the result of creek discharges being forced into storage by high stages on the St. Johns River. This is evident by the fact that the minimum discharge of record at the upstream Etonia Creek station is 54 cfs. The net average discharge from the basin is 345 cfs with a maximum net daily discharge of almost 6,500 cfs.

By assuming an average discharge per square mile comparable to measured discharges on Rice Creek and Etonia Creek, the discharges from the remaining tributaries in the site vicinity areas were determined as shown in Table C-5 and C-6. Average discharges range from 18.0 cfs for Cedar Creek to 0.5 cfs for a small unnamed tributary draining the southwest corner of the site.

2.3.1.3 Onsite Drainage

Site Drainage Characteristics

Site elevations vary from 5 feet MSL in the southeastern corner to 85 feet MSL in the central portion to 25 feet MSL in the north (Figure 2.3-2). Figure E-11 (Appendix E) is based on a site specific U. S. Soil Conservation Service soil survey (SCS, 1978). The soils in the central or upland portion of the site are predominately of the Tavares, Immokalee and Cassia soil series. The Tavares series is a nearly level, moderately wet, acidic, rapidly permeable deep fine sand. The Immokalee series is also a nearly level to gently sloping, rapidly permeable fine sand, but is poorly drained. The Cassia series is a permeable fine sand that is moderately well drained. The upland portion of the site is surrounded by nearly level poorly drained fine sands of the St. Johns-Cassia-Adamsville soil series association.

The high rate of infiltration associated with the soils in the upland portion of the site, and the lack of elevation relief with the poorly drained soils surrounding the upland, results in an absence of well defined surface watercourses on the site. Rainfall percolates into the ground in the upland, migrates downslope, and eventually discharges into the lowlands.

Site Erosion

The capability of a soil surface to resist erosion is a function of the soil's physical and chemical properties, the average rainfall intensity, length and degree of slope, and the vegetative cover. As the site has no defined surface watercourses, soil loss will be principally the result of sheet and rill erosion. Such soil losses may be estimated by the Universal Soil Loss Equation (USLE) developed by the SCS (1975). The parameters listed above are quantified in Appendix C, Section C.1.2.

Site erosion is limited primarily to the upland portion of the site discussed in the previous section. Soils eroded from the upland slopes will be deposited in the surrounding lowlands. The quantity of eroded soils actually reaching the lowlands is dependent on a sediment delivery ratio. The ratio may be determined with SCS (1965) nomographs relating the sediment delivery to drainage basin area.

The site area contributing to the sediment production was estimated to be on the order of 1550 acres. This area consists of the Tavares-Immokalee-Cassia soil series association with a vegetative cover of long leaf pine, turkey oak, grasses, and saw palmetto. As detailed in Appendix C, Section C.1.2, soil loss under the above parameters is calculated to be on the order of from 0.2 to 0.4 tons per acre per year. This is a relatively low rate of soil loss. By comparison, the average rate of erosion in the United States is 1.7 tons per acre per year (EPA, 1974); for agricultural areas, the average is 7 tons per acre per year (Georgia State Soil and Water Conservation Committee, 1973); and unprotected highly erodible soils can yield as much as 350 tons per acre per year (Disiker and Richardson, 1968). The sediment delivery ratio may be as high as 0.5 resulting in the depositions of from 150 to 300 tons of sediment per year in the lowlands on and surrounding the site.

2.3.1.4 Water Quality

Florida Water Quality Standards

Water quality standards are statements of the physical, chemical and biological characteristics of any water body which must be maintained if that water is to be acceptable under specific usage classifications. These standards are defined for the State of Florida by the Florida Department of Environmental Regulation (DER) under Chapter 17-3, 17-4, and 17-6, Florida Administrative Code, effective March 1, 1979.

The DER has established a designation system by which waters of the State are classified according to their usage. Except for a portion of the headwaters, the entire length of the St. Johns River has been designated as a Class III water body. These waters are used for recreational purposes, including such body contact activities as swimming and water skiing, and for the maintenance of a well-balanced fish and wildlife population.

The DER also has set specific standards for discharges of heated effluent into waters of the State of Florida. As part of these standards, the State has designated its waters as being fresh, coastal, or open and in either Peninsular or Northern Florida Climatic Zone. The St. Johns River in the vicinity of the proposed site is classified as freshwater and is in the Northern Climatic Zone.

The DER allows a "zone of mixing" within which certain standards are not applicable. The "zone of mixing" is defined in Chapter 17-3.021 as "... a volume of surface water containing the point or area of discharge and within which an opportunity for the mixture of water with receiving surface waters has been afforded." The DER has classified the St. Johns in the vicinity of the proposed discharge as estuary (Florida DER, 1978). For such classification the maximum allowable mixing zone shall be 125,600 square meters.

The water quality standards which apply to surface waters beyond the zone of mixing include 17-3.061 setting forth the criteria that apply to all waters of the state, 17-3.121 setting forth the criteria that apply to Class III waters, and 17-3.05 setting forth thermal criteria for surface waters.

Federal Effluent Quality Standards

In addition to the in-stream regulations of the State of Florida, limitations on effluent quality have been promulgated by the U. S. Environmental Protection Agency (EPA) pursuant to the Federal Water Pollution Control Act (PL 92-500). Effluent quality criteria have been defined for the electric power industry under 40 CFR 423, Effluent Guidelines and Standards for Steam Electric Power Generating Point Source. These regulations require application, not later than July 1, 1983, of the "best available technology economically achievable which will result in reasonable progress toward the national goal of eliminating the discharge of all pollutants." The effluent limitations pertinent to achieving the above goal are shown in Appendix C, Table C-11.

Ambient Water Quality

The St. Johns River water quality sampling station nearest to the site is located at the U.S. Route 17 bridge at Palatka approximately four miles upstream of the site. Sampling is conducted by the USGS and published in "Water Resources Data for Florida", under sampling station number 02244450 (USGS, 1977). Measurement of chemical quality parameters began in 1962 and were performed weekly from June to October of 1962 and from November 1966 to July 1973. From January 1974 to present the measurements have been monthly. Water temperature measurements began in October 1970 and were performed on a weekly basis until 1973. From January 1974 through February 1976 temperature measurements were conducted once-daily. Appendix C, Table C- 8 contains the USGS water quality data base at the Palatka station. Table 2.3-1 summarizes measurements from the St. Johns River compared with applicable Florida Water Quality standards.

The St. Johns River in the vicinity of the site is classified as Effluent Limited (DER, 1975) meaning that additional wastewater discharges will be permitted so long as the wastewater meets secondary treatment standards (secondary waste treatment removes no less than 90

percent of BOD-5 and suspended solids). Effluent limited segments, in general, are not greatly affected by additional wastewater discharges provided that existing and new discharges meet specified effluent standards (Jacksonville Area Planning Board, 1977).

In the site vicinity, the St. Johns has relatively high nitrogen concentrations and, as a result, has some dissolved oxygen (DO) problems (DER, 1975). Ten samples out of the available 64 had DO concentrations less than the DER standard of 5.0 mg/liter, and a minimum concentration of 2.7 mg/liter has been recorded.

Specific conductance and concentrations of total dissolved solids (TDS) and chlorides are relatively high in the Lower St. Johns, even though the river is classified as freshwater. Four heavy metals--cadmium, lead, mercury, and zinc--have been recorded at concentrations in excess of state standards at the Palatka sampling station. Historical water quality records (STORET Data System) indicated that these elements are exceeded at nearly every St. Johns River station.

In addition to USGS water quality data, Dames & Moore collected baseline water quality data in September 1977 and January, February, and March 1978 in conjunction with the aquatic ecological monitoring program. Sediment samples were collected in April, 1978. Sampling stations are depicted in Figure 2.3-3. Results of field and laboratory water quality analyses are shown in Appendix C, Table C-10 and C-11 while the data from the sediment samples are shown in Table C-12. In general, concentrations of various parameters measured were similar to those recorded by the USGS.

Water quality in Rice Creek is not as good as that in the St. Johns River. The creek has been classified as Water Quality Limited, meaning that unusually stringent effluent limitations are required in order to meet water quality standards. Although water quality data is limited for Rice Creek, available samples summarized in Appendix C, Table C-9 indicate problems with nitrogen, phosphate and DO.

TABLE 2.3-1
WATER QUALITY OF THE ST. JOHNS RIVER
AT PALATKA
COMPARED WITH STATE STANDARDS

<u>Parameter^a</u>	<u>Number of Measurements</u>	<u>State Limitation^b</u>	<u>Number of Measurements Not Meeting Standards</u>
Alkalinity	48	20 ^c	0
Ammonia ^d	54	20 ^e	0
Cadmium	23	1.2 ^e	3
Copper (total)	12	30 ^e	0
Dissolved Oxygen	64	5 ^c	10
Iron (total)	16	1	0
Lead (total)	23	30 ^e	2
Mercury (total)	25	0.2 ^e	6
Nickel (total)	3	0.1	0
pH	51	6.0-8.5 ^f	0
Selenium (total)	5	25 ^e	0
Zinc (total)	20	30 ^e	3

Source: STORET Data File

^aUnits in milligrams/liter unless otherwise noted

^bChapter 17-3.121, FAC, effective 3-1-79

^cMinimum limitation

^dUn-ionized

^eMicrograms/liter

^fUnits

Table 2.3-2

Deleted

Table 2.3-2

Water Quality of Rice Creek
Compared With State Standards

<u>Parameter Measured</u>	<u>Units</u>	<u>Number of Measurements</u>	<u>DER Limitations^a</u>	<u>Number of Measurements In Excess of Standards</u>
Turbidity	JTU	7	50	0
DO	mg/l	15	5 ^b	14
BOD (5-day)	mg/l	8	5	4
pH	unit	16	6.0-8.5	0
Chloride Cl, Dissolved	mg/l	11	250	0
Arsenic As, Totalled	mg/l	5	0.05	0
Copper Cu, Totalled	mg/l	6	0.5	0
Iron Fe, Totalled	mg/l	5	0.3	4
Lead Pb, Totalled	mg/l	4	0.5	0
Zinc Zn, Totalled	mg/l	6	1.0	0
Fluorine F, Dissolved	mg/l	11	10	0
TSS	mg/l	2	5	0
TDS Residue @180°	mg/l	11	500 (1000) ^c	2 above 500
Phenols	mg/l	1	0.001	-
KJELDAHL Nitrogen Totalled	mg/l	-	3	-

^aMaximum limitations except as noted.

^bMinimum limitations

^c500 mg/l TSD - maximum monthly average
1000 mg/l TDS - maximum instantaneous measurement.

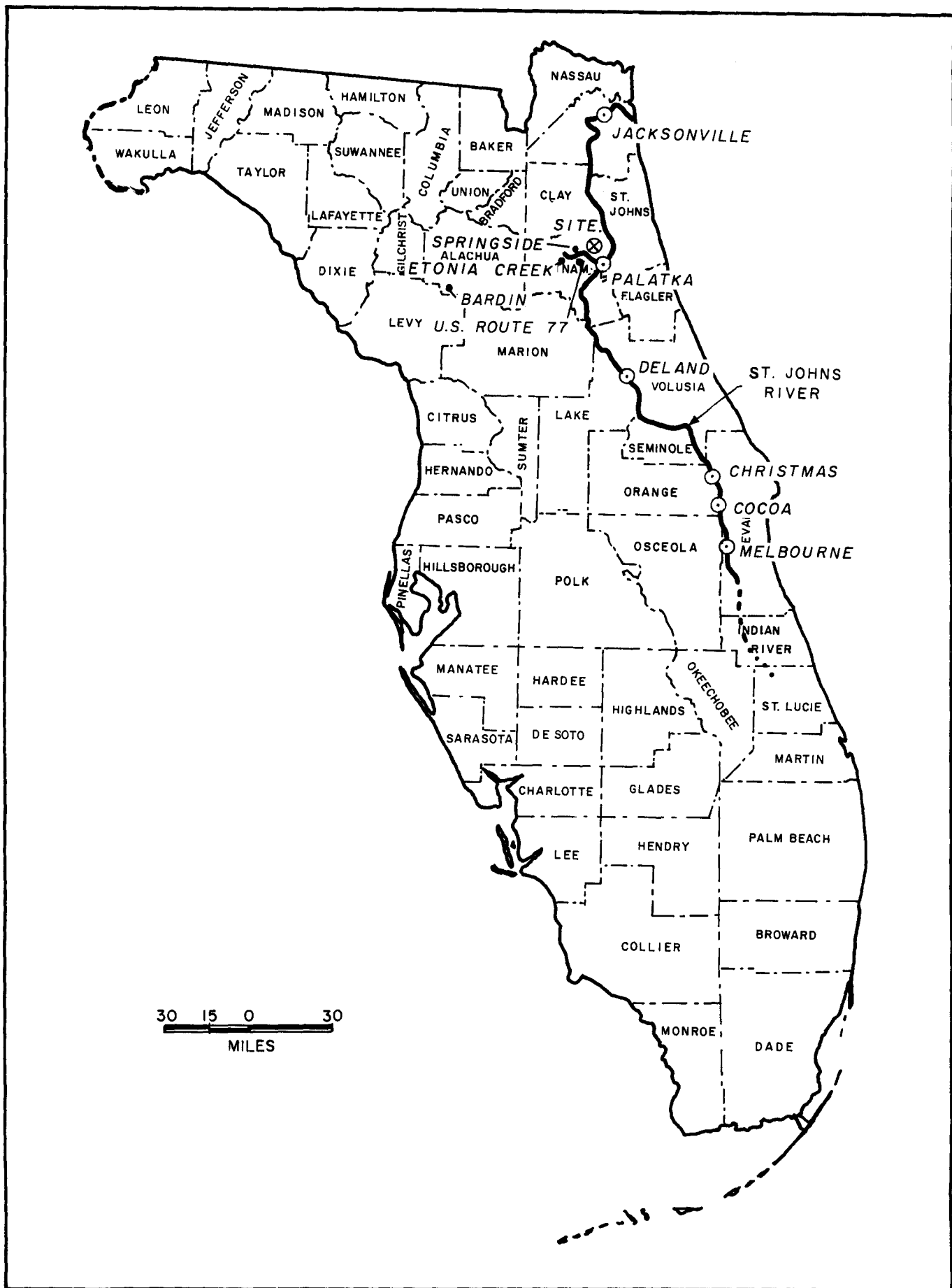


Figure 2.3-1. St. Johns River Basin.

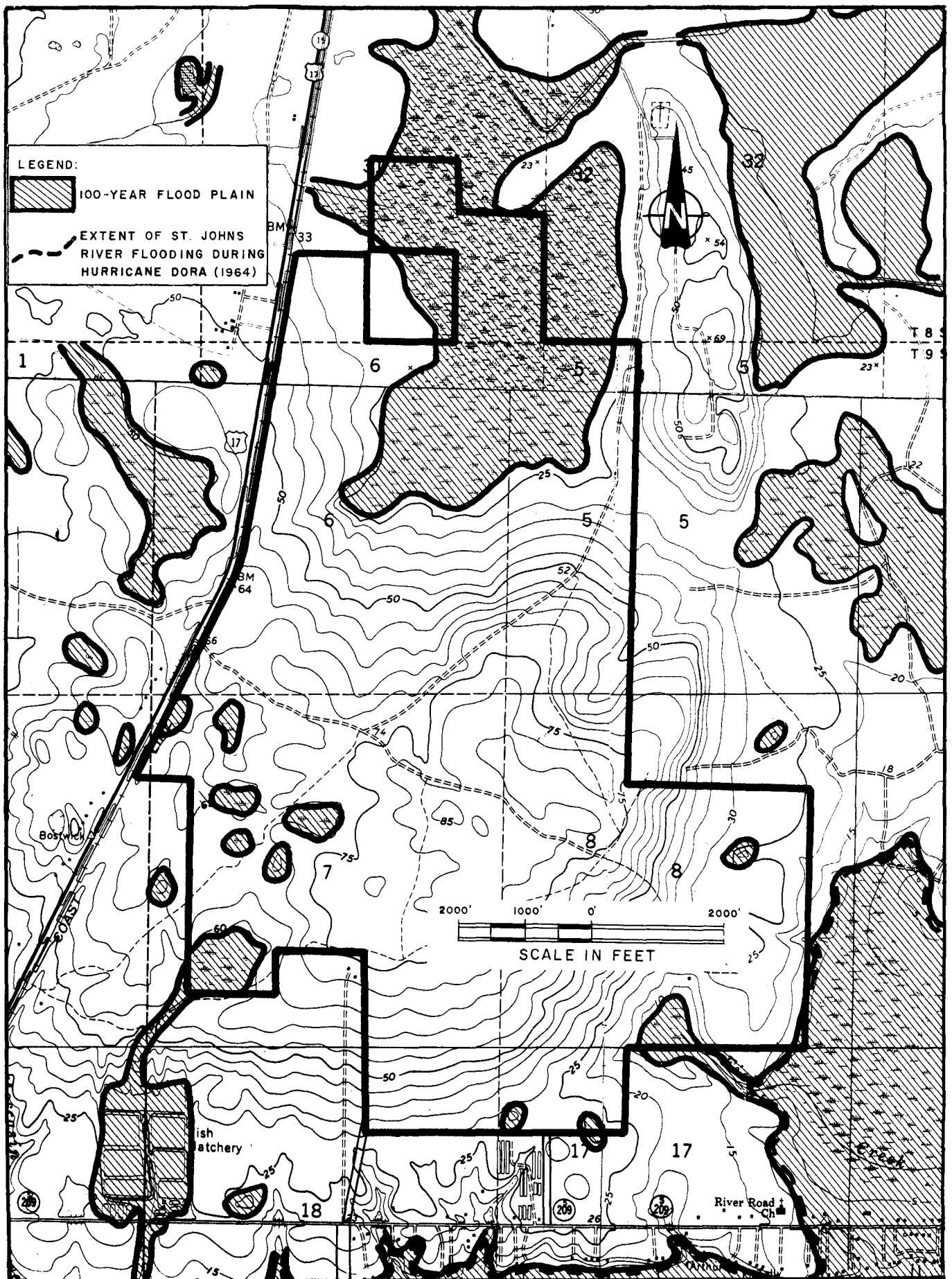


Figure 2.3-2. 100 Year Flood Plain and Extent of Hurricane Flooding.

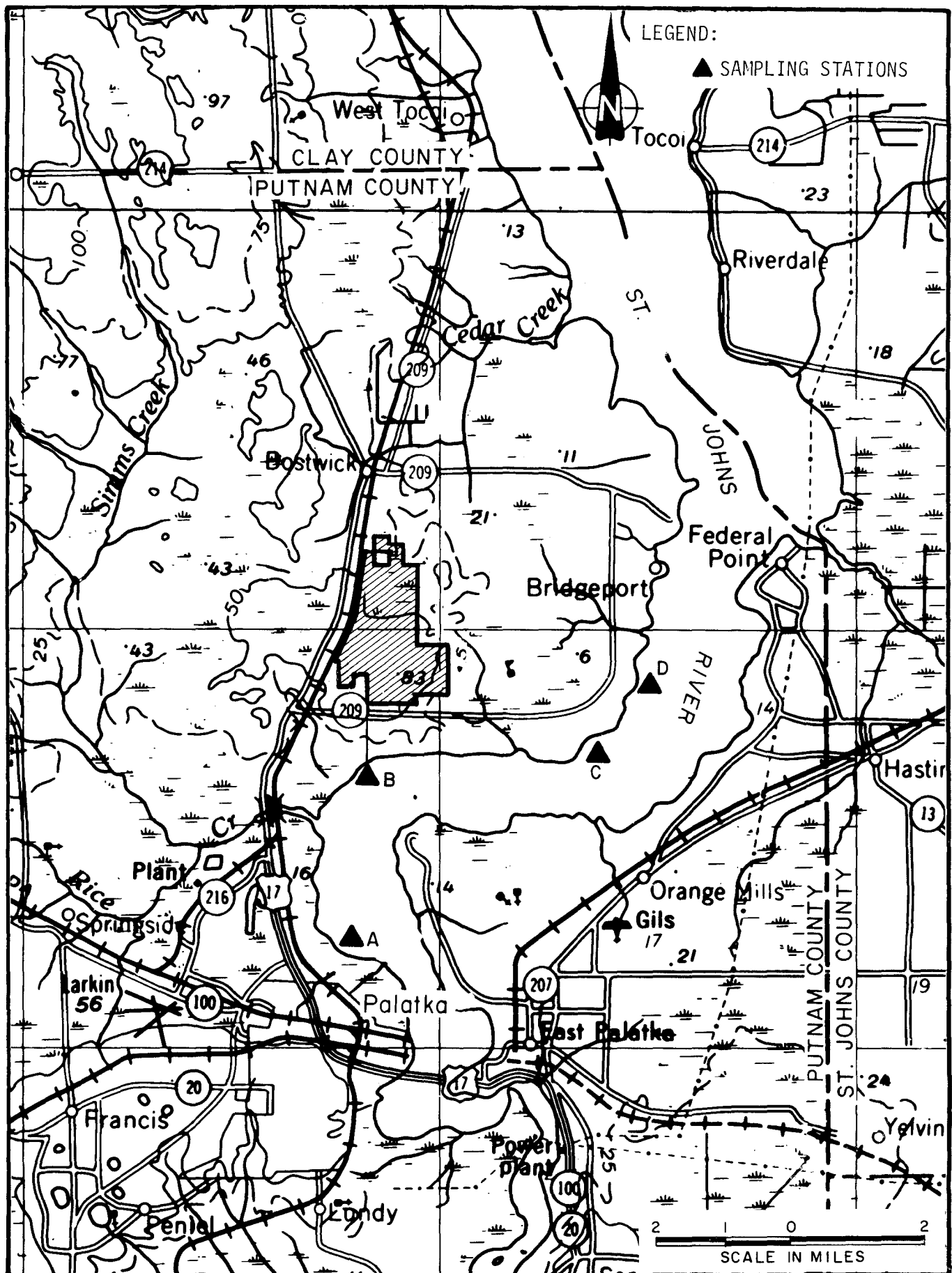


Figure 2.3-3. Local Tributaries and Dames & Moore Sampling Stations.

APPENDIX C

SURFACE WATER HYDROLOGY

C.1 BASELINE CONDITIONS

C.1.1 St. Johns River

General

As discussed in Section 2.3.1.1 the Seminole steam-electric generating station is located northwest of the St. Johns River, approximately 73 miles from its mouth and five miles downstream from Palatka, Florida. Although USGS (1977) flow records at Palatka and Jacksonville are available, the strong tidal action at both stations makes mean daily flow computations difficult. Due to the uncertainty of the data and the limited period of record, substantiation of the Palatka records was sought through analysis and comparison with other stations in the St. Johns watershed. Average discharges in cubic feet per second (cfs) per square mile are given in Table C-1 for the selected stations shown in Figure C-1. As seen in the table, the average fresh water discharge at Palatka of 1.07 cubic feet per second per square mile (cfsm) is comparable to the discharge from upstream stations that are not tidally influenced.

However, due to the tremendous storage capacity in the estuary from Palatka to Jacksonville, daily flow records from upstream stations cannot be used to extend the daily records at Palatka. In addition, as shown in Table C-2, the Jacksonville station with its 20 years of records shows no flow correlation with flows at Palatka.

The only source of meaningful data on the flow regime of the St. Johns River near the site other than the Palatka station is the USGS station on Rice Creek (Figure C-1). Because Rice Creek is a backwater to the St. Johns River at the station and experiences rapid response to stage fluctuations in the river, it may be used to extend the state record available on the St. Johns station. The peak stage records from the two stations are shown in Table C-3.

Low Flows

In order to assess the impact of the plant surface water discharges, a design low flow condition was selected for the St. Johns River which approximated minimum flushing from the estuary during a seven day period with a return interval of once in ten years. This flow, termed the minimum absolute flow, is hereinafter referred to as the 7-day MAF. The flow regime at Palatka during the 7-day MAF is summarized in Table C-4.

The flow regime at Palatka was extrapolated to the site vicinity using a Dames & Moore hydrodynamic model, TIDAL2, described in Section C.4. The speed of wave propagation or wave celerity through the estuary in the vicinity of the site utilized in the model was approximated by comparing continuous stage records from Rice Creek Station and the St. Johns Palatka station. The results of the comparison are shown in Figure C-2. From this comparison the average wave celerity was found to be approximately 16.0 fps. According to shallow water theory (Stoker, 1957) the speed of propagation of a wave is given by:

$$C = \sqrt{gh}$$

where, C = the wave celerity,
 g = the gravitational constant, and
 h = the water depth for an average depth of 10 feet.

The theoretical wave celerity is 18 fps which compares closely to the measured value of 16 fps. The computed velocity vectors for three different periods of the tidal cycle relating to a slack tide, flood tide and ebb tide during the 7-day MAF are shown in Figures C-3 through C-5.

High Flows

In order to obtain a quantitative estimate of the potential flood elevations in the vicinity of the site, the available data base was examined for peak stage events during each year of record. As described earlier, the eight years of record at Palatka were increased by utilizing stage data from the Rice Creek station. The results of the comparison is

shown on Table C-3. As seen in the table, for the five years of overlapping record between the stations, the Rice Creek stages were from 0.05 feet to 0.16 feet higher than the St. Johns stages. An average value of 0.08 feet was used to convert the Rice Creek stages from 1959 to 1967 to St. Johns River stages.

C.1.2 Local Tributaries and Site Hydrologic Characteristics

Local Tributaries

The tributaries draining the general site area are shown in Figure C-6. Average discharge data is available from only two stations in the Rice Creek drainage basin. In order to obtain average discharge values for the ungaged tributaries, the discharges in cfs from the two gaged stations were assessed. As seen in Table C-5, the cfs of 0.76 at the Rice Creek station was significantly different from the Etonia Creek station discharges of 0.23 cfs. The 0.76 cfs was utilized in obtaining the average discharges shown in Table C-6 because it represented a drainage area that better approximated the small areas drained by the subject tributaries.

From Figure C-6 and Table C-6, each of the watercourses draining the site area has an average discharge of less than five cfs. As defined by 33 CFR 323, an average discharge of five cfs is utilized by the U.S. Corps of Engineers (COE) to define those watercourses for which they exercise jurisdiction.

Site Erosion

The quantity of soil eroded per year may be estimated with the Universal Soil Loss Equation (USLE) developed by the Soil Conservation Service (SCS, 1975). The complete USLE is $A = RKLSCP$, where:

A = computed soil loss (sheet and rill erosion) in tons per acre per year;

R = rainfall factor; number of erosion-index units in a normal year's rain;

- K = soil-erodibility factor; erosion rate per unit of erosion index for a specific soil in cultivated continuous fallow, on a 9-percent slope 72.6 feet long;
- L = slope-length factor; ratio of the soil loss from the field slope length to that from a 72.6 feet length on the same soil type and gradient;
- S = slope-gradient factor; ratio of soil loss from the field gradient to that from a 9-percent slope;
- C = cropping management factor; ratio of soil loss from area with specific vegetative conditions to that from the fallow condition on which the factor K is evaluated;
- P = erosion-control practice factor; ratio of soil loss with contouring, stripcropping, or contour irrigated furrows to that with straightrow farming, up-down slope.

The parameter values are shown in Table C-7. The soil loss should average from 0.18 to 0.36 tons per acre per year or 300 to 600 tons/year over the 1550-acre area experiencing erosion.

Only a portion of the soil lost will actually leave the upland area. This portion, which is determined by a sediment delivery ratio, is deposited in the lowlands surrounding the upland area. Based on SCS (1965) data, the delivery ratio to the lowlands may be related to the drainage areas contributing sediment. The upland area drains into five distinct lowland areas of which four are partially within site boundaries. The respective drainage areas range from approximately 0.1 to 0.5 square miles. With such areas, the delivery ratio should be between 0.4 and 0.5. Using a conservative value of 0.5, the sediment deposition would be between 150 and 300 tons/year.

C.1.3 Water Quality Standards

Florida Water Quality Standards

The use classifications for the surface waters in the State of Florida as defined by the Florida Department of Pollution Control (Florida Department of Environmental Regulation, 1977) are presented below:

Class I Waters - public water

Any waters from which water is withdrawn for treatment and distribution as a potable supply.

Class II Waters - shellfish harvesting

Waters in areas which either actually or potentially have the capability of supporting recreational or commercial shellfish propagation and harvesting.

Class III Waters - recreation and propagation and management of fish and wildlife.

Waters to be used for recreational purposes, including such body contact activities as swimming and water skiing; and for the maintenance of a well-balanced fish and wildlife population. All surface waters within the coastal waters contiguous to these basins, including off-shore waters, not otherwise classified shall be classified as Class III.

Class IV Waters - agricultural and industrial water supply

Waters to be used for agricultural or stock watering or industrial water supply. Additionally, all secondary and tertiary canals wholly within agricultural areas are Class IV waters.

Class V Waters - navigation, utility and industrial

Waters which will be suitable for navigation and any other uses except for waters previously classified.

In addition to the above classifications, waters in the State of Florida are either freshwater, coastal waters, or open water as defined below:

Freshwater - all waters of the State which are contained in lakes, and ponds, or are in flowing streams above the zone in which tidal actions influence the salinity of the water and where the concentration of chloride ions is normally less than 1500 mg/l.

Coastal waters - all waters in the State which are not classified as freshwaters or as open waters.

Open waters - all waters in the State extending seaward from the most seaward 18-foot depth contour line (three-fathom bottom depth contour) which is off shore from any island; exposed or submerged bar or reef; or mouth of any embayment or estuary which is narrowed by headlands. Contour lines shall be determined from Coast and Geodetic Survey Charts.

The St. Johns is classified in the site vicinity as a Class III freshwater stream.

C.1.4 Water Discharges

Downstream of the site, there are twelve waste water treatment facilities discharging into the St. Johns River in water quality segment 20.3 FA shown in Figure C-7. These twelve facilities, detailed in Table C-17, have a total design capacity of 5.55 mgd (DER, 1975).

Upstream of the site there are seven facilities which discharge into either Rice Creek or the St. Johns in water quality segments 20-3 GA and 20-3 HA shown in Figure C-7. These facilities are detailed in Table C-18. Hudson Pulp and Paper Company is the major discharger with 50 mgd of industrial waste discharged into Rice Creek. The next major contributor is a Florida Power & Light electric generating plant whose major contribution is 2.1 mgd of heated cooling water.

TABLE C-12

WATER QUALITY DATA - ST. JOHNS RIVER*

Parameter Measured	Units	Measurements	Data Average	Maximum Value	Minimum Value	Beginning Date	Ending Date
Water Temp.	°C	68	23.9	30.5	8.5	62-08-16	77-05-20
Turb. JKSN	JTU	56	4.875	21	1	68-09-24	77-05-20
Specific Conductivity at 25°C	mhos	66	974	1400	510	62-06-08	77-05-20
DO	mg/l	64	6.6	11.6	2.7	68-04-26	77-05-20
DO saturated	%	57	76	107	35	68-04-26	77-05-20
BOD (5-day)	mg/l	35	.6	8.2	.6	68-09-24	77-05-20
pH	units	51	6.1	9.4	5.4	62-06-08	77-05-20
Bicarbonate HCO ₃	mg/l	48	102	150	48	62-08-16	77-02-25
Carbonate CO ₃	mg/l	1	3	3	3	66-11-22	76-07-18
Phosphate PO ₄ Tot	mg/l	5	.15	.24	.05	68-04-26	70-09-21
Ortho PO ₄ Diss.	mg/l	7	.09	.16	.01	66-11-22	71-00-14
TOT Hard CaCO ₃	mg/l	58	196.1	310	94	62-06-08	77-05-20
Ammonia Nitrogen Tot	mg/l	54	.05	.28	.01	68-09-24	77-05-20
Calcium Ca, Diss.	mg/l	52	47.7	78	30	62-06-08	77-05-20
Magnesium Mg, Diss.	mg/l	52	17.8	28	10	62-06-08	77-05-20
Sodium Na, Diss.	mg/l	48	121.6	180	70	62-06-08	77-02-25
Potassium K, Diss.	mg/l	48	4.5	8.8	1.2	62-06-08	77-02-25
Chloride Cl, Diss.	mg/l	57	220	400	120	62-06-08	77-05-20
Sulfate SO ₄ , Diss.	mg/l	48	64.7	114	37	62-06-08	77-02-25

*Source: USGS, STORET data file.

TABLE C-12 (Continued)

Parameter Measured	Units	Measurements	Data Average	Maximum Value	Minimum Value	Beginning Date	Ending Date
Arsenic As, Tot	µg/l	13	5.4	20	1	72-05-22	77-02-25
E- Cadmium Cd, Tot	µg/l	6	2.1	6	1	72-05-22	77-02-25
Chromium Cr, Tot	µg/l	11	<12.7	20	<9	70-05-18	77-02-25
Copper Cu, Tot	µg/l	12	3.25	10	1	72-05-22	77-02-25
Iron Fe, Tot	µg/l	16	218	350	40	72-05-22	77-02-25
E- Lead Pb, Tot	µg/l	16	14.6	74	1	72-05-22	77-02-25
E- Mercury Hg, Tot	µg/l	10	.19	.5	.1	71-05-12	77-02-25
E- Manganese Mn, Tot	µg/l	14	15.7	30	6	72-05-22	76-05-18
E- Zinc Zn, Tot	µg/l	11	26.4	70	4	72-05-22	77-02-25
CO ₂	mg/l	36	4.5	14	.1	62-08-16	77-02-25
Fec.Col.	/100ml	31	74.2	1200	5	74-01-16	76-11-10
Fecstrep	/100ml	2	27.5	50	5	76-12-21	77-05-20
Aldrin Whl Smp1	µg/l	0	0	0	0	68-09-24	68-09-24
DDD Whl Smp1	µg/l	0	0	0	0	68-09-24	68-09-24
DDT Whl Smp1	µg/l	0	0	0	0	68-09-24	68-09-24
DDE Whl Smp1	µg/l	0	0	0	0	68-09-24	68-09-24
Endrin Whl Smp1	µg/l	0	0	0	0	68-09-24	68-09-24
HCHLR Whl Smp1	µg/l	0	0	0	0	68-09-24	68-09-24
Lindane Whl Smp1	µg/l	0	0	0	0	68-09-24	68-09-24
Alkalinity (CaCO ₃)	mg/l	48	73	123	39	62-06-08	77-02-25
Total Carbon (C)	mg/l	30	32.8	72	24	71-05-12	77-05-20

TABLE C-12 (Continued)

<u>Parameter Measured</u>	<u>Units</u>	<u>Measurements</u>	<u>Data Average</u>	<u>Maximum Value</u>	<u>Minimum Value</u>	<u>Beginning Date</u>	<u>Ending Date</u>
Silica SiO ₂ , Diss.	mg/l	48	4.4	14	.1	62-06-08	77-02-25
Flouride f, Diss.	mg/l	48	.3	.8	.1	62-06-08	77-02-25
Cobalt Co, Tot	µg/l	5	2	5	1	72-05-22	77-02-05
Nickel Ni, Tot	µg/l	3	2	3	1	73-05-25	76-05-18
Strontium Sr, Diss	µg/l	42	1086	8600	80	66-11-22	77-02-25
Aluminum Al, Tot	µg/l	3	83	150	40	70-05-18	76-05-18
Selenium Se, Tot	µg/l	5	5	10	1	74-01-16	77-02-25
Silvex	ug/l	0	0	0	0	75-07-22	75-07-22
Eldrin Whl Smp1	µg/l	0	0	0	0	68-09-24	68-09-24
Total 24-D	µg/l	2	23	28	18	75-07-22	76-01-27
Total 245-T	µg/l	1	.04	.04	.04	75-07-22	76-01-27
TSS	mg/l	2	8	8	8	73-05-25	73-09-21
TDS Residue @180°	mg/l	48	578	935	378	62-06-08	77-02-25
Phenols	µg/l	1	1	1	1	68-09-24	70-05-18
Nitrite Tot	mg/l	41	.013	.10	.01	68-09-24	77-05-20
Nitrate Tot	mg/l	39	.098	.54	.01	62-06-08	77-05-20
KJELDAHL Nitrogen Tot	mg/l	50	1.0	2.5	.10	73-05-25	77-05-20

TABLE C-13

WATER QUALITY FIELD ANALYSIS - ST. JOHNS RIVER

Transect ^a	Date	Time	Water Depth (m)	Sample Depth (m)	Water Temp. (c)	Air Temp. (c)	D.O. (mg/l)	Conductivity (μmhos)	pH	Secchi (m)	
										Down ^b	Up ^c
A	9-13-77	0925	1.22	0.10	29.8	--	4.9	1200	7.2	.60	.60
			--	1.00	29.5	--	3.9	1210	7.2	--	--
A-1	1-30-78	0940	2.00	0.10	8.5	--	12.0	780	8.3	.62	.62
			--	1.00	8.5	--	11.4	780	--	--	--
			--	2.00	8.5	--	11.4	780	--	--	--
A-2	3-28-78	0800	2.00	--	18.5	11.0	7.8	850	7.2	.55	--
	1-30-78	0840	1.00	.10	6.0	--	12.1	620	8.2	.59	.60
			--	1.00	6.0	--	12.0	620	--	--	--
	3-28-78	0730	1.52	--	18.5	--	7.5	850	7.2	.55	--
		2400	1.52	--	20.00	13.0	9.1	920	7.2	--	--
	4-13-78	1100	1.5	--	24.5	25.0	8.1	975	7.4	.55	--
B	9-13-77	0910	1.22	0.10	29.3	--	4.2	1175	7.3	.85	.59
			--	1.00	29.0	--	3.9	1180	7.3	--	--
B-1	1-30-78	1125	3.00	0.10	9.0	--	8.1	550	8.4	.46	.45
			--	1.00	9.0	--	8.3	575	--	--	--
			--	2.00	9.0	--	8.9	625	--	--	--
			--	3.00	9.0	--	8.8	625	--	--	--
	3-28-78	0850	3.00	--	19.5	17.8	6.2	815	7.2	.45	--

TABLE C-13 (Continued)

Transect ^a	Date	Time	Water Depth (m)	Sample Depth (m)	Water Temp. (c)	Air Temp. (c)	D.O. (mg/l)	Conductivity (μmhos)	pH	Secchi (m)	
										Down ^b	Up ^c
B-2	1-30-78	1040	1.00	.10	9.0	--	6.4	550	8.4	.48	.47
			---	1.00	9.0	--	6.2	550	--	--	--
	3-28-78	0920	1.00	--	19.0	--	5.4	800	7.0	.55	--
		1945	1.00	--	21.5	15.0	9.7	960	7.1	--	--
	4-13-78	1230	1.5	--	26.0	25.0	6.8	1000	7.3	.50	--
C	9-13-77	0850	.90	.10	29.0	--	5.9	1120	7.3	.51	.51
			--	.73	29.0	--	5.4	1120	7.3	--	--
C-1	1-30-78	1310	3.00	.10	10.0	--	11.0	750	8.1	.67	.66
			--	1.00	10.0	--	10.9	750	--	--	--
			--	2.00	10.0	--	10.8	750	--	--	--
			--	3.00	10.0	--	10.7	750	--	--	--
	3-28-78	1100	3.00	--	20.0	18.0	7.6	860	7.2	.60	--
C-2	1-30-78	1220	1.00	.10	9.5	--	11.4	700	8.5	.55	.54
			---	1.00	9.5	--	10.3	700	--	--	--
	3-28-78	1030	1.00	--	20.0	--	7.7	850	7.2	.60	--
		2125	1.00	--	19.5	14.0	9.0	930	7.1	--	--
	4-13-78	1330	1.5	--	26.5	25.0	7.6	1010	7.5	.35	--
D	9-13-77	0810	.90	.10	28.8	--	5.5	1120	7.5	.60	.59
			--	.73	28.5	-	4.7	1120	7.5	--	--

TABLE C-13 (Continued)

Transect ^a	Date	Time	Water Depth (m)	Sample Depth (m)	Water Temp. (c)	Air Temp. (c)	D.O. (mg/l)	Conductivity (μmhos)	pH	Secchi (m)	
										Down ^b	Up ^c
D-1	1-30-78	1450	3.00	.10	10.0	--	11.6	700	8.6	.55	.55
			--	1.00	10.0	--	11.5	700	--	--	--
			--	2.00	10.0	--	11.5	700	--	--	--
			--	3.00	10.0	--	11.5	700	--	--	--
	3-28-78	1215	3.00		21.0	19.0	8.9	850	7.4	.60	--
D-2	1-30-78	1405	1.00	.10	10.0	--	11.8	700	8.7	--	--
			--	1.00	10.0	--	11.8	700	--	.47	.47
	3-28-78	1230	1.00	--	20.5	--	8.1	900	7.4	.60	--
		2230	1.00	--	19.5	14.0	9.6	890	7.1	--	--
	4-13-78	1430	.8	--	26.5	24.5	7.6	975	7.4	.60	--

^aFor transect locations see Figure C-6.

^bReading taken as secchi disk is being lowered.

^cReading taken as secchi disk is being raised.

TABLE C-14

ST. JOHNS RIVER - WATER QUALITY LABORATORY ANALYSIS
(Samples Collected by Dames & Moore)

Parameter ^b	February 1, 1978				March 29, 1978			
	TRANSECTS ^a				TRANSECTS ^a			
	A	B	C	D	A	B	C	D
Total Alkalinity CaCO ₃	76	68	64	68	55	70	55	60
Total Hardness CaCO ₃	224	184	196	200	195	190	190	190
Total Dissolved Solids	815	680	715	730	608	596	606	606
Total Suspended Solids	<1	1	1	1	28	4	6	46
Ortho-Phosphate, P	0.01	0.01	0.07	0.03	0.02	<0.01	<0.01	<0.01
Total Phosphate, P	0.06	0.07	0.14	0.05	0.10	0.10	0.10	0.25
Nitrate Nitrogen, N	1.00	1.60	1.10	2.60	0.01	0.02	0.02	0.01
Nitrite Nitrogen, N	0.010	0.002	0.002	0.004	0.001	0.002	0.004	0.006
Amonia Nitrogen, N	0.05	0.12	0.09	0.10	0.38	0.14	0.12	0.16
Kjeldahl Nitrogen, N	0.06	0.14	0.11	0.11	1.58	1.36	1.11	2.09
Sulfate, SO ₄	80	80	68	65	67	1.79	73	65
Silica, SiSO ₂	2.6	3.8	4.0	4.0	1.1	11	1.0	1.0
BOD (5-day)	0.2	1.2	0.6	0.4	3.0	1.0	2.0	3.0
Detergents, MBAS ^c	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fecal Coliform/100 ml (MFT) ^d	2	8	4	2	300	40	12	12
Magnesium Hardness, CaCO ₃	80	60	72	68	65	70	70	70
Calcium Hardness, CaCO ₃	144	124	124	132	130	120	120	120
Chemical Oxygen Demand, COD	46	56	60	58	88	64	64	106

TABLE C-14 (Continued)

Parameter ^b	February 1, 1978				March 29, 1978			
	TRANSECTS ^a				TRANSECTS ^a			
	A	B	C	D	A	B	C	D
Oil & Grease, Infrared	10	4.0	20	22	13	10	10	12
Phenols ($\mu\text{g/l}$)	<1	<1	<1	<1	<1	<1	<1	<1
Turbidity, JTu	<25	<25	<25	<25	<25	<25	<25	<25
Turbidity, NTU	2.5	3.5	<3.2	2.9	6.2	4.5	4.4	9.5
Color (units)	80	120	80	75	100	140	110	80
Chloride, Cl	290	230	225	245	210	230	240	204
Flouride, F	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Carbonate, CO_3	0	0	0	0	0	0	0	0
Bicarbonate, HCO_3	93	83	78	83	67	85	67	73
Chromium, Total ($\mu\text{g/l}$)	<10	<10	<10	<10	<10	<10	<10	<10
Mercury, Hg ($\mu\text{g/l}$)	<1	<1	<1	<1	<1	<1	<1	<1
Arsenic, As ($\mu\text{g/l}$)	2.9	1.9	1.9	1.9	20	5	2	4
Lead, Pb ($\mu\text{g/l}$)	1.89	<0.01	1.86	<0.01	13	12	9	10
Copper, Cu ($\mu\text{g/l}$)	<100	<100	<100	<100	<100	<100	<100	<100
Iron, Fe ($\mu\text{g/l}$)	80	120	80	60	100	90	50	20
Zinc, Zn ($\mu\text{g/l}$)	140	160	180	120	14	22	20	56
Cadmium	--	--	--	--	1	2	<1	<1

^aFor transect locations see Figure C-6.

^bValues in mg/liter unless otherwise noted.

^cMethyl blue active substance.

^dMembrane filter technique.

TABLE C-15

SEDIMENT SAMPLES - ST. JOHNS RIVER
(in mg/kg dry weight)

<u>Parameter</u>	<u>Analysis</u> <u>A</u>	<u>Analysis</u> <u>B</u>	<u>Analysis</u> <u>C</u>	<u>Analysis</u> <u>D</u>
Chromium, Cr	2.98	5.29	42.58	0.998
Mercury, Hg	5.3	1.4	6.0	<0.1
Arsenic, As	1.99	3.17	1.77	0.998
Lead, Pb	2.49	2.11	17.74	0.998
Copper, Ca	2.53	4.23	10.64	0.998
Iron, Fe	1,491	1,480	14,192	289
Zinc, Zn	30.8	54.9	97.6	469
Cadmium, Cd	0.10	0.21	0.43	0.37
Phenols	27.0	<0.2	19.7	<0.02
BHC	<0.001	<0.001	<0.001	<0.001
Lindane	0.023	0.011	0.004	0.002
Heptachlor	<0.001	<0.001	<0.001	<0.001
Aldrin	0.280	0.024	0.009	0.006
Heptachlor Epoxide	0.026	0.029	0.004	0.002
Dieldrin	<0.001	0.022	<0.001	<0.001
Endrin	<0.001	<0.001	<0.001	<0.001
Captan	<0.001	<0.001	<0.001	<0.001
DDE	<0.001	<0.001	<0.001	<0.001
DDD	<0.001	<0.001	<0.001	<0.001
DDT	<0.001	<0.001	<0.001	<0.001
Methoxyghchlor	<0.001	<0.001	<0.001	<0.001
Endosulfan	<0.001	<0.001	<0.001	<0.001
Dichloran	<0.001	<0.001	<0.001	0.001
Mirex	<0.001	<0.001	<0.001	<0.001
Pentachloroni- trohenzene	<0.001	<0.001	<0.001	<0.001
Trifluralin	<0.001	<0.001	<0.001	<0.001
Strobane	<0.001	<0.001	<0.001	<0.001
Toxaphene	<0.001	<0.001	<0.001	0.001
Chlordane	<0.001	<0.001	<0.001	<0.001
Polychlorinated Biphenyls	<0.001	<0.001	<0.001	<0.001

Notes: 1) Date of collection: April 13, 1978.

2) Collecting device: K-B Cora Sampler; sample contained a plastic tube liner.

3) Samples placed in containers supplied by Orlando Laboratories Inc. (no preservative added).

4) Analysis for: Heavy metals (similar to the water column) PCB's; Pesticides.

TABLE C-16
WATER QUALITY DATA - RICE CREEK*

<u>Parameter Measured</u>	<u>Units</u>	<u>Measure- Ments</u>	<u>Data Average</u>	<u>Maximum Value</u>	<u>Minimum Value</u>	<u>Beginning Date</u>	<u>Ending Date</u>
Water Temp.	°C	17	28.9	30.0	25.0	67-05-12	73-09-26
Turb. JTU	JTU	7	15.3	20	2	70-09-28	73-09-26
Specific Conductivity at 25°C	mhos	14	564	1120	220	67-05-12	73-09-26
DO	mg/l	15	1.82	6.0	.1	67-05-12	73-09-26
DO saturated	%	10	17.8	77	1	67-05-12	72-09-27
BOD 5-day	mg/l	8	4.91	11	.5	70-04-29	73-09-26
pH	units	16	6.11	7.9	6.3	67-05-12	73-09-26
Bicarbonate HCO ₃	mg/l	10	121.1	192	52	67-05-12	73-06-27
Carbonate CO ₃	mg/l	0	0	0	0	67-05-12	73-06-27
Phosphate PO ₄ T	mg/l	2	.99	1.1	.88	70-04-29	70-09-28
Ortho PO ₄ Diss.	mg/l	2	.56	.85	.27	67-05-12	68-04-26
TOT Hard CaCO ₃	mg/l	12	99.7	183	47	67-05-12	73-09-26
Ammonia Nitrogen Tot	mg/l	5	.05	.09	.03	71-09-14	73-06-27
Calcium Ca, Diss.	mg/l	12	28.2	50	13	67-05-12	73-09-26
Magnesium Mg, Diss.	mg/l	12	6.9	14	3.4	67-05-12	73-09-26
Sodium Na, Diss.	mg/l	11	91.8	172	32	67-05-12	73-09-26
CO ₂	mg/l	1	6.6	6.6	6.6	73-06-27	73-06-27
Alkalinity (CaCO ₃)	mg/l	10	99.3	157	43	67-05-12	73-06-27
Carbon (C)	mg/l	5	48	57	42	72-05-10	73-06-26
Potassium K, Diss.	mg/l	11	2.6	3.8	1.3	67-05-12	73-06-26
Chloride Cl, Diss.	mg/l	11	102	242	10	67-05-12	73-06-26

*Source: USGS, STORET data file

TABLE C-16 (Continued)

<u>Parameter Measured</u>	<u>Units</u>	<u>Measure-ments</u>	<u>Data Average</u>	<u>Maximum Value</u>	<u>Minimum Value</u>	<u>Beginning Date</u>	<u>Ending Date</u>
Sulfate SO ₄ , Diss.	mg/l	11	43.4	78	16	67-05-12	73-09-26
Silica SiO ₂ , Diss	mg/l	11	6.8	9.0	5.8	67-05-12	73-09-26
Flouride F, Diss.	mg/l	11	.4	.6	.3	67-05-12	73-09-26
Arsenic As, Tot	ug/l	5	14	20	5	72-02-10	73-09-26
Cadmium Cd, Tot	ug/l	4	1	1	1	72-05-10	73-09-26
Cobalt Co, Diss.	ug/l	2	1	1	1	70-09-28	72-09-27
Copper Cu, Tot	ug/l	6	15.3	30	3	70-09-28	72-09-27
Iron Fe, Tot	ug/l	5	637	750	460	72-05-10	73-09-26
Lead Pb, Tot	ug/l	4	4.2	7	2	72-05-10	73-09-26
Manganese Mn, Tot	ug/l	5	45	70	20	72-05-10	73-09-26
Nickel Ni, Tot	ug/l	1	17	17	17	73-06-27	73-09-26
Strontium Sr, Diss.	ug/l	9	280	460	120	67-05-12	73-09-26
Zinc Zn, Tot	ug/l	6	141	400	30	70-04-29	72-09-27
Alumimum Al, Tot	ug/l	3	790	840	740	70-04-29	73-09-26
TSS	mg/l	2	8	8	8	73-06-27	73-09-26
TDS Residue @180°	mg/l	11	407	685	192	67-05-12	73-09-26
TDS sum of const.	mg/l	10	352	664	135	67-05-12	73-09-26
Nitrite Tot	mg/l	5	.01	.02	.01	72-05-10	73-09-26
Nitrate Tot	mg/l	3	.01	.02	.01	72-05-10	73-09-26
Mercury Hg, Tot	ug/l	5	1.19	3.5	.3	70-09-28	73-09-26

2.3.2 Ground Water

2.3.2.1 Principal Aquifers

General

Two principal aquifers underlie the site: the water table aquifer and the artesian Floridan aquifer. The Floridan Aquifer is of much greater local importance.

The water table Aquifer consists of unconsolidated sand with some shell beds and some silty sands. Secondary aquifer zones, some of which are under pressure, are associated with this sand aquifer in some areas. However, the secondary artesian aquifers are not always present, and the water table aquifer can in general be thought of as being a single hydrologic unit. The water table aquifer extends from the surface to a depth of about 100 feet.

The Hawthorn Formation separates the water table and Floridan aquifers and is about 100 feet thick. These strata are confining but can locally include some permeable beds which act as secondary artesian zones; however, their primary function in the hydrologic system is that of a confining layer.

Under the confining strata is the Floridan Aquifer, the principal and most important aquifer. This hydrologic unit consists of porous limestones with some solution cavities. A generalized stratigraphic column, indicating the principal hydrologic units and their water bearing characteristics, is given in Figure 2.3-4.

Approach To Present Study

The published literature provided the general geologic and hydrologic background for the present study. A field program for constructing test wells and monitoring wells was devised for site-specific information.

The field program provided information on the hydraulic characteristics of the water table and Floridan aquifers, and identified sites at which water samples could be obtained for baseline water quality data. Figure 2.3-5 gives the locations of the borings and permeability tests. Appendices D.1 and D.2 provide logs and technical information on the borings.

Some borings served three purposes: soil sampling (reported in Section 2.2, Geology and Soils), ground water quality sampling, and monitoring of water surface elevations and potentiometric elevations.

Industrial and domestic wells within a five-mile area also provided useful information. Most wells tap the Floridan Aquifer, only a few domestic wells tap the water table aquifer. The well inventory from this program and selected data from an earlier published inventory (Bermes and others, 1963b) appear in Appendix D.6.

Water Table Aquifer

The unconsolidated sand at the surface of the site, together with somewhat indurated beds below that unit to a depth of approximately 100 feet, constitute a single aquifer. Some discontinuous beds of finer materials below about 45 feet in depth cause localized artesian conditions, but these are the exception. Most of the water in this aquifer exists under unconfined (water table) conditions (Figure 2.3-4).

The loose uncemented sand forming the top 40- to 50-ft layer is fine-grained and is Recent and Pleistocene in age (Section 2.2). The lack of cement within the sand permits interstitial openings allowing moderate to high vertical and horizontal permeabilities. Recharge is from local precipitation.

The top or first layer overlies a second layer of silty sands, silts, clays, and sands of upper Miocene age which are about 50 to 60 feet thick. Shell beds within the second layer provide water supplies locally. The less permeable beds may act as confining beds for the Floridan Aquifer. Recharge can be from the water table aquifer, underlying artesian aquifer, or rainfall.

The water table aquifer is used as a source of water for some sixteen families in the town of Bostwick northwest of the site, and at a few scattered dwellings elsewhere within the five-mile radius of study. Most wells within five-miles, however, tap Floridan Aquifer.

The water table aquifer provides adequate water supplies for general domestic uses. During this study, a production well was pumped at 48 gallons per minute (gpm) for 24 hours. A relatively shallow cone of depression was created with a 5.5-foot drawdown at its center. The specific capacity of the well was 9 gpm/foot of drawdown. Hydraulic characteristics of the aquifer and well design are given in Appendix D.2; water level fluctuations are discussed in Appendix D.4.

Confining Strata

The Hawthorne Formation is the confining unit, about 100 feet thick, between the water table aquifer and the underlying Floridan Aquifer. It is early- to mid-Miocene in age and consists of clay, marl, and sandy clays, together with some interbedded sands and limestones. These sands and limestones can sometimes act as secondary artesian aquifers of low yield, especially along the St. Johns River. Recharge to these secondary aquifers may come from the overlying water table aquifer, and from the Floridan Aquifer (Bermes and others, 1963a).

Floridan Aquifer

The Floridan Aquifer is the primary aquifer at the site and is under artesian pressure. Since it is limestone, its waters are generally higher in dissolved calcium carbonate than the waters of the overlying water table aquifer. It is composed of several stratigraphic formations: the Lake City Limestone (oldest), Avon Park Limestone, and the Ocala Group (Inglis Formation, Williston Formation and the Crystal River Formation) (St. Johns River Water Management District, 1977). In addition, about 10 feet of the lower beds of the Hawthorne Formation may be hydraulically connected to the underlying limestone formations, and, in effect, would be part of the Floridan Aquifer. A test well drilled during the study penetrated a total of 220 feet of the aquifer (Appendix L).

The thickness of the principal water-bearing zone in the Putnam-St. Johns-Flagler County area is about 450 feet (Bentley, 1977). Within that range, the upper 50 to 200 feet of the Floridan Aquifer are more permeable than the lower 200 to 300 feet. An estimate of the average porosity of the upper 400 feet of the Floridan Aquifer is 62 percent (Bermes and others, 1963a). Hydraulic characteristics are given in Appendix D.3; water level fluctuations are in Appendix D.4.

At the site, the height to which water in a tightly-cased well will rise from the Floridan Aquifer when penetrated by a drill (called the potentiometric head) is about 30 to 28 feet above mean sea level (MSL), and 37 to 44 feet below land surface in wells F-1 and F-2, respectively (November 1977 to February 1978). These wells, therefore, are non-flowing artesian wells.

Recharge to the Floridan Aquifer is from areas remote from the site. Direct recharge is also through sinkholes in the vicinity of western and southeastern Putnam County (Bermes and others, 1963a).

It is unlikely that percolating water from the onsite land surface could reach the Floridan aquifer. Movement would be severely, if not completely, retarded by 100 feet of confining materials (Hawthorne Formation) of very low permeability. Further, under present conditions, the percolating water could not reach the Floridan aquifer due to the hydraulic gradient from upward artesian pressure of the Floridan Aquifer waters.

The potential for sinkhole development in the site vicinity has also been reviewed. Solutioning of the aquifer at depth, transport of subsurface material, and sink development is unlikely under existing gradients. This is reflected in the lack of topographic expression of recent sink activity in the site area.

2.3.2.2 Ground Water Flow

The topography of the site causes water within the water table aquifer to flow radially from the topographic high. In the northern part of the site, the flow direction is generally toward the lowland

area, which is in turn drained by a ditch flowing northeast away from the site. In the southern part of the site, the water table aquifer flow is directly toward the St. Johns River. On the eastern and western areas of the site the flow is away from the site, toward lowlands.

Water table contours for the fall of 1977 are shown in Figure 2.3-6. Flow occurs at right angles to the contour lines, from higher toward lower elevations.

The flow of the Floridan Aquifer is best evaluated with a regional perspective. The potentiometric contours of the Floridan Aquifer in Putnam and adjacent counties are shown in Figure 2.3-7 (Healy, 1975; St. Johns River Water Management District, 1977). Direction of flow is perpendicular to the contours and from higher to lower pressures.

2.3.2.3 Ground Water Quality

A monitoring program was established to develop a ground water quality baseline for both the water table aquifer and the Floridan Aquifer. Site sampling began in two wells in each aquifer in November 1977. An offsite domestic well (S-1) was added to the program in December 1977 to monitor the water table aquifer offsite. All were monitored, as field conditions permitted, through April 1978. Particulars of the monitoring program appear in Appendix D.5.

Water Table Aquifer

The quality of the water in the water table aquifer was generally good compared to U. S. Environmental Protection Agency (EPA) and Florida Department of Environmental Regulation (DER) existing and proposed drinking water standards. Total dissolved solids (TDS) averages were not over 164 milligrams per liter (mg/liter) on the site, and 310 mg/liter at the offsite well. Individual inorganic chemical constituents are also below the prescribed limits. However, turbidity in Well Number 1 and color in Well Number 3 were above the limits. In Well S-1, average turbidity was also above acceptable levels. Iron content was high enough to be noticed by users, but no EPA or DER standards prescribed iron.

Floridan Aquifer

The quality of water from the Floridan Aquifer is considered to be good. An objectionable odor, mainly due to hydrogen sulfide gas, was above EPA/DER limits in both wells (F-1 and F-2). Well F-1 was above the limits in odor, color and turbidity averages. The average total dissolved solids of Well F-2 is 617 mg/liter, which was above the 500 mg/liter recommended limit. No measured inorganic chemical constituents were above the limits set by EPA/DER. Only minor treatment of this water would be necessary to make it a good potable water supply.

Chloride content was measured in the Floridan Aquifer wells. Average chloride for Well F-1 was 12 mg/liter, whereas it was 189 mg/liter for Well F-2 about one mile east of Well F-1. Both wells produce from the upper 20 to 25 feet of the Floridan Aquifer. The difference was probably caused by the proximity of the brackish water near the bottom of Well F-2. That well is not only nearer the coast, but is also nearer an area across the St. Johns River in which artesian pressures have been lowered by pumping for irrigation. This area apparently has non-potable water located at a higher elevation (Figure 2.3-9).

The interface between brackish and fresh water slopes inland from the coast (fresh water across the entire Florida peninsula can, in general, be thought of as floating on denser sea water, with higher water table elevations corresponding to a deeper salt water-fresh water interface). The continuous lowering of artesian pressures in the agricultural area since 1900 (Kellum, Patterson & Bell, Inc., 1977) has caused increased salt water intrusion. Lowering of the artesian pressures allows both an upward movement of more saline water as well as horizontal movement from the coast.

Regional water quality data (Figure 2.3-8) indicate that the reported higher chloride content of Well F-2 is to be expected. The depth to the base of potable water is shown to be about 250 feet below

the land surface at the site (St. Johns River Water Management District, 1977) (Figure 2.3-8). Chloride content at this elevation is, in part, a result of irrigation pumping and the area's proximity to the coast. Klein (1971), furthermore, attributes the presence of nonpotable water at higher elevations to faulting along the St. Johns River. Fractures may allow water of poorer quality to rise closer to the surface.

2.3.3 References

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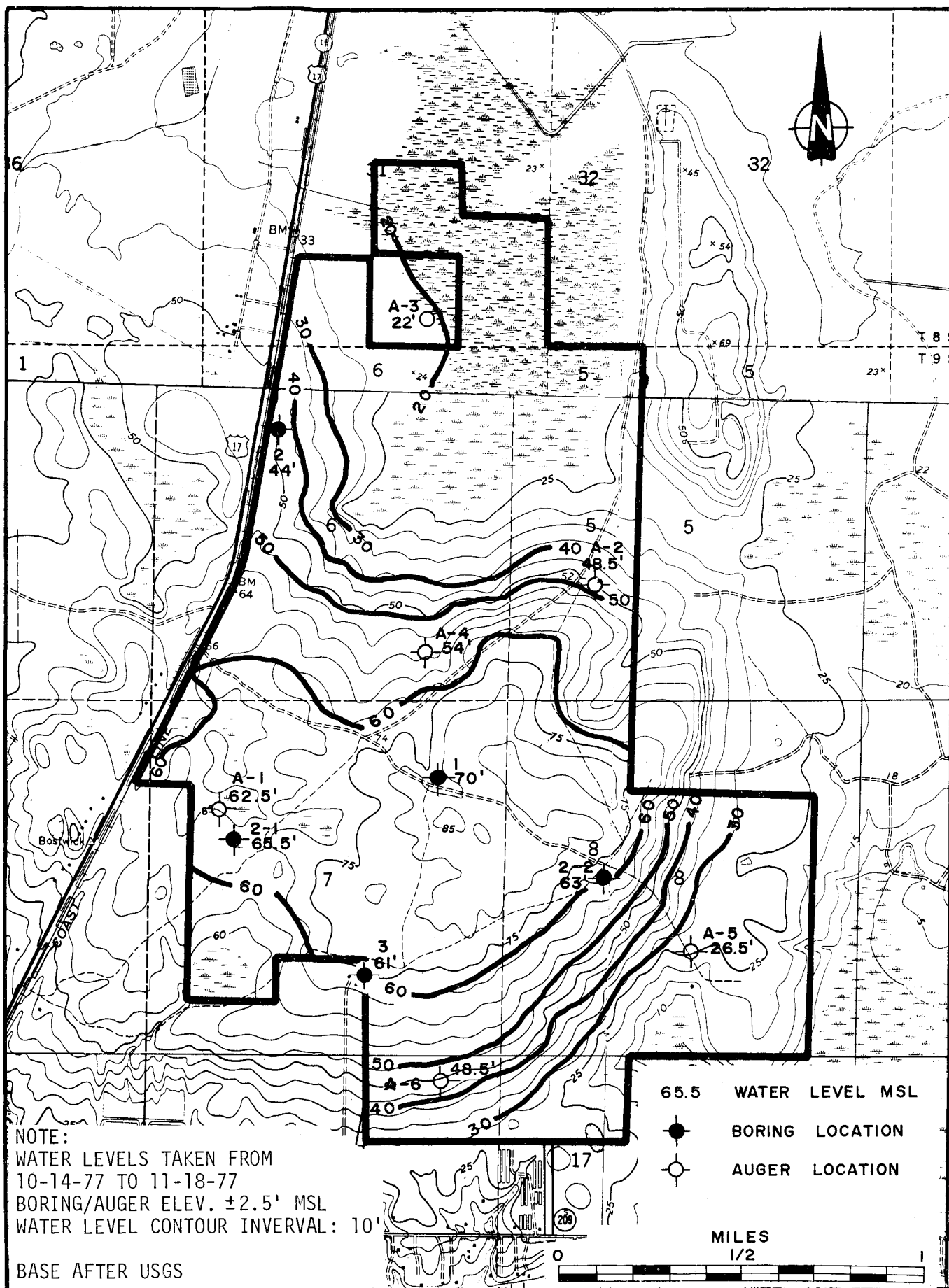


Figure 2.3-6. Site Water Level Contour Map of Water Table Aquifer.

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APPENDIX D
GROUND WATER HYDROLOGY

D.1 MONITOR WELLS

Borings 1 and 3 from the drilling program of June 1977 were used as monitor wells for the water table aquifer. Figure D-1 shows their locations; Figures D-2 and D-3 show their geologic characteristics and details of construction.

A private domestic well outside the site boundary near Bostwick was chosen for additional sampling of water from the water table aquifer. Mr. S. R. Harrison, Sr. is the owner and has given permission to sample. He reports the well to be completed at 80 feet total depth in the water table aquifer. It is cased with 1-1/2 inch diameter steel casing.

Water from the Floridan Aquifer was sampled in two wells (F-1 and F-2) drilled for that purpose. The wells are adjacent to Borings 2-1 and 2-2 drilled for soil samples and reported under Section 2.2, Geology and Soils. Details of construction and geologic characteristics of Wells F-1 and F-2, and shallow water supply wells drilled during drilling, are given in Figures D-4, D-5, and D-6.

D.2 HYDRAULIC CHARACTERISTICS OF THE WATER TABLE AQUIFER

A hydraulic test of the water table aquifer was made in November 1977. A test well 100 feet deep with casing slotted from 10 to 95 feet (Figure D-6) was pumped for 24 hours at 48 gpm. Drawdown observed in Boring No. 1, 74 feet west of the test well, was 5.5 feet at the end of the test period.

The specific capacity was computed to be about 9 gallons per minute per foot of drawdown. The transmissivity of the aquifer was computed to be about 16,500 gallons per day per foot (gpd/ft) of aquifer and the storage coefficient was computed to be about 0.30.

Storage coefficients, as calculated, were highly variable. Most were inapplicable because values pertaining to artesian conditions were obtained because of incomplete aquifer drainage. However, the average of the values obtained by using the Boulton curves that are applicable to unconfined conditions is comparable to reported results from similar well-sorted, fine-grained sands. Table D-1 gives details of the aquifer test.

The upper 40 to 50 feet of the water table aquifer is of primary concern with reference to water movements (this unit is referred to as Layer 1 in Section 2.2). In calculating horizontal permeabilities, the total transmissivity of the unconfined aquifer (16,500 gpd/ft) is considered to be 80 percent attributable to Layer 1. The saturated thickness of Layer 1 was 34 feet at the time of the aquifer test. Results appear in Table D-2.

D.3 HYDRAULIC CHARACTERISTICS OF THE FLORIDAN AQUIFER

Studies by the U. S. Geological Survey (USGS) and the Florida Geological Survey (FGS) provide information on the hydraulic and other characteristics of the Floridan Aquifer. A transmissivity of about 275,000 gpd/ft of aquifer is representative of the Floridan Aquifer in the Putnam County vicinity. This figure is based on results of pumping tests performed by the USGS (Bermes and others, 1963) and by a more recent pumping test near Bostwick in which a transmissivity of about 127,000 gpd/ft was calculated (Bentley, 1977) based on a well that does not completely penetrate the aquifer. The full transmissivity is considered to be possibly about 500,000 gpd/ft (Craig Bentley, personal communication, October 1977). For the entire Putnam, St. Johns, and Flagler County area, Bentley (1977) considers about 450,000 gpd/ft as representative.

The storage coefficient of the Floridan Aquifer ranges from less than 1.0×10^{-4} to more than 9.0×10^{-4} with the high end of the range measured near Palatka at the Hudson Pulp and Paper Company (Bermes and others, 1963). The small values of the coefficients are indicative of artesian conditions. The well tested was pumped at 5,000 gpm for two days. Bentley (1977) considers 8×10^{-4} to be the best estimate for the three-county area.

However, the transmissivities and storage coefficients of the Floridan Aquifer may vary throughout the State of Florida and locally by several orders of magnitude. This variance is especially common in limestone karst topographic regions as solutioning of the aquifer in many localized areas magnifies this variance.

As detailed in Appendix L, analysis of the Floridan Aquifer pumping test on the Putnam Site indicates a transmissivity of 46,000 gpd/ft and a storage coefficient of 1×10^{-4} .

D.4 WATER LEVEL FLUCTUATIONS

Water level measurements of both the water table and Floridan Aquifer taken during the monitoring program are shown in Table D-3 and D-4. Because of the short monitoring period, the data may not necessarily be indicative of long-term fluctuations.

The longest-term available record of water level fluctuations in the water table aquifer consists of measurements in three borings drilled during June 1977. In order to compare the three wells, Table D-3 shows water levels in the three wells over a six-month period from June to November 1977. (Sometime after the November readings, Boring No. 2 was disturbed and, therefore, was eliminated from the monitoring program.) Table D-3 also contains the maximum measured fluctuations in the three wells. The largest recorded fluctuation was seven feet amplitude and occurred between June 1977 and February 1978.

Water level data for the two wells in the Floridan Aquifer are based on a six month period of record from November 1977 to April 1978 (Table D-4). The largest recorded fluctuation was 4 feet in amplitude between March and April 1978. This figure agrees with short term reported fluctuations (Bermes and others, 1963).

D.5 GROUND WATER QUALITY MONITORING DATA

Results of the six-month monitoring program (November 1977 through April 1978) are presented in Table D-5, Ground Water Quality Parameters. Well locations are shown in Figure D-1.

D.6 WATER WELL INVENTORY

Introduction

Wells within a five-mile radius of the site were inventoried for physical characteristics and use. The wells are numbered according to quadrants, based on townships (see Figures D-7 and D-9), and designated with prefixes of A through D.

The inventory was performed from October 17 to 28, 1977, with a special inventory near Bostwick on November 16, 1977 (Figure D-8). Well information, such as casing depth and total depths, were based on interviews with the well owners. Efforts were made to obtain drillers logs for the wells to verify well construction. However, very limited well data were available. Table D-6 presents the inventory data. Figure D-7 locates the wells in the October inventory, and Figure D-8 shows the well locations in the special inventory.

Published data from an earlier inventory by the U. S. Geological Survey (USGS) provided information on additional wells within the five-mile radial area. Results are in Table D-7. Only a few of the wells inventoried by the USGS were located and restudied during the field inventories.

An average of one well per square mile was inventoried as a representative number. In areas of low well density, all wells were inventoried. In areas in which similar wells were clustered, one or more were selected. All wells known to have higher than average yields were given particular attention. Wells producing from the Floridan Aquifer and those tapping the water table aquifer were identified. Near Bostwick, the special inventory identified water table wells at a greater density than the other inventory. The results of the inventories are summarized in the following sections.

Quadrant A

Quadrant A covers the area north and northeast of the site and includes the Community of Bostwick (approximately 150 families). Bostwick is in an area of moderate artesian flow. The well and water use inventory located a total of 16 water table aquifer wells ranging from 56 to 120 feet in depth with 14 wells in the range of 80-100 feet (Figure D-8). The remainder of the wells serving Bostwick produce from the Floridan Aquifer with depths ranging from 180 to 300 feet. Those were not inventoried, but one Floridan well (S-17) downstream from the site was inventoried. Most wells serve one family only; a trailer park is served by a single well tapping the water table aquifer. One well located during the special inventory (S-1) was monitored monthly to assist in establishing baseline water quality.

The area directly to the east of Bostwick along State Route 209 is lightly populated, with approximately one family per quarter mile. The wells serving this area are flowing Floridan Aquifer wells ranging from 150 to 500 feet in depth. These wells serve one family each, with the exceptions of Well A-16 which is a 6-inch Floridan well that serves the St. Johns Harbor Trailer Park (approximately 75 families), and Well A-23, a 6-inch Floridan well serving the Community of Bridgeport (approximately 12 families). The wells in the Flint Point, Pine Bluff, Deadman Point, Nine Mile Point, and Palmetto Bluff areas are flowing Floridan wells serving one family each.

Quadrant B

Quadrant B located to the northwest of the site is a sparsely populated area, in which the Floridan Aquifer is tapped by single-family wells ranging in depth from 180 to 500 feet. Only one water table aquifer well could be found in this area.

Quadrant C

Quadrant C covers the area to the west and southwest of the site and includes the Community of Bardin (approximately 50 families), Hudson Pulp and Paper Company, and the St. Johns River Barge Port.

No flowing wells were found in the area directly west of the site between State Route S209 and Bostwick along U. S. Route 17. However, well depths suggest that at least some wells reach the Floridan Aquifer. The wells range in depth from 135 to 200 feet and serve individual families.

The inventory in the Bardin area showed Floridan Aquifer wells ranging in depths from 114 to 300 feet and serving one family each. Also two wells owned by Hudson Pulp and Paper Company, Well C-6 (12 inches; 600 feet) and Well C-7 (20 inches; 1203 feet), were uncapped and flowing into Etonia Creek. These wells were also included in the 1963 USGS inventory.

Quadrant D

This quadrant includes the area directly south and east of the site. The wells in this area are flowing Floridan Aquifer wells ranging in depth from 150 to 310 feet. Each serves one family. These wells were, for the most part, located between State Route S209 and the St. Johns River.

Also included in this quadrant is an area on the east bank of the St. Johns River just north of East Palatka. This is mainly an agricultural area (potatoes, cabbage); however, the wells inventoried were mostly residential and each served a single family. These wells were found to be flowing Floridan wells ranging in depth from 150 to 350 feet. Each owner reported that his well was affected by irrigation pumping in the fields directly to the east in the Patersonville-Orange Mills area. Data on agricultural wells were unavailable at the time of inventory.

General Findings

In all areas covered, the Floridan Aquifer wells observed were equipped with aeration and filtration systems to eliminate hydrogen sulfide odor in the water. About 40 percent of the owners of water table aquifer wells surveyed reported a high iron content in their water.

Well yields from the Floridan Aquifer are usually dependent on the size of pipe chosen for water delivery, hence not likely to be representative of the capacity of the well. Well yields from the water table aquifer were unavailable, but presumed to be modest, inasmuch as most are two inches in diameter. No springs were found during the inventory.

Table D-1

Hydraulic Parameters of the Water Table Aquifer

<u>Well</u>	<u>Plot</u>	<u>Method</u>	<u>Transmissivity (gpd/ft.)</u>			<u>Storage Coefficient</u>
			<u>No. of Calc.</u>	<u>Range</u>	<u>Ave. For Method</u>	
Test well (pumped)	time vs. recovery	non-leaky artesian aquifer curve (Theis, 1935).	3	16,120-16,670	16,400	inapplicable
D&M #1 (observ.)	time vs. drawdown	leaky artesian/un- confined aquifer curve (Bolton, 1963)	2	16,450-17,030	16,700	0.22 - 0.37
Selected representative value					16,500	0.30

Table D-2

Permeability of Upper Part of Water Table Aquifer
(Layer 1)

Vertical ^a		Horizontal ^b	
(ft/sec.)	(gpd/ft ²)	(ft/sec.)	(gpd/ft ²)
4.4×10^{-5}	28.4	6.03×10^{-4}	389

^aAverage of results of 3 field tests using falling-head parameters.

^bComputed from pumping test.

Table D-3

Water Level Fluctuations in Water Table Aquifer

<u>Boring No.</u>	<u>Land Surface^a Elevation (ft MSL)</u>	<u>Water Level^b (ft. LSD) (ft. MSL)</u>		<u>Six Month Amplitude of Fluctuation (ft)</u>	<u>Date Recorded</u>	<u>Maximum Measured Fluctuation</u>	<u>Period of Record</u>
1	79	7 10	72 69	3	6-27-77 11-4-77	4	6/77-4/78
2	49	5 5	44 44	0	6-29-77 11-4-77	0	6/77-11/77
3	75	8 14	67 61	6	6-30-77 11-4-77	7	6/77-4/78

^aElevations estimated from 1/24,000 scale topographic map; Above mean sea level (MSL).

^bBelow land surface datum (LSD); above mean sea level (MSL).

Table D-4
Water Level Fluctuations in Floridan Aquifer

<u>Well</u>	<u>Land Surface^a Elevation (ft. MSL)</u>	<u>Water Level^b (ft. LSD) (ft. MSL)</u>		<u>Six Month Amplitude of Fluctuation (ft.)</u>	<u>Dates Recorded</u>
F-1	67	35	32	4	3-21-78
		39	28		4-26-78
F-2	72	43	29	3	2-20-78
		46	26		4-26-78

^aElevations estimated from 1/24,000 scale topographic map; above mean sea level (MSL)

^bBelow land surface datum (LSD); Above mean sea level (MSL)

TABLE D-5
GROUND WATER QUALITY PARAMETERS

NOTE: All values are expressed in milligrams per liter (mg/l) unless otherwise noted. Analyses by Orlando Laboratories, Inc., Orlando, Florida, except for December 9, 1977 duplicate analysis.

PARAMETER	WELL NO. 1						AVERAGE
	AQUIFER Water Table						
	DATE SAMPLED						
	11-4-77	12-9-77	1-4-78	2-14-78	3-21-78	4-26-78	
Water level (ft. below LSD)	9.6	10.2	9.6	9.0	6.2	7.7	--
Color (PCU)	30	5	25	5	5	5	13
Odor Threshold	15	0	1	1	0	0	3
Turbidity (field) (NTU)	--	28	32	--	65	20	30
Turbidity (lab) (NTU)	40	--	--	41	120	380	180
Temperature (°C)	23	--	23.1	22	21	--	22.3
Specific conductance (umhos/cm @ 25°C)	115	63	61	58	67	62	69
Total Dissolved Solids	95	50	40	44	56	36	54
pH field (units)	--	6.1	6.7	--	--	5.7	6.2
pH lab (units)	6.0	--	--	6.1	5.6	6.1	5.9
Alkalinity, total as CaCO ₃	24	20	21	16	25	20	21
Hardness, total as CaCO ₃	56	26	20	22	24	30	30
Hardness, Non carbonate as CaCO ₃	32	6	2	6	1	10	10
Alkyl Benzene Sulfonate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	<0.01	<0.01	<0.01	0.012	0.01	0.016	<0.013
Barium	<0.5	<0.5	<0.5	<0.1	<0.5	<0.1	<0.37
Bicarbonate as HCO ₃	29	24	26	20	31	24	26
Boron	--	--	0.06	0.05	0.07	0.05	0.058
Cadmium	<0.01	<0.01	<0.01	0.001	<0.005	0.004	<0.005
Calcium	13	6.4	4.8	5.6	6.4	8	7.4
Carbon Dioxide as CO ₂	50.0	35	9.0	18.0	130	32	46
Carbonate as CaCO ₃	0	0	0	0	0	0	0
Chloride	6.6	5.9	4.0	4.6	5.1	5.9	5.35
Chromium Hexavalent	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Flouride	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
Hydrogen Sulfide as Sa	1.4	<0.1	0.25	0.06	<0.01	<0.01	<0.31
Hydroxide as OH	0	0	0	0	0	0	0
Iron ^b	28.0	24.0	5.90	4.95	18	15	10.9
Lead	<0.01	<0.01	<0.01	0.007	<0.01	0.019	<0.011
Magnesium	5.8	2.4	1.9	1.9	1.9	2.4	2.7
Manganese	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrate	5.67	0.80	1.28	3.32	4.43	0.89	2.73
Phenols	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphate as PO ₄	0.62	0.34	0.34	0.37	1.43	<0.16	0.54
Potassium	1.0	0.1	0.1	0.32	0.74	0.75	0.50
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	0.003	0.009
Silica	6.0	3.0	3.0	2.9	2.8	6.4	3.9
Silver	<0.01	<0.01	<0.01	0.041	<0.01	<0.01	<0.015
Sodium	8.1	3.5	3.4	3.6	4.7	3.6	4.5
Sulfate	50	4	5.0	3.0	<1	10	12.2
Zinc	0.08	0.02	0.06	0.03	0.04	0.10	0.06
Stability Index	12.2	12.9	12.5	13.1	13.2	12.0	12.7
Saturation Index	-3.1	-3.4	-2.9	-3.5	-3.8	-2.9	-3.3

^a Hydrogen sulfide titrated in field, except November, 1978 and duplicate of December 9, 1977.

^b Values for iron invalid in November, 1977, and not included in average. Sample not filtered in the field.

TABLE D-5 (cont'd)
GROUND WATER QUALITY PARAMETERS

NOTE: All values are expressed in milligrams per liter (mg/l) unless otherwise noted. Analyses by Orlando Laboratories, Inc., Orlando, Florida, except for December 9, 1977 duplicate analysis.

PARAMETER	WELL NO. 3 AQUIFER Water Table						AVERAGE
	11-4-77	12-9-77	1-4-78	2-14-78	3-21-78	4-26-78	
Water level (ft. below LSD)	14.0	14.7	14.4	15.1	13.2	14.7	--
Color (PCU)	35	30	25	30	30	30	30
Odor Threshold	5	5	0	40	0	0	9
Turbidity (field) (NTU)	--	3.8	2.4	--	4.1	3.4	3.4
Turbidity (lab) (NTU)	2.8	--	--	5.2	4.3	4.6	4.7
Temperature (°C)	23	--	22.8	22	--	--	22.6
Specific conductance (µmhos/cm @ 25°C)	450	240	194	119	139	123	210
Total Dissolved Solids	350	210	135	64	112	112	164
pH field (units)	--	7.0	6.6	--	--	6.4	6.7
pH lab (units)	6.8	--	6.6	6.4	6.9	6.7	6.7
Alkalinity, total as CaCO ₃	208	120	88	60	60	52	98
Hardness, total as CaCO ₃	196	112	88	55	60	56	94
Hardness, Non carbonate as CaCO ₃	12	8	0	5	<1	4	5
Alkyl Benzene Sulfonate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	<0.01	<0.01	<0.01	0.012	<0.01	0.014	<0.011
Barium	<0.5	<0.5	<0.5	<0.1	<0.5	<0.1	<0.367
Bicarbonate as HCO ₃	254	146	107	73	73	63	119
Boron	--	--	0.04	0.02	0.05	0.01	0.030
Cadmium	<0.01	<0.01	<0.01	<0.001	<0.005	0.003	0.007
Calcium	74	42	27	6.3	19	19	31.2
Carbon Dioxide as CO ₂	69	25	46	48	16	21	37.5
Carbonate as CaCO ₃	0	0	0	0	0	0	0
Chloride	15	6.8	6.1	6.3	8.4	8	8.4
Chromium Hexavalent	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Flouride	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Hydrogen Sulfide as S	0.5	0.4	0.34	<0.1	0.03	0.03	0.23
Hydroxide as OH	0	0	0	0	0	0	0
Iron	1.9	0.93	0.38	0.88	0.88	0.68	0.75
Lead	<0.01	<0.01	<0.01	0.013	0.02	0.018	0.014
Magnesium	2.9	1.9	4.9	<0.2	2.9	1.9	2.45
Manganese	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrate	.71	3.99	0.27	0.66	0.93	1.99	1.43
Phenols	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphate as PO ₄	0.16	0.43	0.43	1.40	0.37	<0.03	<0.470
Potassium	2.6	0.6	0.39	0.51	0.84	0.35	0.89
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	0.002	<0.01
Silica	6.5	7.0	9.0	8.1	6.8	7.5	7.5
Silver	<0.01	<0.01	<0.01	0.045	<0.01	<0.01	<0.01
Sodium	28	9.0	5.0	5.3	11	5.5	10.6
Sulfate	25	2.0	<1.0	<1.0	15	8	8.6
Zinc	0.13	0.02	0.29	<0.01	0.02	0.02	0.08
Stability Index	8.0	8.8	9.0	10.6	10.1	9.9	9.4
Saturation Index	-0.6	-0.9	-1.2	-2.1	-1.6	-1.6	-1.3

TABLE D-5 (cont'd)
GROUND WATER QUALITY PARAMETERS

NOTE: All values are expressed in milligrams per liter (mg/l) unless otherwise noted. Analyses by Orlando Laboratories, Inc., Orlando, Florida, except for December 9, 1977 duplicate analysis.

PARAMETER	DATE SAMPLED				AVERAGE
	12-9-77	2-14-78	3-21-78	4-26-78	
Water level (ft. below LSD)	--	--	--	--	
Color (PCU)	10	5	0	10	8.3
Odor Threshold	0	0	0	0	0
Turbidity (field)(NTU)	13	15	5.0	5.4	9.6
Turbidity (lab)(NTU)	--	--	4.5	7.2	5.9
Temperature (°C)	--	--	20	--	2.0
Specific conductance (umhos/cm @ 25°C)	455	400	460	460	444
Total Dissolved Solids	380	268	288	304	310
pH field (units)	--	7.1	--	7.3	7.2
pH lab (units)	7.3	7.3	7.5	7.0	7.3
Alkalinity, total as CaCO ₃	270	240	240	240	247
Hardness, total as CaCO ₃	220	224	236	232	228
Hardness, Non carbonate as CaCO ₃	20	16	4	8	12
Alkyl Benzene Sulfonate	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	<0.01	0.006	<0.01	0.014	0.01
Barium	<0.5	0.7	<0.5	<0.1	<0.5
Bicarbonate as HCO ₃	293	293	293	293	293
Boron	--	<0.01	0.03	0.05	0.03
Cadmium	<0.01	0.002	<0.005	0.002	0.005
Calcium	80	80	82	80	80
Carbon Dioxide as CO ₂	24	26	16	49	29
Carbonate as CaCO ₃	0	0	0	0	0
Chloride	13	12	12	13	13
Chromium Hexavalent	<0.01	<0.01	<0.01	<0.01	0.01
Copper	<0.1	<0.1	<0.1	0.35	<0.16
Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01
Flouride	0.3	0.3	0.3	0.3	0.3
Hydrogen Sulfide as S ^a	<0.1	0.04	0.02	0.01	0.04
Hydroxide as OH	0	0	0	0	0
Iron ^b	1.80	1.00	0.44	0.82	0.75
Lead	<0.01	0.006	<0.01	<0.01	<0.01
Magnesium	4.9	5.8	7.8	7.8	6.6
Manganese	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	<0.001	<0.001	0.0006	<0.001	<0.001
Nitrate	2.92	3.81	0.22	6.65	3.4
Phenols	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphate as PO ₄	0.59	0.78	0.47	0.03	0.47
Potassium	2.2	2.74	2.53	1.4	2.22
Selenium	<0.01	<0.01	<0.01	0.004	<0.01
Silica	25	30	29	28	28
Silver	<0.01	0.045	<0.01	<0.01	0.019
Sodium	17	14	13	12	14
Sulfate	3	1.5	5	2	2.9
Zinc	0.74	0.32	0.14	0.13	0.33
Stability Index	7.3	7.3	7.1	7.2	7.2
Saturation Index	0.0	0.0	0.2	-0.1	--

^a Hydrogen sulfide titrated in field, except November, 1978 and duplicate of December 9, 1977.

^b Values for iron invalid in November, 1977, and not included in average. Sample not filtered in the field.

TABLE D-5 (cont'd)
GROUND WATER QUALITY PARAMETERS

NOTE: All values are expressed in milligrams per liter (mg/l) unless otherwise noted. Analyses by Orlando Laboratories, Inc., Orlando, Florida, except for December 9, 1977 duplicate analysis.

PARAMETER	DATE SAMPLED						AVERAGE ^d
	11-18-77	12-9-77	12-9-77 ^c	1-4-78	2-21-78	4-26-78	
Water level (ft. below LDS)	37.6	--	36.3	35.8	35.1	38.6	
Color (PCU)	5	160	300	0	30	30	87.5
Odor Threshold	1	15	--	5	10	0	8
Turbidity (field) (NTU)	--	28	--	1.6	1.1	3.3	12.2
Turbidity (lab) (NTU)	144	--	27	--	1.2	3.3	2.3 ^c
Temperature (°C)	--	--	--	23	--	--	23
Specific con- ductance (umhos/cm @ 25°C)	285	295	272	290	275	300	286
Total Dissolved Solids	240	250	229	170	220	212	220
pH field (units)	--	--	--	7.7	--	6.9	7.3
pH lab (units)	9.0	7.7	8.2	7.7	7.6	7.7	7.8 ^c
Alkalinity, total as CaCO ₃	160	164	159	128	132	136	146
Hardness, total as CaCO ₃	190	155	176	140	140	140	157
Hardness, Non carbonate as CaCO ₃	30	9	17	12	8	4	13
Alkyl Benzene Sulfonate	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01
Arsenic	<0.01	<0.01	0.028	<0.01	<0.01	<0.01	<0.01
Barium	<0.5	<0.5	0.24	<0.5	<0.5	<0.1	<0.39
Bicarbonate as HCO ₃	156	200	159	156	161	166	166
Boron	--	--	0.11	0.05	0.04	0.04	0.06
Cadmium	<0.01	<0.01	<0.001	<0.01	<0.005	0.004	0.007
Calcium	52	44	43.8	35	38	34	41
Carbon Dioxide as CO ₂	<1.0	7.0	--	5.1	6.5	5.6	5.0
Carbonate as CaCO ₃	20	0	0	0	0	0	0 ^c
Chloride	11	17	10.0	12	10	10	12
Chromium Hexavalent	<0.01	<0.01	<0.001	<0.01	<0.01	<0.01	<0.009
Copper	<0.1	<0.1	0.007	<0.1	<0.1	<0.1	<0.09
Cyanide	<0.01	<0.01	<0.002	<0.01	<0.01	<0.01	<0.01
Flouride	0.8	0.7	0.57	0.5	0.4	0.4	0.6
Hydrogen Sulfide as S ₈	0.14	1.5	0.1	1.22	1.00	0.04	0.67
Hydroxide as OH	0	0	0	0	0	0	0
Iron ^b	7.30	0.48	0.33	0.07	0.13	0.17	0.26
Lead	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01
Magnesium	12	11	16.17	13	11	14	13
Manganese	<0.05	<0.05	0.02	<0.05	<0.05	<0.05	<0.05
Mercury	<0.001	<0.001	0.0024	<0.001	<0.001	<0.001	0.001
Nitrate	0.93	0.22	--	0.49	0.40	1.86	0.78
Phenols	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001
Phosphate as PO ₄	0.56	0.78	0.80	0.22	0.62	<0.03	<0.495
Potassium	3.7	2.6	3.05	1.40	2.05	1.25	2.34
Selenium	<0.01	<0.01	<0.005	<0.01	<0.01	0.002	<0.01
Silica	17	9.5	10.0	15	12	13	13
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	6.8	9.0	7.76	5.4	7.7	7.9	7.4
Sulfate	11	3	11.6	10	21	9	11
Zinc	0.17	0.06	0.021	0.02	<0.01	0.04	0.05
Stability Index	6.4	7.7	7.18	8.1	8.2	7.7	7.55
Saturation Index	1.3	0.0	0.51	-0.2	-0.3	<0.1	--

^a Hydrogen sulfide titrated in field, except November, 1978 and duplicate of December 9, 1977.

^b Values for iron invalid in November, 1977, and not included in average. Sample not filtered in the field.

^c By Southern Analytical Laboratories, Jacksonville, Florida
Turbidity is measured in Jackson Turbidity Units and hydroxide is expressed as CaCO₃.

^d Averages exclude suspect values when water stagnation caused non-representative values in Floridan aquifer wells (November 18, and some December 9 values).

TABLE D-5 (cont'd)
GROUND WATER QUALITY PARAMETERS

NOTE: All values are expressed in milligrams per liter (mg/l) unless otherwise noted. Analyses by Orlando Laboratories, Inc., Orlando, Florida, except for December 9, 1977 duplicate analysis.

	WELL NO. F-2			AQUIFER Floridan					
PARAMETER	DATE SAMPLED								AVERAGE ^e
	11-19-77	12-9-77	12-9-77 ^c	12-28-77	1-4-78	2-14-78	3-21-78	4-26-78	
Water level (ft. below LSD)	45.2	44.7	--	44.3	43.4	43.1	43.3	46.4	
Color (PCU)	5	10	30	0	0	0	0	0	0
Odor Threshold	10	15	--	33	0	3	35	20	18
Turbidity (field) (NTU)	--	8.4	--	--	2.3	1.54	0.4	1.2	1.4
Turbidity (lab) (NTU)	100	17	17	4.8	--	--	0.76	6.5	2.78
Temperature (°C)	--	--	--	--	24	23	25	--	24
Specific conductance (umhos/cm @ 25°C)	800	2660	2320	910	920	950	940	910	930
Total Dissolved Solids	500	1862	979	640	615	586	628	542	617
pH field (units)	--	11.7	--	--	7.8	7.3	7.3	8.0	7.5
pH lab (units)	9.4	--	12.1	7.4	--	--	7.6	7.7	7.5
Alkalinity, total as CaCO ₃	40	490	538	106	80	100	102	58	97
Hardness, total as CaCO ₃	260	460	448	268	248	276	276	250	267
Hardness, Non carbonate as CaCO ₃	220	56	0	140	168	56	174	192	134
Alkyl Benzene Sulfonate	<0.01	<0.01	--	0	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	<0.01	<0.01	0.018	<0.01	<0.01	0.012	<0.01	0.011	<0.01
Barium	<0.5	<0.5	1.79	<0.05	<0.5	<0.1	<0.5	<0.1	<0.29
Bicarbonate as HCO ₃	20	0	0	129	98	122	124	71	118
Boron	--	--	0.11	--	0.01	0.07	0.07	0.05	0.05
Cadmium	<0.01	<0.01	<0.001	<0.01	<0.01	0.002	<0.005	<0.001	0.007
Calcium	72	176	135.43	56	82	62	67	62	67
Carbon Dioxide as CO ₂	<1.0	<1.0	--	9.0	2.9	10	5.5	2.4	6.8
Carbonate as CaCO ₃	15	34	76	0	0	0	0	0	0
Chloride	180	240	142	180	175	188	211	195	189
Chromium Hexavalent	<0.01	<0.01	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	<0.1	<0.1	0.020	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cyanide	<0.01	<0.01	0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Flouride	0.4	0.3	0.27	0.3	0.1	0.3	0.3	0.3	0.25
Hydrogen Sulfide as S ^a	1.20	1.50	0.8	3.3	1.72	0.8	3.28	2.0	2.27
Hydroxide as OH	0	434	462	0	0	0	0	0	0
Iron ^b	2.15	0.20	0.05	0.09	0.03	0.02	0.01	0.05	0.04
Lead	<0.01	<0.01	0.02	<0.01	<0.01	0.015	<0.01	<0.01	<0.01
Magnesium	19	4.9	2.81	31	11	29	26	23	24
Manganese	<0.05	<0.05	0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	<0.001	<0.001	0.0020	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrate	0.49	<0.01	0.04	<0.01	<0.04	2.46	<0.04	2.35	0.64
Phenols	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphate as PO ₄	0.77	0.16	0.15	0.12	0.12	0.03	0.28	0.03	<0.14
Potassium	0.9	79	5.74	3.0	5.0	7.0	3.95	6.0	4.7
Selenium	<0.01	<0.01	<0.005	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01
Silica	14	9.0	8.0	16	14	14.0	13.0	12.0	14.3
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	0.035	<0.01	<0.01	<0.02
Sodium	64	128	106.29	94	80	78	88	82	85
Sulfate	94	100	82	110	100	78	90	95	94.5
Zinc	0.29	0.02	0.034	<0.01	<0.04	0.235	<0.01	0.03	<0.07
Stability Index	6.8	1.7	1.36	8.2	7.8	8.3	8.0	8.0	8.1
Saturation Index	1.3	5.0	5.37	-0.4	0.0	-0.5	-0.2	-0.1	--

^a Hydrogen sulfide titrated in field, except November, 1978 and duplicate of December 9, 1977.

^b Values for iron invalid in November, 1977, and not included in average. Sample not filtered in the field.

^c By Southern Analytical Laboratories, Jacksonville, Florida
Turbidity is measured in Jackson Turbidity Units and hydroxide is expressed as CaCO₃.

^d Averages exclude suspect values when water stagnation caused non-representative values in Floridan aquifer wells (November 18, and some December 9 values).

^e Only analyses for December 28 through March 21 averaged for F-2. Air compressor not available in April 1978.

TABLE D-6

WELL INVENTORY AND WATER USE WITHIN 5-MILE RADIUS OF SITE
 (ALL WELL SPECIFICATIONS BASED ON INTERVIEW WITH OWNER)

Well	Location	Well ^a Depth (ft.)	Casing Dia. (in)	Depth (ft)	Ground Surface ^b Elevation (ft above MSL)	Static Water Level (ft MSL)	+(Above) or -(Below) Ground Surface	Date Measured	Use	Remarks
A-1 ^c	T8S, R27E SW $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$, Section 19	350*	4	40*	10	17.5	+7.5*	10-27-77	Residential	Flowing
A-8	NE $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 26	218*	2.5	126*	2	-	-	10-19-77	Residential	Flowing
A-9	NW $\frac{1}{4}$, NE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 35	220*	2	-	5	-	-	10-19-77	Residential	Flowing
A-10	NE $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 35	229*	2	138*	2	-	-	10-19-77	Residential	Flowing
A-11	SE $\frac{1}{4}$, SW $\frac{1}{4}$, SE $\frac{1}{4}$ Section 27	257*	2.5	125*	19	-	-	10-19-77	Residential Cattle (30)	Flowing
A-12	SW $\frac{1}{4}$, NE $\frac{1}{4}$, SE $\frac{1}{4}$ Section 28	250*	4	-	15	9.37	-5.63	10-19-77	Livestock	-
A-13	NW $\frac{1}{4}$, NE $\frac{1}{4}$, SW $\frac{1}{4}$ Section 13	210*	2	63*	20	-	-	10-19-77	Commercial Residential	Flowing
A-14	NE $\frac{1}{4}$, NE $\frac{1}{4}$, SW $\frac{1}{4}$ Section 30	95*	2	95*	25	-	-	10-19-77	Residential 8 Families	-
A-15	SE $\frac{1}{4}$, SE $\frac{1}{4}$, SE $\frac{1}{4}$ Section 27	252*	4	100*	12	-	-	10-26-77	Livestock	Flowing
A-16	Section 35 Irregular	-	6	-	12	-	-	10-26-77	Trailer Park 75 Units	-
A-17	SW $\frac{1}{4}$, NW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 23	195*	2	-	2	-	-	10-27-77	Residential	Flowing
A-18	SE $\frac{1}{4}$, SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 23	500*	2	-	3	-	-	10-27-77	Residential	Flowing
A-19	SW $\frac{1}{4}$, SE $\frac{1}{4}$, SE $\frac{1}{4}$ Section 23	450*	3	-	2	-	-	10-27-77	Residential	-
A-20	NW $\frac{1}{4}$, NE $\frac{1}{4}$, SW $\frac{1}{4}$ Section 28	310*	3	-	15	-	-	10-27-77	Residential	Flowing
A-21	SW $\frac{1}{4}$, SE $\frac{1}{4}$, NW $\frac{1}{4}$ Section 31	250*	4	-	52	22.69	-29.31	10-27-77	Livestock	-
A-22	SE $\frac{1}{4}$, SW $\frac{1}{4}$, SE $\frac{1}{4}$ Section 35	250*	3	-	2	-	-	10-26-77	Residential	Flowing
A-23	SW $\frac{1}{4}$, SW $\frac{1}{4}$, SE $\frac{1}{4}$ Section 35	300*	6	-	3	-	-	10-26-77	Residential 4 Homes	-
B-2	T8S, R26E NE $\frac{1}{4}$, NW $\frac{1}{4}$, SW $\frac{1}{4}$ Section 12	180*	2	-	52	53.3	+1.3	10-24-77	Residential	-
B-3	SE $\frac{1}{4}$, NW $\frac{1}{4}$, SW $\frac{1}{4}$ Section 12	474*	2	200*	51	51.85	+0.85	10-24-77	Livestock	Flowing
B-4	NE $\frac{1}{4}$, NE $\frac{1}{4}$, SE $\frac{1}{4}$ Section 24	88*	3	88*	42	-	-	10-24-77	Residential	-
C-6 ^c	T9S, R26E SW $\frac{1}{4}$, SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 9	600*	12	178*	10	-	-	10-25-77	To Create Surface Water	Flowing
C-7 ^c	NE $\frac{1}{4}$, SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 7	1203*	20	183*	10	-	-	10-25-77	To Create Surface Water	Flowing

NOTES:

^a Well and casing depths are below ground surface

^b Ground surface elevations estimated from 1:24,000 topographic maps

^c Well was also inventoried prior to study (1963) (Fla. Geological Survey Info. Circular 37)

* Data is reported; not measured

TABLE D-6 (cont'd)

WELL INVENTORY AND WATER USE WITHIN 5-MILE RADIUS OF SITE
(ALL WELL SPECIFICATIONS BASED ON INTERVIEW WITH OWNER)

Well	Location	Well ^a Depth (ft.)	Casing Dia. (in)	Depth (ft)	Ground Surface ^b Elevation (ft above MSL)	Static Water Level (ft MSL)	+ (Above) or - (Below) Ground Surface	Date Measured	Use	Remarks
C-10	NE $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 13	-	10	-	26	29.25	+0.25	10-20-77	Commercial Fish Hatchery	Flowing
C-11	SW $\frac{1}{4}$, NE $\frac{1}{4}$, NW $\frac{1}{4}$ Section 13	190*	2	80*	27	-	-	10-24-77	Residential	-
C-12	NW $\frac{1}{4}$, NE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 17	180*	2	180*	15	-	-	10-25-77	Irrigation Fern Farm	Flowing
C-13	NW $\frac{1}{4}$, NE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 17	270*	5	-	20	-	-	10-25-77	Livestock	(3200 gpm Reported Pump cap)
C-14	SW $\frac{1}{4}$, SE $\frac{1}{4}$, SE $\frac{1}{4}$ Section 8	37*	1 $\frac{1}{2}$	37*	17	-	-	10-25-77	Residential	-
C-15	SE $\frac{1}{4}$, SW $\frac{1}{4}$, NE $\frac{1}{4}$ Section 8	312*	2	135*	21	-	-	10-25-77	Residential	Flowing
C-16	SE $\frac{1}{4}$, SW $\frac{1}{4}$, NE $\frac{1}{4}$ Section 8	114*	1 $\frac{1}{2}$	85*	23	-	-	10-25-77	Abandoned	Flowing
C-17	NW $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 8	106*	2	85*	17.5	19.5	+2.0*	10-25-77	Residential	Flowing. Affected by pumping at Hudson Paper Co.*
C-18	SE $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 8	300*	2	-	17	-	-	10-25-77	Abandoned	-
C-19	SE $\frac{1}{4}$, SE $\frac{1}{4}$, SE $\frac{1}{4}$ Section 5	250*	3	-	22	29.5	+7.5	10-25-77	Residential	Flowing
C-20	SW $\frac{1}{4}$, SE $\frac{1}{4}$, SW $\frac{1}{4}$ Section 12	210*	4	96*	37	26.42	-10.58	10-27-77	Residential	-
C-21	SW $\frac{1}{4}$, SW $\frac{1}{4}$, SW $\frac{1}{4}$ Section 13	179*	3	-	14	-	-	10-27-77	Residential	Flowing Approx. 16 gpm thru 1.5" Pipe
C-22	NW $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 23	237*	2	90*	10	-	-	10-27-77	Residential	Flowing
C-23	NW $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 12	130*	2	-	65	-	-	10-27-77	Residential	-
C-24	Section 37 Irregular	280*	2	-	9	-	-	10-27-77	Residential	Flowing
C-25	Section 37 Irregular	300*	2	-	7	-	-	10-27-77	Residential	Flowing
C-26	Section 37 Irregular	-	12	-	5	17.55	+11.55	10-27-77	Fire Control	5 psi head Flowing
C-27	SW $\frac{1}{4}$, SW $\frac{1}{4}$, SW $\frac{1}{4}$ Section 6	68*	2	-	62	-	-	10-24-77	Residential	-
C-28	Irregular Section 1 mi. N. of Palatka	200*	2	-	15	-	-	10-27-77	Residential	Flowing
C-29	NE $\frac{1}{4}$, NE $\frac{1}{4}$, SE $\frac{1}{4}$ Section 23	200*	4	-	5	-	-	11-8-77	Residential	-
D-1 ^c	T9S, R27E NW $\frac{1}{4}$, SW $\frac{1}{4}$, SE $\frac{1}{4}$ Section 7	279*	4	-	77	29.85	-47.15	10-20-77	Residential	-
D-34 ^c	Section 40 Irregular	190*	4	110	7	11.0	+4.0	10-21-77	Residential	Flowing

NOTES:

^a Well and casing depths are below ground surface

^b Ground surface elevations estimated from 1:24,000 topographic maps

^c Well was also inventoried prior to study (1963) (Fla. Geological Survey Info. Circular 37)

* Data is reported; not measured

TABLE D-6 (cont'd)

WELL INVENTORY AND WATER USE WITHIN 5-MILE RADIUS OF STL
 (ALL WELL SPECIFICATIONS BASED ON INTERVIEW WITH OWNER)

Well	Location	Well ^a Depth (ft.)	Casing Dia. (in)	Depth (ft)	Ground Surface ^b Elevation (ft above MSL)	Static Water Level (ft MSL)	+ (Above) or - (Below) Ground Surface	Date Measured	Use	Remarks
D-39	NE $\frac{1}{4}$, NW $\frac{1}{4}$, SE $\frac{1}{4}$ Section 18	50*	2	50*	20	-	-	10-20-77	Residential	-
D-40	NW $\frac{1}{4}$, NW $\frac{1}{4}$, SW $\frac{1}{4}$ Section 16	220*	2	-	5	14.23	+9.23	10-20-77	Residential	4 psi head Flowing
D-41	NW $\frac{1}{4}$, NW $\frac{1}{4}$, SW $\frac{1}{4}$ Section 16	186*	2	186*	5	14.23	+9.23	10-20-77	Residential	4 psi head Flowing
D-42	SW $\frac{1}{4}$, SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 16	220*	2	-	5	16* (1966)	+11	10-20-77	Residential	Flowing
D-43	SW $\frac{1}{4}$, SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 18	280*	2	100*	22	31.24	+9.24	10-20-77	Residential	4 psi head Flowing
D-44	SW $\frac{1}{4}$, SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 18	85*	2	85*	21	15.0	-6*	10-20-77	Residential	-
D-45	SW $\frac{1}{4}$, SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 18	275*	4	100*	20	-	-	10-20-77	Commercial Fish Hatchery	Flowing (No Flow when Hudson Paper is Pumping*)
D-46	SW $\frac{1}{4}$, NW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 18	310*	4	100*	30	-	-	10-20-77	Commercial Fish Hatchery	Same as D-45
D-47	NW $\frac{1}{4}$, SW $\frac{1}{4}$, SW $\frac{1}{4}$ Section 18	310*	4	100*	6	-	-	10-20-77	Abandoned	-
D-48	NW $\frac{1}{4}$, NE $\frac{1}{4}$, SW $\frac{1}{4}$ Section 17	300*	2	-	17	-	-	10-20-77	Residential	* Flows except during potato season
D-49	NW $\frac{1}{4}$, NE $\frac{1}{4}$, SE $\frac{1}{4}$ Section 16	250*	2	-	6	-	-	10-26-77	Residential	Flowing
D-50	NW $\frac{1}{4}$, NE $\frac{1}{4}$, SE $\frac{1}{4}$ Section 16	173*	2	105*	5	21.17	+16.17	10-26-77	Residential	7 psi head Flowing
D-51	Section 51 Irregular	160*	2	100*	10	-	-	10-26-77	Residential	Flowing
D-52	Section 51 Irregular	300*	2	-	10	-	-	10-26-77	Residential	Flowing
D-53	Section 3 Irregular	5.5	3	-	15	9.93	-5.07	10-26-77	Residential	Well is wood plank installed approx. 1900*
D-54	Section 3 Irregular	-	6	-	12	-	-	10-26-77	Abandoned	Flowing
D-55	Section 10 Irregular	300*	2	-	7	-	-	10-26-77	Residential	Flowing
D-56	NE $\frac{1}{4}$, NE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 3	285*	4	-	10	-	-	10-26-77	Residential	Flowing
D-57	Section 45 Irregular	360*	4	-	10	20	+10	10-21-77	Residential Livestock Quail Farm	Flowing; affected by irriga- tion pump- ing to East *
D-58	Section 45 Irregular	300*	3	-	7	-	-	10-21-77	Residential	Same as D-57 *
D-59	Section 40 Irregular	-	3	-	10	-	-	10-21-77	Residential Commercial (Nursery)	-
D-60	Section 40 Irregular	330*	4	-	4	-	-	10-21-77	Residential	Flowing

NOTES:

^a Well and casing depths are below ground surface^b Ground surface elevations estimated from 1:24,000 topographic maps^c Well was also inventoried prior to study (1963) (Fla. Geological Survey Info. Circular 37)

* Data is reported; not measured

TABLE D-6 (cont'd)

WELL INVENTORY AND WATER USE WITHIN 5-MILE RADIUS OF SITE
(ALL WELL SPECIFICATIONS BASED ON INTERVIEW WITH OWNER)

Well	Location	Well ^a Depth (ft.)	Casing Dia. (in)	Depth (ft)	Ground Surface ^b Elevation (ft above MSL)	Static Water Level (ft MSL)	+(Above) or -(Below) Ground Surface	Date Measured	Use	Remarks
D-61	Section 45 Irregular	125*	1½	100*	10	-	-	10-21-77	Residential	-
D-62	NW¼, NE¼, NE¼ Section 40	150*	3	-	5	17	+12	10-21-77	Residential	Flowing
D-63	NW¼, NW¼, NE¼ Section 40	180*	3	-	10	11.33	+1.33	10-21-77	Decorative Pond	Flowing 80 gpm *
D-64	NW¼, NW¼, SW¼ Section 17	178*	2	-	10	-	-	10-20-77	-	Flowing
D-65	NW¼, NW¼, SW¼ Section 16	-	6	-	5	-	-	10-20-77	Residential	Flowing; approx. 35 gpm
D-66	SW¼, NE¼, SE¼ Section 16	-	6	-	7	-	-	10-26-77	Residential	Flowing
D-67 (D&M #3)	NW¼, SW¼, SE¼ Section 7	100*	2	100*	75	61.25	-13.75	10-20-77	-	-
S-1	NW¼, SE¼, NW¼ Section 32 T8S, R27E	80*	1½	80*	30	-	-	11-16-77	Residential	-
S-2	SE¼, NW¼, NW¼ Section 32	95*	1½	95*	21	8.42	-12.58	11-16-77	Abandoned	-
S-3	NE¼, NW¼, NW¼ Section 32 T8S, R27E	95*	1½	95*	25	-	-	11-16-77	Residential	-
S-4	Bostwick	100*	1½	100*	23	-	-	11-16-77	Residential	-
S-5	Bostwick	85*	1½	85*	21	-	-	11-16-77	Residential	-
S-6	Bostwick	120*	1½	120*	20	-	-	11-16-77	Residential	-
S-7	Bostwick	80*	2	80*	20	-	-	11-16-77	Residential	-
S-8	Bostwick	85*	2	85*	20	-	-	11-16-77	Residential	-
S-9	Bostwick	80*	2	80*	20	-	-	11-16-77	Residential	-
S-10	Bostwick	85*	1½	85*	20	-	-	11-16-77	Residential	-
S-11	Bostwick	67*	2	67*	20	-	-	11-16-77	Residential	-
S-12	Bostwick	56*	1½	56*	20	-	-	11-16-77	Residential	-
S-13	Bostwick	80*	2	80*	20	-	-	11-16-77	Residential	-
S-14	Bostwick	85*	2	85*	20	-	-	11-16-77	Residential	-
S-15	Bostwick	80*	2	80*	20	-	-	11-16-77	Residential	-
S-16	Bostwick	85*	2	85*	20	-	-	11-16-77	Residential	-
S-17	NE¼, SE¼, NE¼ Section 29 T8S, R27E	-	6	-	9	-	-	2-21-78	Residential	Flowing (Floridan aquifer)

NOTES:

a Well and casing depths are below ground surface

b Ground surface elevations estimated from 1:24,000 topographic maps

c Well was also inventoried prior to study (1963) (Fla. Geological Survey Info. Circular 37)

* Data is reported; not measured

TABLE D-7
GROUND WATER LEVELS AND YIELD PRIOR TO STUDY^a
(within 5 mile radius of site)

Well Number	Location	Well ^b Depth (ft)	Casing Dia. (in.)	Depth (ft)	Ground Surface ^c Elevation (ft MSL)	Static Water Level High (ft above MSL)	Low	Date Measured	Amplitude (ft)	Yield (gal./min.)	Remarks
<u>T 8 S, R 27 E</u>											
A-1 ^d	SW $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 19	350	4	40	20	37	25	6-1-34 2-18-57	12	-	-
A-2	SW $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 29	-	-	-	9.5	24	-	1-28-57	-	-	-
A-3	SW $\frac{1}{4}$, SE $\frac{1}{4}$, NW $\frac{1}{4}$ Section 28	300	4	-	12	27	-	1-28-57	-	-	-
A-4	NE $\frac{1}{4}$, SW $\frac{1}{4}$, SW $\frac{1}{4}$ Section 28	350	6	-	19	33	31	12-4-57 6-2-58	2	440	-
A-5	SW $\frac{1}{4}$, NE $\frac{1}{4}$, NW $\frac{1}{4}$ Section 31	260	6	90	31.67	31.67	31.45	3-20-56 9-17-58	.22	5	-
A-6	SW $\frac{1}{4}$, SE $\frac{1}{4}$, NW $\frac{1}{4}$ Section 31	267	6	110	30	31.2	29.5	7-5-56 4-3-56	1.70	30	-
A-7	SE $\frac{1}{4}$, NE $\frac{1}{4}$, SE $\frac{1}{4}$ Section 32	278	4	126	20	30.5	-	-	-	80	-
<u>T 8 S, R 26 E</u>											
B-1	SE $\frac{1}{4}$, SW $\frac{1}{4}$, SW $\frac{1}{4}$ Section 33	700	12	174	25	51	-	4-28-56	-	1,200	Floridan Aquifer, Hudson Well 1-12 (abandoned)
<u>T 9 S, R 26 E</u>											
C-1	SE $\frac{1}{4}$, NE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 23	480	4	-	17.73	40.7	27.7	5-31-34 2-18-57	13.0	-	-
C-2	NW $\frac{1}{4}$, SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 22	415	6 4	180 $\frac{1}{2}$ 405 1/3	2	29	-	10-30-55	-	703	Hudson Well 1-6; sp. cap. 16 gpm/ft (1973)
C-3	SW $\frac{1}{4}$, NE $\frac{1}{4}$, SE $\frac{1}{4}$ Section 27	218	6	170	10	-	-	-	-	195	-
C-4 ^d	South Half Section 37	260	4	9	15	31	-	7-13-56	-	-	-
C-5	SW $\frac{1}{4}$, NW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 9	700	12	174	15	-	-	-	-	490	Hudson Well 4-12; sp. cap. 27 gpm/ft (1973)
C-6 ^d	SW $\frac{1}{4}$, SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 9	600	12	178	13	-	-	-	-	440	Hudson Well 3-12; sp. cap. 20 gpm/ft (1973)
C-7 ^d	NE $\frac{1}{4}$, SW $\frac{1}{4}$, NW $\frac{1}{4}$ Section 17	1203	20	183	17	-	-	-	-	1590	Hudson Well 2-20; sp. cap. 61 gpm/ft (1973)
C-8	SE $\frac{1}{4}$, SE $\frac{1}{4}$, NW $\frac{1}{4}$ Section 16	975	20	177	3	-	-	-	-	2260	Hudson Well 3-20; sp. cap. 62 gpm/ft (1973)
C-9	NE $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$ Section 17	600	12	179	15	-	-	-	-	680	Hudson Well 2-12; sp. cap. 43 gpm/ft (1973)
<u>T 9 S, R 27 E</u>											
D-1 ^d	Section 7	279	4	103	77	35	-	5-27-57	-	-	-
D-2	Section 7	188	2	73	13.77	32.3	27.8	3-15-56 9-17-58	4.5	210	-
D-3	Section 40	227	4	108	10.04	30.0	27.5	6-7-57 9-29-58	2.5	-	Floridan Aquifer
D-4	Section 40	209	4	108	11	35	-	5-8-34	-	-	-
D-5	Section 48	450	6	80	15	24	-	6-3-57	-	440	-
D-6	Section 48	450	6	80	19	29	-	6-3-57	-	650	-
D-7	Section 48	408	6	76	17	25	-	7-8-57	-	325	-
D-8	Section 38	300	3	60	5	14	-	4-11-57	-	-	-
D-9	Section 38	280	4	-	3	19	-	4-17-57	-	-	-
D-10	Section 48	-	6	-	10	25	-	9-21-56	-	-	-
D-11	Section 48	155	6	115	15	26	-	4-16-57	-	528	-
D-12	Section 48	245	4	185	5	19	-	9-21-56	-	-	-
D-13	Section 49	370	6	120	8	18	-	6-3-57	-	-	-

- NOTES: a Measurements by U.S. Geological Survey published in 1963 by Florida Geological Survey Information Circular 37; and from Hudson Paper Company as noted.
- b Well and casing depths are below ground surface
- c Elevation estimated from 1:24,000 topographic maps when not given in publication
- d Irregular sections; see location map.

TABLE D-7 (cont'd)

GROUND WATER LEVELS AND YIELD PRIOR TO STUDY^a
(within 5 mile radius of site)

Well Number	Location	Well ^b Depth (ft)	Casing Dia. (in.)	Casing Depth (ft)	GROUND Surface ^c Elevation (ft MSL)	Static Water Level High (ft above MSL)	Low (ft above MSL)	Date Measured	Amplitude (ft)	Yield (gal./min.)	Remarks
D-14	Section 49	410	8	-	12	25	-	2-1-56	-	225	-
D-15	Section 48	356	6	120	15	29	23	9-23-57 3-19-56	6	95	-
D-16	Section 48	350	6	120	15.99	28.5	18.7	9-23-57 2-20-57	9.8	170	-
D-17	Section 48	411	6	115	14.64	27.4	19.1	3-4-58 4-3-56	8.7	100	-
D-18	Section 48	-	1	-	15	18	-	3-21-56	-	-	-
D-19	Section 48	337	4	60	11	19	-	9-5-56	-	-	-
D-20	Section 48	450	4	84	12	25	-	4-11-57	-	140	-
D-21	Section 49	144	4	-	17	20	-	3-20-56	-	50	-
D-22	Section 49	250	4	-	17	24	18	6-12-57 4-3-56	6.0	22	-
D-23	Section 49	258	4	-	18	20	18	3-20-56	-	19	-
D-24	Section 49	222	4	-	18	21	-	3-21-56	-	50	-
D-25	Section 49	245	4	63	19	24	-	8-13-56	-	-	Floridan Aquifer
D-26	Section 48	185	4	-	18	21	-	3-21-56	-	60	-
D-27	Section 48	272	4	63	19	27	21	4-14-58 2-20-57	6.0	115	-
D-28	Section 49	-	4	-	20	24	-	7-8-57	-	150	-
D-29	Section 49	13	1 1/2	10	18	14	-	11-15-57	-	-	-
D-30	Section 49	-	4	-	18	23	-	7-8-57	-	-	-
D-31	Section 49	-	4	-	20	24	-	7-8-57	-	40	-
D-32	Section 10	275	4	-	15.45	29.0	24.8	9-17-58 4-3-56	4.2	80	-
D-33	Section 48	300	3	60	15	24	-	4-11-57	-	-	-
D-34	Section 40	190	4	110	7	20	-	8-13-56	-	-	-
D-35	Section 48	450	6	-	12	20	-	4-16-57	-	-	-
D-36	Section 48	100	4	-	13	21	-	6-3-57	-	-	-
D-38	Section 49	-	6	-	16.91	23.66	-	7-18-57	-	75	-

NOTES:

^a Measurements by U.S. Geological Survey published in 1963 by Florida Geological Survey Information Circular 37; and from Hudson Paper Company as noted.

^b Well and casing depths are below ground surface

^c Elevation estimated from 1:24,000 topographic maps when not given in publication

^d Irregular sections; see location map.

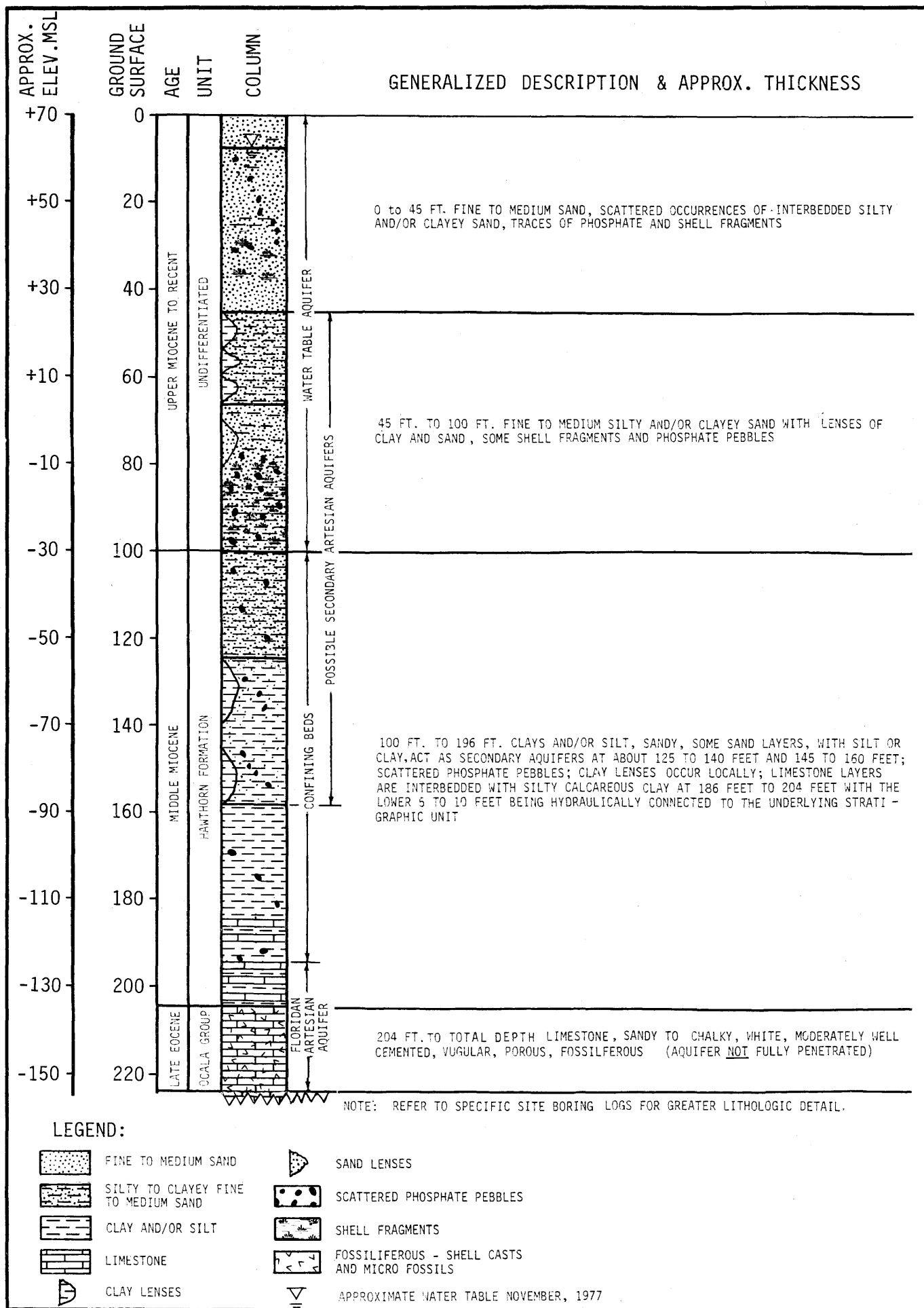


Figure 2.3-4. Generalized Stratigraphic Column and Water Bearing Characteristics.

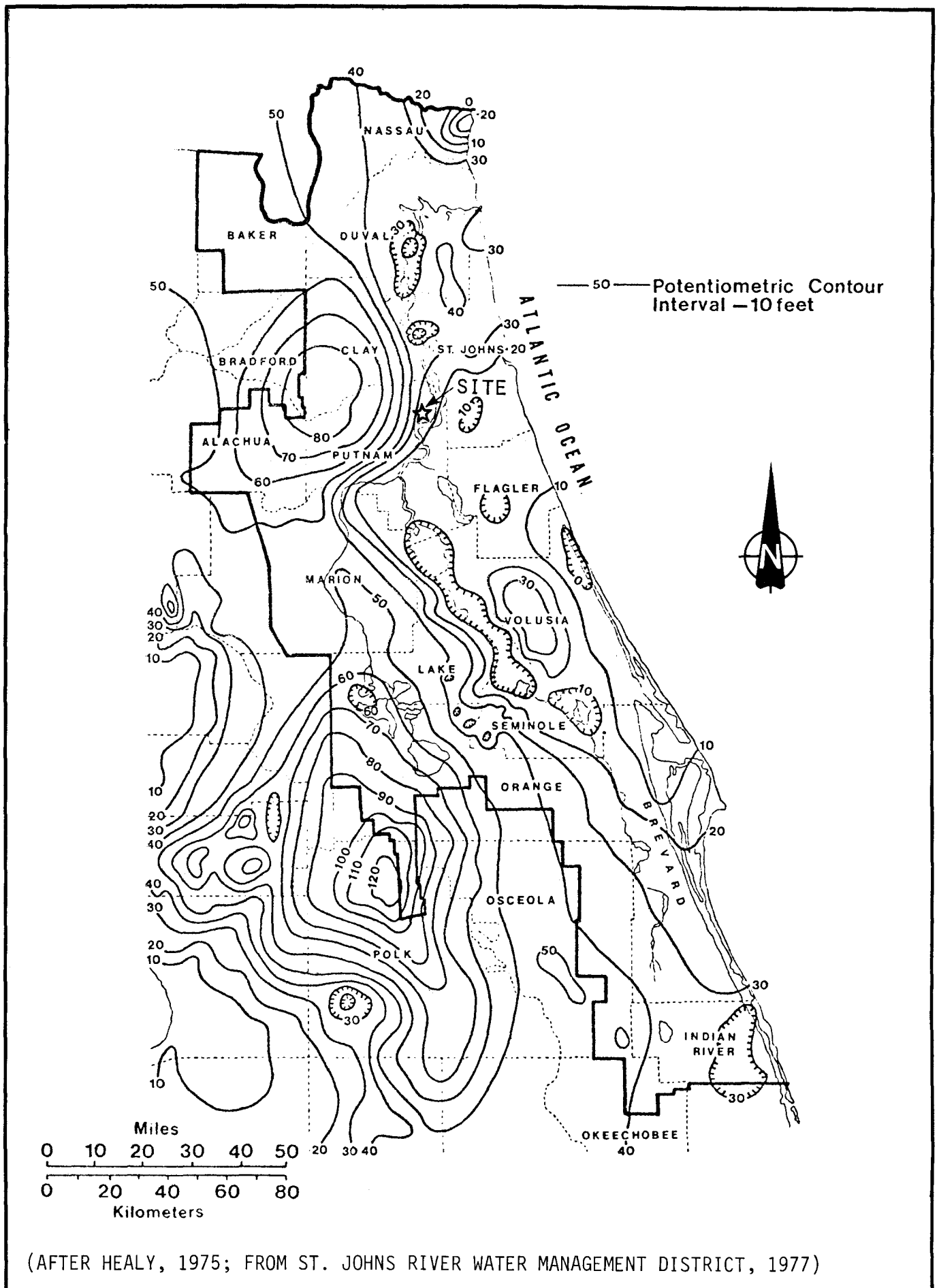


Figure 2.3-7. Regional Potentiometric Surface of Floridan Aquifer.

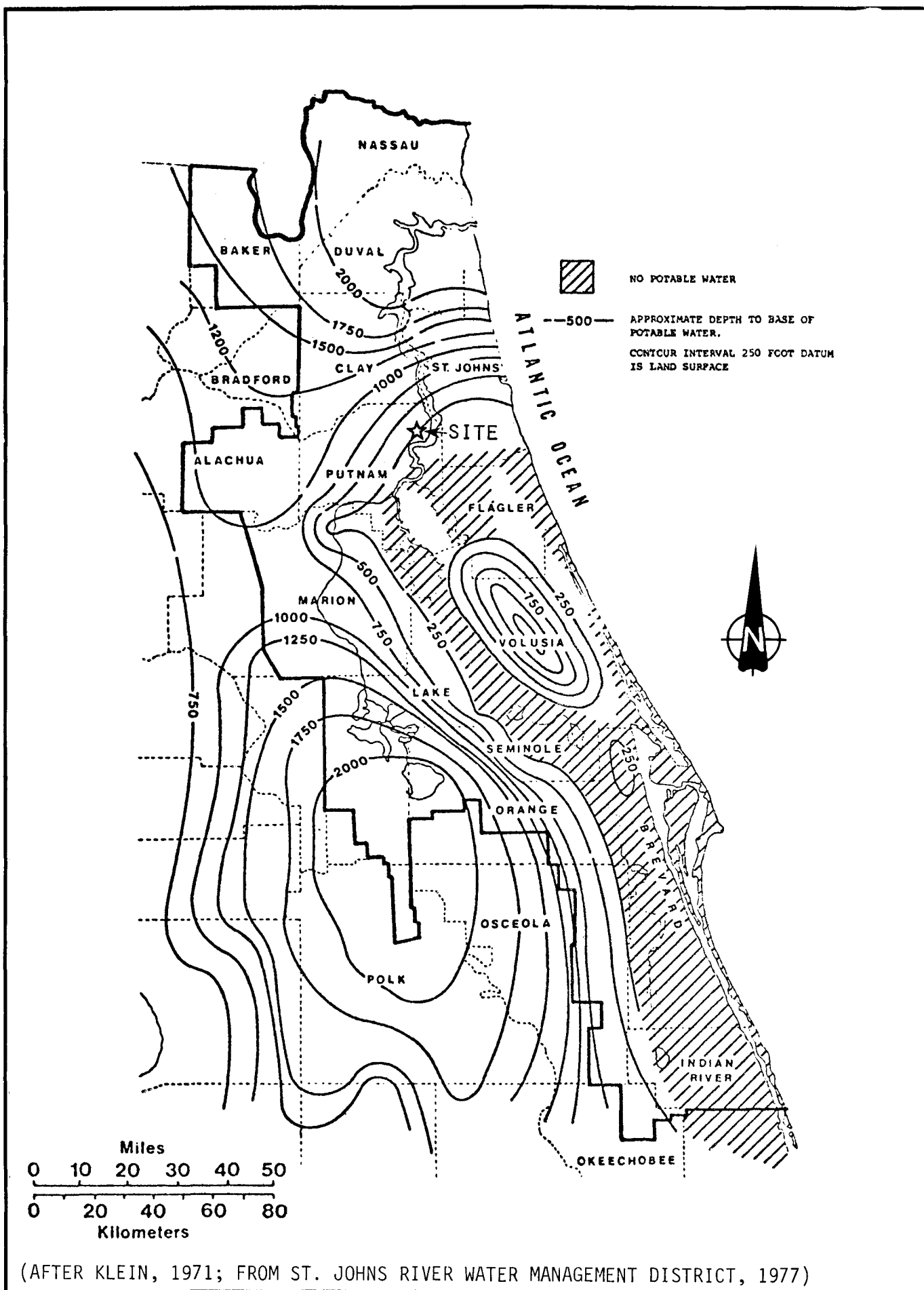


Figure 2.3-8. Depth to Base of Potable Water.

2.4 METEOROLOGY

2.4.1 General Climate

The prevailing sub-tropical marine climate of the northeastern Florida region results from the influence of the Atlantic Ocean and the Bermuda high pressure system. Long, warm, humid summers and short, mild winters prevail. Because of its southerly location and marine influences, this area has a notably equable climate, evidenced by small annual and diurnal temperature variations. Rainfall is moderate to heavy during the summer and light during the winter. Well developed extra-tropical migratory high and low pressure centers usually travel to the north of the region.

Winds are of moderate speed, and blow from the southeast to southwest during the warmer half of the year. During the cooler months the predominant direction is northwesterly. Along the coastal areas of northeastern Florida, local land-sea breeze circulations modify regional wind patterns by superimposing an easterly wind component during the daytime hours and a westerly component at night.

The average annual rainfall in this region is over 50 inches. Summer precipitation (May-October) exceeds winter precipitation (November-April) by a ratio of approximately 2 to 1. Winter precipitation results from frontal systems, pre-frontal squall lines, and wave disturbances along fronts stalled over the Florida peninsula. Summer precipitation is mostly of the convective type, resulting in frequent summertime afternoon thundershowers in this region. Tropical disturbances periodically cause significant precipitation during the summer and fall seasons.

Extremely hot weather is rare because of the ocean influence; maximum temperatures over a summer usually do not exceed the middle 90's. Winter temperatures are mild, interrupted only a few times per season by northerly or northwesterly advections of polar air. Inland locations generally display a greater range of temperatures due to the rapid heating and cooling of ground surfaces as compared with water bodies.

Due to sea breeze circulations, good ventilation, and flat terrain, the dispersion characteristics of the region are generally good. This is especially true for coastal areas due to higher wind speeds and infrequent ground level inversions.

2.4.2 Site Climatology

In describing site climatology, frequent reference is made to weather measurements collected at Jacksonville. Many types of observations are made only at major stations operated by the National Weather Service. The nearest and probably the most representative of these stations is located at the Jacksonville Airport. Weather patterns for locations not directly on the coastline are generally similar throughout northeastern Florida.

2.4.2.1 Temperature and Water Vapor

Monthly and annual values of average daily mean, maximum, and minimum temperatures recorded at Jacksonville are presented in Table 2.4-1 (USDC, 1974). Temperature extremes are also included.

Because the Putnam Site is both further inland and south of Jacksonville Airport, slightly higher temperatures would be expected there than at Jacksonville. This is confirmed by observations during the period 1941-1970 during which the mean annual temperature at Palatka was 71.3°F, compared to a mean annual temperature at Jacksonville of 68.4°F (USDC, 1973).

The atmosphere in northeastern Florida is moist, with an average relative humidity of about 75 percent. Table 2.4-2 (USDC, 1974) presents monthly and annual averages of relative humidity observed at Jacksonville for the hours 0100, 0700, 1300, and 1900 local time. Relative humidities are generally highest during the early morning hours, typically ranging between 80 and 90 percent, compared to about 50 to 60 percent during the afternoon. Mean relative humidities tend to be lowest in the spring months and highest in the summer months; however, the seasonal differences are small.

2.4.2.2 Wind, Stability, and Limited Dispersion Characteristics

Wind

Figure 2.4-1 is an annual surface-level wind rose for the period 1970 to 1974 at Jacksonville (USDC, 1974). These data indicate that winds from the southwest and northwest quadrants are most common, but all directions occur fairly often. Table 2.4-3 presents monthly average wind speeds and directions recorded at Jacksonville during the period 1941-1974. The annual average wind speed for this period was 8.6 mile per hour (mph), with northwesterly winds being most common. The most common direction varies from southwesterly in the spring and summer to northwesterly in the fall. The monthly mean wind speed varies from 9.7 mph in February to 7.7 mph in July.

Stability

Atmospheric stability in conjunction with general wind patterns indicates the potential of the atmosphere to disperse airborne pollutants. Atmospheric conditions are typically categorized as unstable, neutral, or stable. An unstable atmosphere is one in which rapid diffusion takes place in both the horizontal and vertical direction. Viewed in terms of changes in temperature with height, an unstable atmosphere is characterized by a sharp decrease in temperature with height. Neutral conditions are common in the atmosphere and are associated with moderate diffusion rates. Temperatures also decrease with height in a neutral atmosphere but not as rapidly as under unstable conditions. A stable atmosphere is characterized by slight decreases, or even increases of temperature with height, and greatly reduced diffusion rates in comparison with unstable or neutral atmospheres.

The stability classifications presented in this section are based on the well-known Turner (1964) or STAR method, which assigns a stability on the basis of surface wind speed, cloud cover, and solar angle. The mean annual frequency distribution of stability classes for a 5-year period from 1970 to 1974 at Jacksonville (USDC, 1974) is summarized in Table 2.4-4.

Seasonal stability distribution indicates that during the summer months there is a high incidence of unstable conditions (39%), while winter has the lowest incidence of unstable conditions (13%) and the highest percentage of neutral conditions (48%). The largest relative percentage of stable conditions (57%) occurs during the fall. There are also distinct diurnal trends displayed by atmospheric stability. The daytime hours are characterized by very unstable conditions (A,B); moderately stable conditions prevail at night. Atmospheric instability during mid-day is caused by strong incoming solar radiation.

Appendix F includes Tables F-1 through F-5, which present annual average joint frequency distributions of wind speed, wind direction, and stability.

Limited Dispersion Characteristics

One indication of dispersion capability is mixing height, defined as the vertical extent of the surface layer within which relatively vigorous mixing takes place. Holzworth (1972) has compiled statistical summaries for mixing height at various locations throughout the United States based on twice-daily balloon soundings. Average mixing heights and associated average wind speeds through the mixing layer for Jacksonville during the period 1960 to 1964 are shown in Table 2.4-5. This table also shows the number of episodes characterized by two or more consecutive days with mixing heights and mixing layer wind speeds lower than selected values. Holzworth's comparison of 62 locations throughout the United States indicates that conditions in northeastern Florida are more favorable to dispersion than are most other areas of the country.

2.4.2.3 Precipitation

Rainfall in the area surrounding the Putnam Site reaches maximum occurrence during summer months and diminishes during the late fall and winter months. Summer rainfall tends to be in the form of convective showers with large differences in amounts from one location to another on any given day. Winter precipitation is generally associated with frontal activity from migrating low pressure systems.

The average annual rainfall at Palatka during the period 1941 to 1970 was 54.84 inches (USDC, 1973). Monthly average rainfall amounts are listed in Table 2.4-6. The month with the highest average rainfall was July (7.74 inches). Lowest average rainfall occurred during November (1.85 inches).

2.4.2.4 Severe Weather

Thunderstorms and Hail

Based on a 33-year period of observation at Jacksonville, thunderstorms can be expected to occur on about 62 days a year in the vicinity of the site. Ninety percent of this thunderstorm activity occurs in the warmest 6 months of the year, and is usually associated with summertime land mass heating and low level convergence of moist air by sea-breeze effects. Thunderstorms can also be spawned by tropical storms as they approach the Florida coast. Northeastern Florida's thunderstorm season peaks in July, when such storms can be expected to occur about once every two days.

Hail is not considered a significant hazard. According to Pautz (1969) there were only 4 reports of hail 3/4 inches or greater in diameter in the 1-degree longitude-latitude square containing the Putnam Site during the period 1955 through 1967.

Windstorms

Winds in excess of 40 mph have been recorded in every month of the year at Jacksonville (Table 2.4-3). Strong, gusty, surface winds often occur in association with severe thunderstorm activity, well-developed cold fronts, and tropical cyclones. The fastest mile of wind on record at Jacksonville is 82 mph; it was associated with Hurricane Dora in September 1964.

Tornadoes

During the period 1955 through 1967, a total of 16 tornadoes were recorded in the one degree latitude-longitude square containing the

Putnam Site (Pautz, 1969). According to Thom (1963), the probability of a tornado hitting a point is:

$$P = (2.8209) t/A$$

where A is the area in square miles of a 1° square centered on the point, and t is the mean annual frequency of tornadoes in the area. The probability of a tornado hitting the Putnam Site in any given year is 0.00054 with a return frequency of once every 1,839 years. By comparison, the maximum probability in the United States, based on 1955-1967 tornado occurrences, was 0.00588 (return period of 170 years) occurring near Oklahoma City.

Tropical Cyclones

The northeast Florida coast lies near the path of tropical cyclones that develop over ocean areas. The hurricane season extends from June through November, but the majority of hurricanes occur from August through October.

A study of all tropical cyclone events from 1886-1970 was performed based on the frequency and intensity of storms crossing the United States coastline within 50-mile sections along the Gulf and Atlantic coasts (Simpson, 1971). This study included all cyclones with maximum sustained winds of 39 mph or higher.

For the coastal sections near the Putnam Site, six tropical cyclones crossed the coastline during the 85-year period of record. Two were of hurricane strength (winds 74 mph or greater). The average number of years between tropical cyclones was 14, and the average number between hurricanes was 42. These statistics are, however, somewhat misleading since cyclones that remain offshore are not counted and since tropical cyclones crossing other sections of the Florida coast can exert significant effects on the area of the Putnam Site.

2.4.3 References

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- Pautz, R., 1969, Severe local storm occurrences, 1955-1967. ESSA Tech. Memo No. WBTM FEST-12, Silver Springs, Maryland.
- Simpson, R. H., 1971, Atlantic hurricane frequencies along the United States coastline. U. S. Dept. of Commerce, Tech. Memo No. NWS SR-58, Fort Worth, Texas.
- Thom, H. C. S., 1963, Tornado probabilities. Monthly Weather Review Boston.
- Turner, D. B., 1964, A diffusion model for an urban area, Journal of Applied Meteorology, Vol. 3, p 83-91.
- U. S. Department of Commerce, 1973, Monthly normals of temperature precipitation, and heating and cooling degree days, 1941-1970. No. 81, Florida, Asheville, North Carolina.
- U. S. Department of Commerce, Natural Oceanic and Atmospheric Adm., 1974a, Local climatological data, Jacksonville International Airport. Asheville, North Carolina.
- _____, 1974b, STAR data, Jacksonville International Airport. Asheville, North Carolina.

Table 2.4-1

Atmospheric Temperature (°F) at Jacksonville, Florida
1940 - 1974

<u>Month</u>	<u>Averages</u>			<u>Extremes</u>	
	<u>Daily Max</u>	<u>Daily Min</u>	<u>Mean</u>	<u>Highest</u>	<u>Lowest</u>
Jan	64.6	44.5	54.6	85	19
Feb	66.9	45.7	56.3	88	19
Mar	72.2	50.1	61.2	91	25
Apr	79.0	57.1	68.1	95	35
May	84.6	63.9	74.3	100	45
June	88.3	70.0	79.2	103	56
Jul	90.0	72.0	81.0	105	61
Aug	89.7	72.3	81.0	102	64
Sep	86.0	70.4	78.2	100	50
Oct	79.2	61.7	70.5	96	38
Nov	71.4	51.0	61.2	88	21
Dec	<u>65.6</u>	<u>45.1</u>	<u>55.4</u>	<u>84</u>	<u>12</u>
Annual	78.1	58.7	68.4	105	12

Source: USDC, 1974.

Table 2.4-2

Mean Monthly and Annual Relative
Humidity at Jacksonville, Florida
1936 - 1974

<u>Month</u>	<u>Hour of the Day</u>			
	<u>0100</u>	<u>0700</u>	<u>1300</u>	<u>1900</u>
Jan	85	87	57	74
Feb	82	85	52	68
Mar	81	85	49	65
Apr	83	85	47	64
May	84	84	49	66
Jun	87	86	56	72
Jul	88	87	58	75
Aug	90	90	60	78
Sep	89	91	62	79
Oct	88	90	58	78
Nov	86	89	55	77
Dec	86	88	58	77
Annual	86	87	55	73

Source: USDC, 1974

Table 2.4-3
Wind Conditions at Jacksonville, Florida
1941 - 1974

<u>Month</u>	<u>Average Speed (mph)</u>	<u>Most Common Direction</u>	<u>Fastest Mile</u>
Jan	8.5	NW	41
Feb	9.7	WSW	52
Mar	9.6	NW	44
Apr	9.3	SE	48
May	8.9	WSW	52
Jun	8.6	SW	76
Jul	7.7	SW	49
Aug	7.4	SW	52
Sep	8.5	NE	82
Oct	8.8	NE	72
Nov	8.4	NW	62
Dec	8.3	NW	62
Annual	8.6	NW	82

Source: USDC, 1974

Table 2.4-4

Average Frequency Distribution of
Stability Classes at Jacksonville, Florida
1970 - 1974

<u>Pasquill Stability Class</u>	<u>Description</u>	<u>Percent Frequency by Season</u>				
		<u>Dec-Feb</u>	<u>Mar-May</u>	<u>Jun-Aug</u>	<u>Sep-Nov</u>	<u>Annual</u>
A	Extremely Unstable	0	1	2	1	1
B	Unstable	4	6	15	5	7
C	Slightly Unstable	9	14	22	11	14
D	Neutral	48	40	20	33	35
E	Stable	39	39	41	50	43

Source: USDC, 1974

Table 2.4-5

Average Mixing Height and Episodes of Limited
Dispersion at Jacksonville, Florida
1960 - 1964

	<u>Morning</u>		<u>Afternoon</u>	
	<u>Average Mixing Height (m)</u>	<u>Average Mixing Layer Wind Speed (m/s)</u>	<u>Average Mixing Height (m)</u>	<u>Average Mixing Layer Wind Speed (m/s)</u>
Winter	345	5.2	1058	6.7
Spring	447	5.3	1639	7.1
Summer	567	4.3	1681	5.6
Autumn	418	4.7	1321	6.5
Annual	444	4.9	1424	6.5

Number of Episodes Lasting Two or More Days

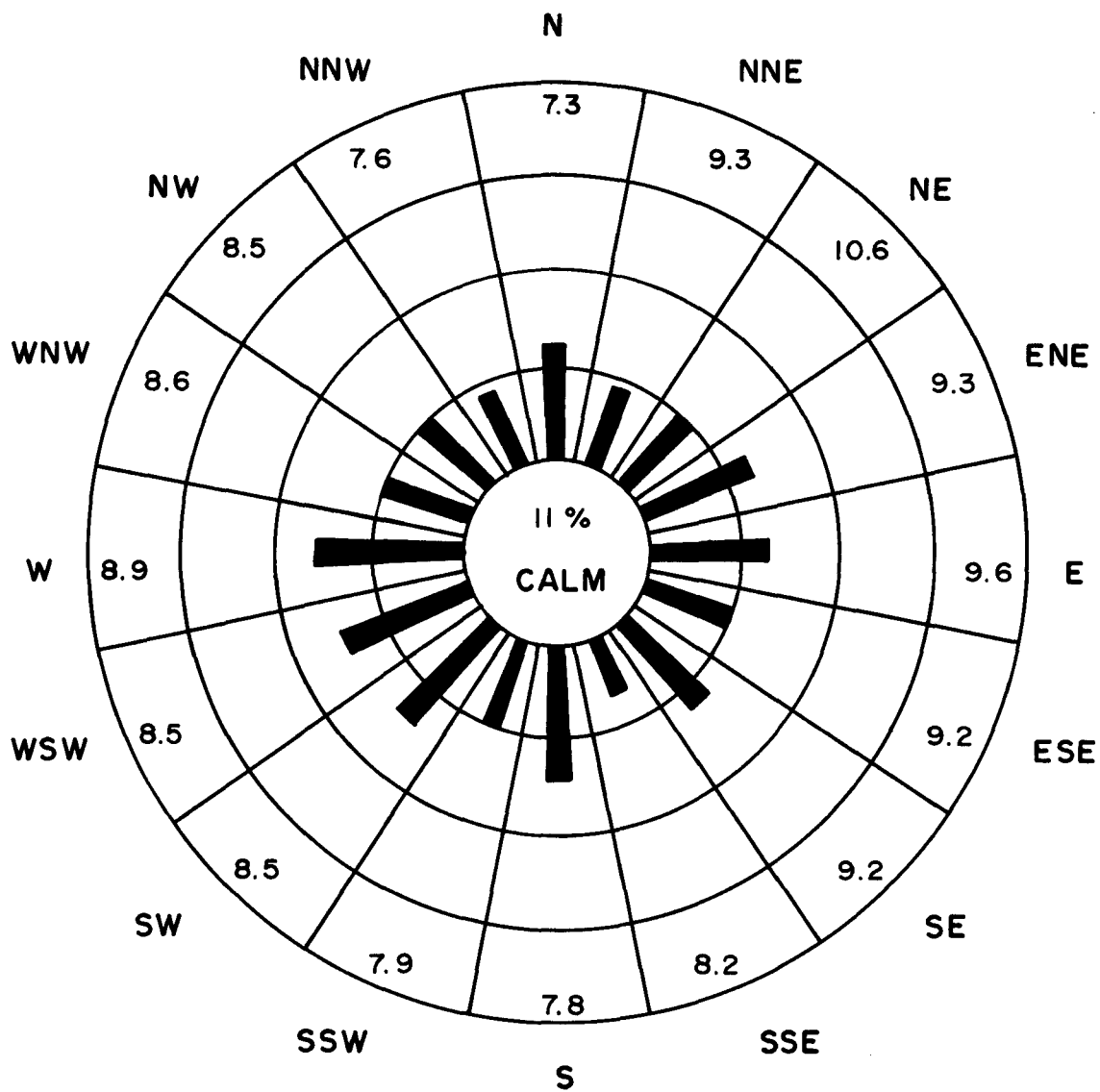
<u>Mixing Height (m)</u>	<u>Mixing Layer Wind Speed (m/s)</u>		
	<u><2</u>	<u><4</u>	<u><6</u>
<u>≤ 500</u>	0	0	1
<u>≤1000</u>	0	2	12
<u>≤1500</u>	0	12	43

Source: Holzworth, 1972

Table 2.4-6
Average Rainfall at Palatka, Florida,
1941 - 1970

<u>Month</u>	<u>Average Amount (Inches)</u>
Jan	2.54
Feb	3.42
Mar	4.05
Apr	3.00
May	3.32
Jun	6.49
Jul	7.74
Aug	7.56
Sep	7.58
Oct	4.88
Nov	1.85
Dec	2.41
Annual	54.84

Source: USDC, 1973



Note: Concentric circles represent 5 percent frequency intervals.
Average wind speed (mph) shown along outer circumference for
each direction.
Period of record: 1970-1974

Source: U.S. Department of Commerce, October 1975.

Figure 2.4-1. Annual Wind Rose for Jacksonville (North Climatic Division).

2.5 AMBIENT AIR QUALITY

2.5.1 Air Quality Standards and Classifications

Ambient Air Quality Standards

Ambient air quality standards define levels of air quality which have been imposed to protect public health and welfare with an adequate margin of safety. Standards applicable to the proposed station have been set by both State and Federal regulatory agencies. These National Ambient Air Quality Standards (NAAQS) and Florida Ambient Air Quality Standards (FAAQS) are listed in Table 2.5-1. Only those standards are listed which apply directly to the major substances emitted by a coal-fired, steam-electric generating station -- sulfur dioxide (SO_2), total suspended particulate matter (TSP), and nitrogen oxides (expressed as nitrogen dioxide, NO_2).

Prevention of Significant Deterioration Requirements

Procedures have been established, in the Clean Air Act Amendments of 1977 and in related regulations, to protect areas where air quality is better than that allowed by NAAQS. A major portion of these Prevention of Significant Deterioration (PSD) requirements is the adoption of restrictions in the increase of ambient concentrations of SO_2 and TSP which can be caused by new emission sources. These restrictions are referred to as PSD increments. It should be remembered that these increments do not constitute new ambient standards. They do not regulate total ambient concentrations as ambient standards, but rather limit increases in concentration above some baseline level which is unique to each location.

Increments have been established for three different types of areas: Class I areas, in which virtually no new emission sources are permitted; Class II areas, in which a moderate amount of growth is permissible; and Class III areas, in which greater increases in ambient concentrations are possible. There are currently no PSD Class III areas in existence anywhere in the United States. Most areas, including the general area around the Putnam Site, are designated as Class II areas. In reference

to the Putnam Site, the nearest existing PSD Class I area is the Okefenokee National Wilderness Area located in Georgia approximately 105 kilometers (km) (65 miles) to the north-northwest. Because of the remoteness of this area from the site, impacts attributable to the proposed station will be minor, as discussed in a later section. Therefore, the effect of emissions from the station will be evaluated by regulatory agencies primarily in terms of the PSD Class II increments. These increments are listed along with the NAAQS and FAAQS in Table 2.5-1.

Before concluding the subject of PSD area classifications, it should be noted that several areas are under consideration for redesignation to Class I status. Congress, through the Clean Air Act (as amended in 1977), has directed Federal land managers to review all national monuments, primitive areas, and national preserves, and recommend appropriate areas for redesignation by 8 August 1978. The Department of Interior (DOI) has published a list in the Federal Register (10 April 1978, 43 FR 10514) of the 82 national monuments and 2 national preserves in the National Park Service and the 11 primitive areas administered by the Bureau of Land Management, and has stated the intention of reviewing these areas to determine whether Class I redesignation should be recommended. Four major criteria will be used by DOI in making this determination, and consultations with appropriate States will also be held to assist in arriving at recommendations.

Two of the areas in the DOI review list are located about 30 km (20 mi) from the Putnam Site. One of these is the Castillo de San Marcos National Monument located in Saint Augustine, and the other is the Fort Matanzas National Monument located about 20 km (12 mi) south of St. Augustine. Both of these monument areas are quite small, the first occupying about 20 acres and the second about 300 acres. This size factor is important because one of the criteria to be applied by DOI consists of deciding whether an area is of such small size, and characterized by resources interdependent with those of the surrounding region,

that redesignation is impractical. Considering that all existing Class I areas are at least 5000 acres in size and typically not located in or adjacent to urban areas, it is unlikely that either of the National Monuments near the Putnam Site will be nominated for Class I status.

Nonattainment Status

A nonattainment area is an area in which one or more of the NAAQS are being violated. According to a list published in the Federal Register on 3 March 1978 (43 FR 8961), there are no nonattainment areas within approximately 50 km (30 mi) of the Putnam Site. The nearest nonattainment area is Duval County which is considered nonattainment for TSP and photochemical oxidants. The oxidants nonattainment problem is not considered relevant to an emission source (Seminole Plant Units No. 1 and No. 2) which emits very small quantities of hydrocarbons. Therefore the following remarks are directed toward TSP nonattainment.

It should first be noted that the nonattainment designation relates to current conditions, whereas Seminole Unit No. 1 is not scheduled to begin operation until June 1983. It is quite possible that by 1983 the TSP problem in Duval County will be under control. However, no credit has been allowed for this possibility in preparing this assessment.

The next point to note is that the southern edge of Duval County is approximately 50 km (30 mi) from the Putnam Site. The point of maximum existing TSP levels in central Jacksonville is even further removed from the site. As will be shown, the TSP concentrations at a distance of 50 km (30 mi) attributable to the proposed station have been calculated and assessed in terms of being significant or insignificant. Guidelines suggested by EPA (EPA, 1977) to determine significant TSP impacts in nonattainment areas are as follows:

Annual Average - $1 \mu\text{g}/\text{m}^3$ (micrograms per cubic meter)

24-Hour Average - $5 \mu\text{g}/\text{m}^3$

If concentrations associated with the emissions of a single source are below these levels, these emissions can be considered negligible in relation to the nonattainment area.

Emission Standards

Emission or performance standards set a minimum level of emissions control which must be achieved by a particular source category. The current State and proposed Federal emission standards applicable to the Seminole Station are listed in Table 2.5-2. The proposed Federal regulations require application of continuous emission controls which, in addition to achieving compliance with an emission rate standard, also result in a percentage reduction in the emissions resulting from fuel combustion.

2.5.2 Background Ambient Air Quality

2.5.2.1 Description of Available Measurements

Three ambient air quality monitoring stations are being operated in the vicinity of the Putnam Site. One of these is a TSP monitoring station operated at the Kay Larkin Airport by the Florida Department of Environmental Regulation (DER). The other two are stations operated by Florida Power & Light Company (FP&L) at which SO₂, NO₂, and TSP are measured. These stations are referred to as the Yelvington Road and Cracker Swamp Road sites. The locations of all three stations are shown in Figure 2.5-1.

Although not located in the immediate vicinity of the Putnam Site, these monitoring points provide a reasonable indication of existing air quality conditions in the general area. This statement is based on the fact that there are few significant emission sources within 50 km (30 mi) of the Putnam Site (as will be discussed below), and therefore ambient concentrations are likely to be basically uniform outside the immediate impact area of the sources which do exist. In this regard, it should be noted that the FP&L monitoring sites were established to monitor the

effects of FP&L's emissions and to determine that ambient standards are not being exceeded as a result of these emissions. Because of the proximity of these sites to FP&L's emission sources, the concentrations measured may be somewhat more influenced by the FP&L plant than are other locations in the general area as a whole.

Both the DER and FP&L TSP measurements are obtained from Hi-Vol samplers. At the DER monitoring site, a 24-hour sample is collected once every 6 days. The sampling frequency of the FP&L stations was once every 6 days in 1975 and 1976 and once every 3 days in 1977. The FP&L measurements also represent a 24-hour average.

The method used to obtain SO₂ measurements at the two FP&L sites is the West-Gaeke pararosaniline bubbler method. Samples are taken over a 24-hour period. The sampling frequency was once every 6 days in 1975 and 1976 and once every 3 days in 1977. Prior to 1977, the SO₂ bubblers were not contained within a cool, temperature-controlled housing, and therefore measured concentrations during this period may be lower than actual concentrations. Since 1976, however, temperature control has been maintained.

The measurement of NO₂ at the FP&L monitoring sites is made with 24-hour bubblers using the Jacobs-Hochheiser technique. Samples were collected once every 6 days in 1975 and 1976 and once every 3 days in 1977.

2.5.2.2 Measurement Results

Total Suspended Particulates

A summary of TSP measurements at all three sampling locations is provided in Table 2.5-3. These values are based on data supplied by DER. The lower number of samples reported for 1976 at the two FP&L sites represents all of the information currently on file at the DER's St. Johns River Subdistrict Office.

Patterns of annual geometric means at all stations are similar. Based on the information shown, a reasonable value for a current background annual geometric mean TSP concentration in the vicinity of the Putnam Site is in the range of 30 to 40 $\mu\text{g}/\text{m}^3$. There have been three instances of 24-hour concentrations at the Cracker Swamp Road station above the FAAQS and secondary NAAQS of 150 $\mu\text{g}/\text{m}^3$, but in comparison with the annual mean it can be seen that these are anomalous events. The FP&L plant was not even in operation on the day on which the highest 24-hour concentration was measured (information concerning the status of the FP&L plant during the other two exceedance events is not available); so it is likely that this concentration can be attributed to some local activity causing fugitive dust emissions. With the exception of a few measurements at the Cracker Swamp Road station, the annual second-high 24-hour concentration in the general area of the Putnam Site has been less than 80 $\mu\text{g}/\text{m}^3$.

Sulfur Dioxide

A summary of SO_2 measurements at both FP&L sites is shown in Table 2.5-4. These values are based on data supplied by DER. The lower number of samples reported for 1976 represents all of the information currently on file at the DER St. Johns River Subdistrict Office.

Measured concentrations of SO_2 have been extremely low. In fact, all of the concentrations are probably below the accurate detectability limit of the West-Gaeke method. Low concentrations in 1975 and 1976 can be attributed in part to a lack of temperature control during sample collection, but 1977 measurements continue to show low concentrations. These results are not surprising in light of the relatively non-industrialized nature of the general area. Based on these measurements and the nature of existing emission sources (see Section 2.5.3), average background concentrations in the vicinity of the Putnam Site can be considered negligible.

Nitrogen Dioxide

A summary of NO_2 measurements at both FP&L sites is shown in Table 2.5-5. Highest and second highest 24-hour concentrations are listed in addition to annual average concentrations, even though ambient standards for NO_2 are presently expressed in terms of an annual average

only. The values presented are based on data supplied by DER. The lower number of samples reported for 1976 represents all of the information currently on file at the DER's St. Johns River Subdistrict Office.

The annual mean concentrations at both sites have been very low. In the absence of heavy traffic flow and concentrated industrial point emission sources, such low concentrations would be expected. Based on these measurements and the nature of existing emission sources, the annual average background NO_2 concentrations in the vicinity of the Putnam Site can be considered negligible.

2.5.2.3 Other Regulated Pollutants

Pollutants regulated by NAAQS are commonly referred to as criteria pollutants. The three criteria pollutants of greatest concern in an evaluation of the effects of a coal-fired steam-electric station are SO_2 , TSP, and NO_2 . The other criteria pollutants are carbon monoxide (CO), hydrocarbons (HC), and photochemical oxidants. HC are usually not considered separately from oxidants. The ambient standard for HC is really not a true standard but a guide to be used in controlling oxidant concentrations.

Measurements of these other criteria pollutants have not been made in the vicinity of the Putnam Site, either by regulatory agencies or industry, primarily because there is no reason to expect that local emission sources would contribute significantly to ambient concentrations. The presence of CO is primarily related to automobile emissions, and CO concentrations are generally not a problem outside major metropolitan areas. High concentrations of oxidants (ozone being the primary species) have been measured in practically every area of the country, urbanized and rural, but the major problem areas are also considered to be major metropolitan areas. Consequently, documenting prevailing concentrations of these pollutants in a non-urbanized area such as that in which the Putnam Site is located is not a typical practice. In any case, as has been stated, the proposed station emissions would not greatly affect these concentrations.

2.5.3 Existing Emission Sources

To evaluate potential interactions among the proposed station and other emission sources and to develop a better understanding of present air quality conditions, an inventory was obtained from DER (St. Johns River Subdistrict Office). The inventory contains a listing with stack characteristics of all significant point emission sources within the Putnam Site area of interest, an area extending to a distance of at least 50 km (30 mi) in all directions and taking in all or portions of Clay, Flagler, Putnam, and St. Johns Counties. The only sources excluded from this listing were two hospital incinerators in Clay County; a hospital incinerator and a small concrete batching plant (estimated annual TSP emissions of 1 ton) in Flagler County; a hospital incinerator, an x-ray film incinerator, and a humane society incinerator in St. Johns County; and a hospital incinerator and a small sand dryer (estimated annual TSP emissions of 4 tons) in Putnam County. All of these are very minor intermittent sources that have a negligible effect on local air quality conditions.

The final PSD regulation published in the Federal Register on 19 June 1978 (43 FR 26388) somewhat revised the definition of emission sources which count against the PSD increments. Without going into all the details of this involved definition, the regulations basically state that emissions from all new "major sources" (as defined in the regulations) commencing construction after 6 January 1975 count against the increments, as do increases in emissions from any source which takes place after 7 August 1977. In addition, major modifications of an existing source which takes place after 6 January 1975 must also be considered unless the modification involves no increase in the net amount of emissions and no "adverse air quality impact" such as might occur if emissions were slightly reduced but stack heights were greatly reduced, thereby causing higher ground-level concentrations.

In order to perform an evaluation of compliance with PSD increments as well as an evaluation of compliance with ambient air quality standards, it was requested that DER supply two inventories - one showing emissions as of the end of 1974 and the other showing current conditions. Information on the difference in emissions and emission sources between 1974 and the present could be used in conjunction with the proposed Seminole emissions to assess PSD increment compliance. (As it turned out, it was not necessary to distinguish between emission increases before and after 7 August 1977, as further explained below.) Current emissions in conjunction with the proposed Seminole emissions and information on general background conditions could be used to assess the probability of compliance with ambient standards.

The DER inventory indicates that there have been no new companies with emission sources added since 1974, that is no new locations, but that there have been changes in emissions at two of the companies in existence as of 6 January 1975. The location of emission sources within about 50 km (30 mi) of the Putnam Site is shown in Figure 2.5-2. A listing of specific sources indicating whether or not emission characteristics have changed since 1974 is provided in Table 2.5-6. As can be seen, the only two sources which have changes are Solite and Hudson Pulp and Paper Company. Of these two, only Hudson is within the immediate vicinity of the Putnam Site. (Hudson is about 8 km (5 mi) from the Site, while Solite is about 38 km (25 mi) away).

Pertinent emission characteristics for each of the sources (listed in Table 2.5-6) are presented in Table 2.5-7. These characteristics include stack height, exit temperature, volumetric flow rate, and total annual emissions of SO_2 , TSP, and NO_2 . Values applicable to both 1974 and current conditions are shown.

A careful review of Table 2.5-7 shows that, for the two sources which have changed emissions (Solite and Hudson Pulp and Paper Company), the change has resulted in a net decrease in SO₂ and TSP emissions. At Solite, SO₂ emissions have decreased from an estimated 7,148 tons per year to 2,137 tons per year; TSP emissions have been reduced from 1,250 to 107 tons per year. Annual SO₂ emissions at Hudson Pulp and Paper Company have decreased from 7,650 to 6,982 tons, and annual TSP emissions have dropped from 13,301 to 849 tons. At Hudson, there are three sources (Recovery Boiler #4, Lime Kiln #4, Smelt Dissolve Tank #4) which are new since 1974, but the units replaced by these new sources had greater emission rates and lower plume rise characteristics, and therefore greater ground-level ambient impact. In addition, two of the sources existing in 1974 (Power Boiler #5 and Combination Boiler #4) have been modified so that now total SO₂ emission rates are greater for both sources by about 5 percent, but stack heights have been increased by 92 feet, thereby offsetting any effect on ground-level SO₂ concentrations. Finally, there has been an increase in annual TSP emissions from Combination Boiler #4 since 1974 of about 172 tons, but the increase in stack height of 92 feet for this source, plus the great decrease in TSP emissions from other sources, means that no increase in ambient TSP concentrations has resulted from this change. The modifications which have take place at Hudson have therefore not resulted in a net emissions increase or an adverse change in air quality impact.

One conclusion to be drawn from this discussion of other SO₂ and TSP emission sources located within the Putnam Site area of interest is that there are no other sources (where source refers to one or more emission points at the same location) which count against the PSD increments available for use by the proposed station. This conclusion is in accord with the discussion of emission source changes affecting increment consumption presented above. Therefore, modeling Seminole's emissions alone is sufficient to demonstrate compliance with PSD increments.

2.5.4 Reference

- U. S. Environmental Protection Agency, 1977, Interim guideline on air quality models. Office of Air Quality Planning and Standards, OAQPS No. 1.2-080, p. A-1.

Table 2.5-1

APPLICABLE AMBIENT AIR QUALITY REQUIREMENTS
FOR PRIMARY POLLUTANTS OF CONCERN

Category and Averaging Period	Sulfur Dioxide, $\mu\text{g}/\text{m}^3$ (ppm)	Particulate, $\mu\text{g}/\text{m}^3$	Nitrogen Dioxide, $\mu\text{g}/\text{m}^3$ (ppm)
<u>Florida Ambient Air Quality Standards</u>			
3-Hour	1300 (0.5) ^a	---	---
24-Hour	260 (0.1) ^a	150 ^a	---
Annual Arithmetic	60 (0.02)	---	100 (0.05)
Annual Geometric	---	60	---
<u>National Ambient Air Quality Standards</u>			
3-Hour, Secondary	1300 (0.5) ^a	---	---
24-Hour, Primary	365 (0.14) ^a	260 ^a	---
24-Hour, Secondary	---	150 ^a	---
Annual Arithmetic, Primary	80 (0.03)	---	100 (0.05)
Annual Arithmetic, Secondary	---	---	100 (0.05)
Annual Geometric, Primary	---	75	---
Annual Geometric, Secondary	---	60 ^b	---
<u>National Prevention of Significant Deterioration Increments</u>			
Class II 3-Hour Maximum	512 ^a	---	---
Class II 24-Hour Maximum	91 ^a	37 ^a	---
Class II Annual Arithmetic	20	---	---
Class II Annual Geometric	---	19	---

^a Not to be exceeded more than once a year.

^b As a guide to be used in assessing implementation plans to achieve the 24-hour standard.

Table 2.5-2
EMISSION STANDARDS APPLICABLE
TO COAL-FIRED STEAM GENERATORS

	Proposed Federal New Source Performance Standards ^a	Florida Emission Limiting Standards ^b
Sulfur Dioxide	1.2 lb/10 ⁶ Btu	1.2 lb/10 ⁶ Btu
Particulate Matter	0.03 lb/10 ⁶ Btu	0.1 lb/10 ⁶ Btu
Nitrogen Oxides (as NO ₂)	0.6 lb/10 ⁶ Btu	0.7 lb/10 ⁶ Btu

Note: Standards applicable to fossil fuel-fired steam generators with greater than 250 x 10⁶ Btu/h heat input.

^aFederal NPS proposed on 9/19/78 also require the following reductions of defined potential emissions when combusting solid fuel:

Sulfur Dioxide reduction = 85 percent, except may be as low as 75 percent up to three 24-hour periods during any calendar month. Percent reduction can include credit for fuel pretreatment (washing).

Particulate Matter reduction = 99 percent.

Nitrogen Oxides reduction = 65 percent.

^bFlorida standards refer to maximum 2-hour average.

Table 2.5-3

PARTICULATE MATTER AMBIENT AIR QUALITY DATA
(All concentrations in $\mu\text{g}/\text{m}^3$)

<u>Station</u>	<u>Year</u>	<u>Highest 24-Hour</u>	<u>2d High 24-Hour</u>	<u>Annual Geometric Mean</u>	<u>Number of Samples</u>
Kay Larkin Airport (DER)	1973	123	75	40	62
	1974	72	67	34	59
	1975	85	64	34	60
	1976	77	77	28	59
	1977	61	60	30	55
Yelvington Road (FP&L)	1975	87	76	34	48
	1976	68	59	30	31
	1977	92 ^a	72	27 ^a	121
Cracker Swamp Road (FP&L)	1975	119	113	42	48
	1976	166	75	31	31
	1977	183 ^a	154	37 ^a	120

^a Does not include a concentration of $331 \mu\text{g}/\text{m}^3$ at Yelvington Road and a concentration of $387 \mu\text{g}/\text{m}^3$ at Cracker Swamp Road measured during a major dust storm in February which caused high TSP concentrations throughout much of the U.S. DER has decided that concentrations measured during this episode are not to be included in determining compliance with ambient standards.

Source: Florida DER

Table 2.5-4

SULFUR DIOXIDE AMBIENT AIR QUALITY DATA
(All concentrations in $\mu\text{g}/\text{m}^3$)

<u>Station</u>	<u>Year</u>	<u>Highest 24-Hour</u>	<u>2d High 24-Hour</u>	<u>Annual Arithmetic Mean</u>	<u>Number of Samples</u>
Yelvington Road (FP&L)	1975	10	8	3	53
	1976	10	5	1	31
	1977	18	10	1	119
Cracker Swamp Road (FP&L)	1975	15	11	3	54
	1976	10	8	1	33
	1977	17	6	1	121

Note: Temperature control not maintained prior to 1977.

Source: Florida DER

Table 2.5-5

NITROGEN DIOXIDE AMBIENT AIR QUALITY DATA
(All concentrations in $\mu\text{g}/\text{m}^3$)

<u>Station</u>	<u>Year</u>	<u>Highest 24-Hour</u>	<u>2d High 24-Hour</u>	<u>Annual Arithmetic Mean</u>	<u>Number of Samples</u>
Yelvington Road (FP&L)	1975	31	17	5	47
	1976	8	5	1	36
	1977	60	20	4	120
Cracker Swamp Road (FP&L)	1975	27	18	5	49
	1976	17	10	3	37
	1977	27	17	3	121

Source: Florida DER

EMISSION SOURCES WITHIN PUTNAM SITE AREA OF INTEREST

<u>Source</u>	<u>1974</u>	<u>1978</u>	<u>Distance From Putnam Site (km)</u>
<u>CLAY COUNTY</u>			
E.I duPont De Nemours			
Ilmenite Dryer	B	S	43
Zircore Dryer	B	S	43
Zipcon Dryer	B	S	43
Gilman Paper Company			
Kiln Boiler	B	S	61
Johns-Manville Products			
Boiler	B	S	55
Finish End-Transite	B	S	55
Making Machine	B	S	55
PVC Blk Tr #15	B	S	55
Bag Fill	B	S	55
New Florida, Inc.			
Boiler	B	S	42
Solite			
Kiln #1	B	D	38
Kiln #2	B	NO	38
Kiln #3	B	NO	38
Kiln #4	B	NO	38
Kiln #5	B	D	38
Titanium Enterprises			
Rock Dryer #1	B	S	17
Rock Dryer #2	B	S	17
Rock Dryer #3	B	S	17
Rock Dryer #4	B	S	17
<u>FLAGLER COUNTY</u>			
ITT Rayonier			
Boiler	B	S	45
<u>PUTNAM COUNTY</u>			
Edgar Plastic Kaolin Co.			
Sand Dryer	B	S	34
Clay Mill	B	S	34
Sand Glass Dryer	B	S	34
Florida Furniture Co.			
Dryer	B	S	10

Table 2.5-6 (continued)

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<u>Source</u>	<u>1974</u>	<u>1978</u>	<u>Distance From Putnam Site (km)</u>
Florida Power & Light Co.			
Combined Cycle 1A-1B	B	S	12
Combined Cycle 2A-2B	B	S	12
Unit #1	B	S	12
Unit #2	B	S	12
Hudson Pulp & Paper Co.			
Recovery Boiler #1	B	R	8
Recovery Boiler #2	B	R	8
Recovery Boiler #3	B	R	8
Recovery Boiler #4	NE	N	8
Power Boiler #1	B	R	8
Power Boiler #2	B	R	8
Power Boiler #3	B	R	8
Power Boiler #4	B	S	8
Power Boiler #5	B	D	8
Combination Boiler #1	B	R	8
Combination Boiler #4	B	D	8
Lime Kiln #1	B	R	8
Lime Kiln #2	B	R	8
Lime Kiln #3	B	R	8
Lime Kiln #4	NE	N	8
Smelt Dissol. Tk #1	B	R	8
Smelt Dissol. Tk #2	B	R	8
Smelt Dissol. Tk #3	B	R	8
Smelt Dissol. Tk #4	NE	N	8

Legend:

B = In 1974 Baseline
 D = Different from 1974 Baseline
 N = New since 1974
 NE = Not in Existence in 1974
 NO = Not Now in Operation
 R = Retired since 1974
 S = Same as 1974 Baseline

Source: Florida DER

Table 2.5-7

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EMISSION CHARACTERISTICS OF SOURCES WITHIN PUTNAM SITE AREA OF INTEREST

Source ^a	UTM Coordinates		SO ₂	TSP	NO ₂	Stack Height (ft)	Exit Temperature (°F)	Volumetric Flow Rate (ft ³ /min)
	East	North	Emission Rate (ton/yr)	Emission Rate (ton/yr)	Emission Rate (ton/yr)			
CLAY COUNTY								
E.I. duPont								
Iln. Dryer	400.2	3308.6	175	28	9	33	240	13,000
Zir. Dryer	"	"	2	2	87	30	311	6,870
Zip. Dryer	"	"	20	2	4	40	300	13,774
Gilman Paper								
Boiler	403.4	3333.6	279	19	50 ^b	30	365	9,450
Johns-Manville								
Boiler	434.9	3316.6	213	28	18	34	350	15,098
Fin. End	"	"	-	15	-	32	72	16,000
Mak. Mach.	"	"	-	13	-	33	72	10,000
PVC Blk	"	"	-	1	-	25	72	8,300
Bag Fill	"	"	-	1	-	25	72	8,300
New Florida								
Boiler	426.0	3329.6	71	5	18	30	1,000	11,170
Solite								
Kiln #1 (1974)	428.3	3326.2	1,314	218	c	65	455	22,443
(1978)	"	"	876	48	11 ^b	110	145	8,969
Kiln #2 (1974)	"	"	1,314	218	c	65	455	22,443
Kiln #3 (1974)	"	"	1,314	218	c	65	455	22,443
Kiln #4 (1974)	"	"	1,314	218	c	65	455	22,443
Kiln #5 (1974)	"	"	1,892	378	c	75	455	54,286
(1978)	"	"	1,261	59	17 ^b	80	150	22,652

Table 2.5-7 (continued)

Page 2 of 3

Source ^a	UTM Coordinates		SO ₂	TSP	NO ₂	Stack Height (ft)	Exit Temperature (°F)	Volumetric Flow Rate (ft ³ /min)
	East	North	Emission Rate (ton/yr)	Emission Rate (ton/yr)	Emission Rate (ton/yr)			
Titanium Ent								
Dryer #1	431.9	3304.2	146	128	73	46	320	6,197
Dryer #2	"	"	34	6	20	46	330	2,280
Dryer #3	"	"	21	2	15	46	235	6,044
Dryer #4	"	"	2	1	1	46	300	2,094
<u>FLAGLER COUNTY</u>								
ITT Rayonier								
Boiler	474.0	3261.5	20	196	66	45	500	8,046
<u>PUTNAM COUNTY</u>								
Edgar Plastic Kaolin								
Sand Dryer	407.8	3274.2	175	28	9	33	240	13,000
Clay Mill	"	"	2	2	87	30	311	6,870
Sand Glass Dryer	"	"	20	2	4	40	300	13,774
Florida Furniture								
Dryer	438.2	3278.9	3	26	59	50	491	7,298
Florida Power & Light								
Comb. Cycle 1A-1B	443.4	3277.6	4,380	603	3,869	53	350	414,348
Comb. Cycle 2A-2B	"	"	4,380	603	3,869	53	350	414,348
Unit #1	442.8	3277.6	277	27	607	150	275	248,414
Unit #2	"	"	163	102	2,000 ^b	150	275	248,475

Table 2.5-7 (continued)

Source ^a	UTM Coordinates		SO ₂	TSP	NO ₂	Stack Height (ft)	Exit Temperature (°F)	Volumetric Flow Rate (ft ³ /min)
	East	North	Emission Rate (ton/yr)	Emission Rate (ton/yr)	Emission Rate (ton/yr)			
Hudson Pulp & Paper								
Rec. Boil. #1 (1974)	434.0	3283.4	156	3,389	c	250	190	76,038
Rec. Boil. #2 (1974)	"	"	297	3,352	c	250	210	120,364
Rec. Boil. #3 (1974)	"	"	311	3,316	c	133	210	112,614
Rec. Boil. #4 (1978)	"	"	107	215	4 ^b	230	400	406,000
Pow. Boil. #1 (1974)	"	"	58	4	14	105	425	21,340
Pow. Boil. #2 (1974)	"	"	56	4	14	105	425	21,340
Pow. Boil. #3 (1974)	"	"	82	6	20	105	425	30,450
Pow. Boil. #4	"	"	909	34	185	122	400	36,000
Pow. Boil. #5 (1974)	"	"	4,125	312	1,086	158	450	189,000
(1978)	"	"	4,342	158	963 ^b	230	450	189,000
Comb. Boil. #1 (1974)	"	"	86	6	15	250	400	31,283
Comb. Boil. #4 (1974)	"	"	1,570	228	c	158	450	187,151
(1978)	"	"	1,624	400	165	230	420	190,000
Lime Kiln #1 (1974)	"	"	-	788	-	50	263	10,177
Lime Kiln #2 (1974)	"	"	-	416	-	50	154	20,679
Lime Kiln #3 (1974)	"	"	-	445	-	52	157	29,234
Lime Kiln #4 (1978)	"	"	-	59	-	149	171	37,312
SDT #1 (1974)	"	"	-	352	-	100	200	7,285
SDT #2 (1974)	"	"	-	619	-	100	215	13,220
SDT #3 (1974)	"	"	-	30	-	109	205	3,450
SDT #4 (1978)	"	"	-	17	-	222	160	19,000

^a Characteristics shown are for both 1974 and 1978 unless otherwise indicated by date in parentheses, in which case characteristics apply to either the 1974 baseline only or to current conditions only.

^b Calculated from information supplied by DER.

^c Not supplied by DER but not needed since NO₂ concentrations do not have to be known for 1974 baseline.

Source: Florida DER

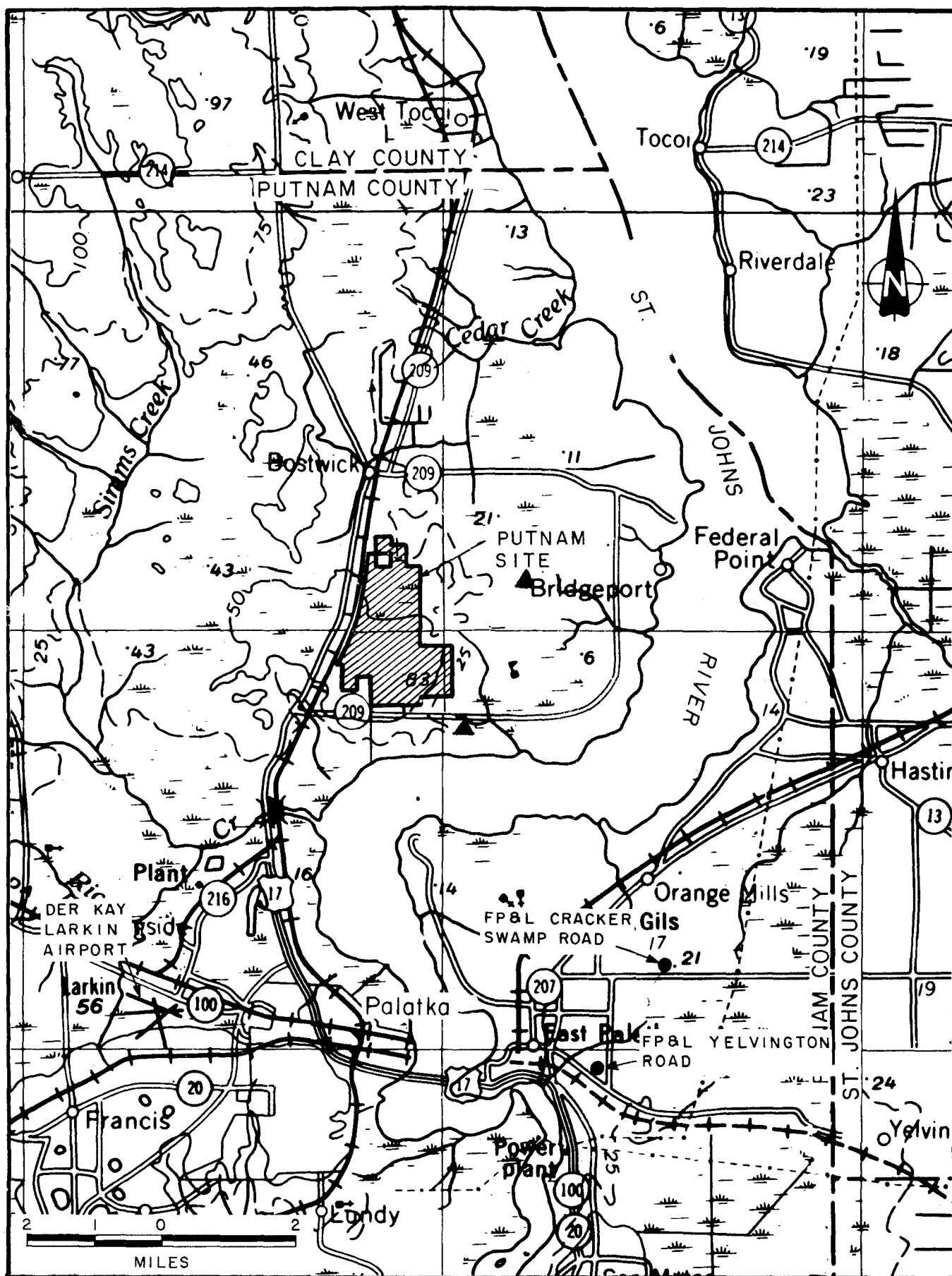


Figure 2.5-1. Location of Ambient Air Quality Monitoring Stations. ▲

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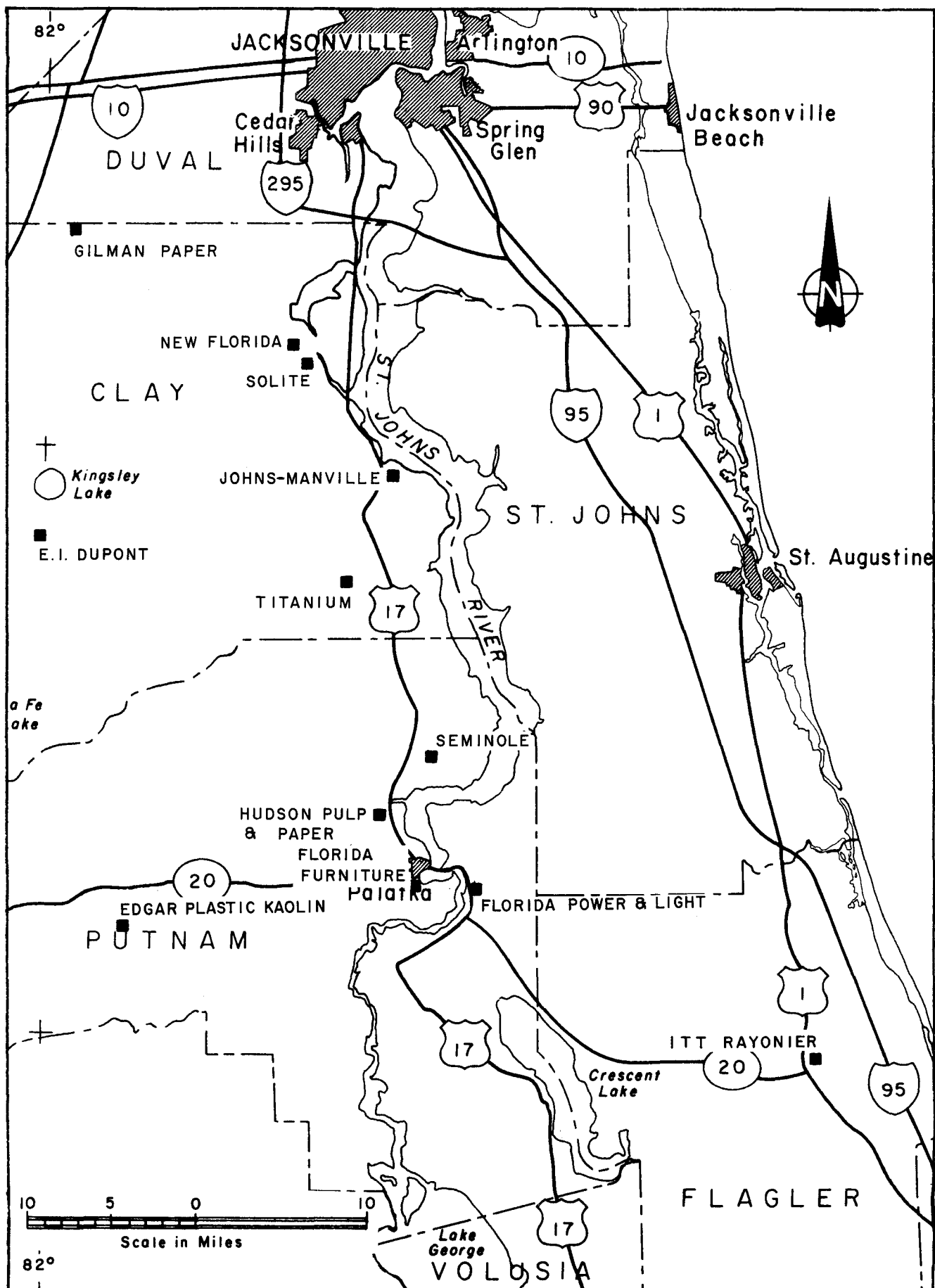


Figure 2.5-2. Location of Existing Emission Sources in Vicinity of the Seminole Site.

2.6 ACOUSTICS

2.6.1 Introduction

This section contains a description and results of the program conducted to obtain baseline ambient sound quality data at and near the proposed station. To describe sound quality, an ambient sound survey was conducted at six locations, discussed below and shown in Figure 2.6-1. These locations were selected to reflect the present sound climates at the site boundary and nearby noise-sensitive areas.

Location 1 is near residences at the end of East River Road, at Warner Point on the east bank of St. Johns River, approximately one and a half miles south of the Putnam site.

Location 2 is at trailer courts adjacent to the DeGeyter Motel on U.S. Route 17 near the northern end of Palatka, approximately five miles south southwest of the site.

Location 3 is at the Wide Waters Trailer Park near State Route S209 (West River Road), along the west bank of the St. Johns River, south of the site.

Location 4 is on the site, approximately one-quarter mile east of U. S. Route 17.

Location 5 is near residences, Bostwick Baptist Church and the Bostwick Elementary School at the corner of Mulberry and Tillman Streets, Community of Bostwick, approximately one mile north of the site.

Location 6 is near residences at U.S. Route 17, adjacent to the Seaboard Coast Line Railroad and the western site boundary, approximately one-quarter mile south of the site entrance.

The ambient sound survey was conducted during the period November 17 to November 19, 1977. Sound level recordings were made on typical weekdays and weekend during daytime (0700-1800), evening (1800-2200) and nighttime (2200-0700) periods. The daytime periods from 0700-2200 hours and nighttime periods from 2200-0700 hours are used by the federal U. S. Environmental Protection Agency (EPA) in its definition of day/night average sound level, L_{dn} .

Sound and noise nomenclature and a description of the instrumentation and techniques used for acquisition and analysis of the ambient sound data are presented in Appendix G.

2.6.2 Summary of Sound Levels

Summaries of weekday and weekend ambient sound survey results for the data collected at the six monitoring locations described above are presented in Tables 2.6-1 and 2.6-2, respectively. These tables contain the statistical A-weighted sound levels, L_{95} , L_{90} , L_{50} , L_{10} , and L_5 and average sound level, L_{eq} , for each measurement period, and L_d , L_n and L_{dn} at each measurement location. These data represent the background ambient sound levels of the existing environment at and near the proposed site. They were acquired during periods when there were no uncharacteristic activities at the site, and thus do not contain any intrusive sounds. A composite of the weekday and weekend ambient sound levels is presented in Table 2.6-3. Detailed results of the ambient sound survey are presented in Appendix G.3.

2.6.3 Description of Ambient Sound Environment

The proposed site is located in a sparsely populated area immediately northwest of the St. Johns River. Noise sensitive land use areas adjacent to the site boundaries are scattered along U.S. Routes 17 and State Route S209 (West River Road), near survey locations 3, 5, and 6. The dominant noise sources there are traffic along major routes, local traffic, resident activities, train noise along the Seaboard Coast Line Railroad and occasional aircraft overflights. During weekends, traffic along U.S. Route 17, State Route S209 and local roads increases. Resident activity also increases during the same periods. There was no noticeable increase in the number of trains passing along the Seaboard Coast Line Railroad. The largest nearby population concentration is the City of Palatka, approximately five miles south-southwest of the site.

Location 2 is representative of the sound climate at the north end of town, where Route 17 enters Palatka and intersects with Highway 19. Traffic is the dominant noise source at this location. Activities at the nearby paper and saw mill also contribute to sound levels at this location.

Measurements at Location 4 are representative of the existing sound climate on the site. Sound levels at this location are contributed by traffic on U.S. Route 17, train noise, and occasional aircraft overflights.

Present sound levels at Location 1 are predominantly due to local traffic, resident activities, train noise and occasional aircraft overflights. There was no noticeable variation in local traffic and resident activities between weekday and weekend measurement periods.

Table 2.6-1

Summary of Ambient Sound Levels -dB

<u>Location</u>	Weekdays					
	<u>Daytime</u> <u>(0700-1800)</u>		<u>Evening</u> <u>(1800-2200)</u>		<u>Nighttime</u> <u>(2200-0700)</u>	
1	11/18/77	1125	11/17/77	1800	11/17/77	2227
L ₉₅	35		41		38	
L ₉₀	36		42		38	
L ₅₀	37		45		39	
L ₁₀	43		46		42	
L ₅	47		46		46	
L _{eq}	40.8		44.7		40.5	
L _d						42.2
L _n						40.5
L _{dn}						47.1
2	11/18/77	1215	11/17/77	1855	11/17/77	2311
L ₉₅	40		42		42	
L ₉₀	41		43		43	
L ₅₀	47		46		51	
L ₁₀	56		53		54	
L ₅	58		54		56	
L _{eq}	52.1		49.1		51.8	
L _d						51.4
L _n						51.8
L _{dn}						58.1
3	11/18/77	1255	11/17/77	1931	11/17/77	2347
L ₉₅	36		35		28	
L ₉₀	37		35		28	
L ₅₀	44		41		31	
L ₁₀	52		49		41	
L ₅	54		52		45	
L _{eq}	48.3		44.9		39.0	
L _d						47.6
L _n						39.0
L _{dn}						48.1

Table 2.6-1 (Continued)

<u>Location</u>	Weekdays					
	<u>Daytime</u> <u>(0700-1800)</u>		<u>Evening</u> <u>(1800-2200)</u>		<u>Nighttime</u> <u>(2200-0700)</u>	
4	11/18/77	1338	11/17/77	2009	11/18/77	0024
L ₉₅	36		29		24	
L ₉₀	36		29		24	
L ₅₀	39		35		26	
L ₁₀	44		44		36	
L ₅	46		50		41	
L _{eq}	43.7		42.9		35.7	
L _d						43.5
L _n						35.7
L _{dn}						44.4
5	11/18/77	1430	11/17/77	2054	11/18/77	0104
L ₉₅	35		31		27	
L ₉₀	36		32		27	
L ₅₀	39		39		29	
L ₁₀	44		48		38	
L ₅	46		50		40	
L _{eq}	41.0		43.4		33.6	
L _d						41.7
L _n						33.6
L _{dn}						42.5
6	11/18/77	1511	11/17/77	2133	11/18/77	0139
L ₉₅	40		30		30	
L ₉₀	42		32		31	
L ₅₀	49		45		36	
L ₁₀	62		57		39	
L ₅	64		61		40	
L _{eq}	58.5		55.1		38.8	
L _d						57.8
L _n						38.8
L _{dn}						56.0

Table 2.6-2

Summary of Ambient Sound Levels -dB

<u>Location</u>	Weekend					
	<u>Daytime</u> <u>(0700-1800)</u>		<u>Evening</u> <u>(1800-2200)</u>		<u>Nighttime</u> <u>(2200-0700)</u>	
1	11/19/77	1050	11/18/77	1800	11/18/77	2238
L ₉₅	36		36		33	
L ₉₀	36		36		33	
L ₅₀	39		37		35	
L ₁₀	48		43		40	
L ₅	51		45		41	
L _{eq}	44.1		42.3		37.1	
L _d						443.6
L _n						37.1
L _{dn}						45.2
2	11/19/77	1142	11/18/77	1845	11/18/77	2326
L ₉₅	43		40		35	
L ₉₀	44		41		36	
L ₅₀	49		48		40	
L ₁₀	56		56		51	
L ₅	59		58		53	
L _{eq}	43.7		52.2		46.3	
L _{dn}						53.3
L _n						46.3
L _{dn}						54.6
3	11/19/77	1216	11/18/77	1925	11/19/77	0002
L ₉₅	36		32		25	
L ₉₀	37		32		26	
L ₅₀	42		40		32	
L ₁₀	50		42		43	
L ₅	53		52		45	
L _{eq}	47.3		45.6		39.6	
L _d						46.9
L _n						39.6
L _{dn}						48.1

Table 2.6-2 (Continued)

<u>Location</u>			Weekend			
	<u>Daytime</u> <u>(0700-1800)</u>		<u>Evening</u> <u>(1800-2200)</u>		<u>Nighttime</u> <u>(2200-0700)</u>	
4	11/19/77	1403				
L ₉₅	39					
L ₉₀	40					
L ₅₀	41		*		*	
L ₁₀	44					
L ₅	45					
L _{eq}	42.1					
L _d						
L _n						
L _{dn}						
5	11/19/77	1329	11/18/77	2105	11/19/77	0150
L ₉₅	39		36		25	
L ₉₀	40		38		25	
L ₅₀	44		43		30	
L ₁₀	50		50		41	
L ₅	52		52		44	
L _{eq}	52.2		47.2		37.8	
L _d						51.3
L _n						37.8
L _{dn}						50.2
6	11/19/77	1249	11/18/77	2000	11/19/77	0037
L ₉₅	46		28		26	
L ₉₀	47		33		27	
L ₅₀	52		46		46	
L ₁₀	59		60		58	
L ₅	61		62		60	
L _{eq}	55.7		56.0		53.8	
L _d						55.7
L _n						53.8
L _{dn}						60.6

*Measurements were not made due to restricted access to the site. Observation indicates that ambient sound levels at this location are similar between weekday and weekend periods.

Table 2.6-3
Composite Ambient Sound Levels

<u>Location</u>	<u>Daytime</u> <u>(0700-2200)</u>	<u>Nighttime</u> <u>(2200-0700)</u>	<u>Day/night</u>
	L_d	L_n	L_{dn}
1	42.6	39.8	46.7
2	52.0	50.8	57.4
3	47.4	39.2	48.2
4	43.2	35.7	44.3
5	46.9	35.3	46.4
6	57.3	48.7	57.9

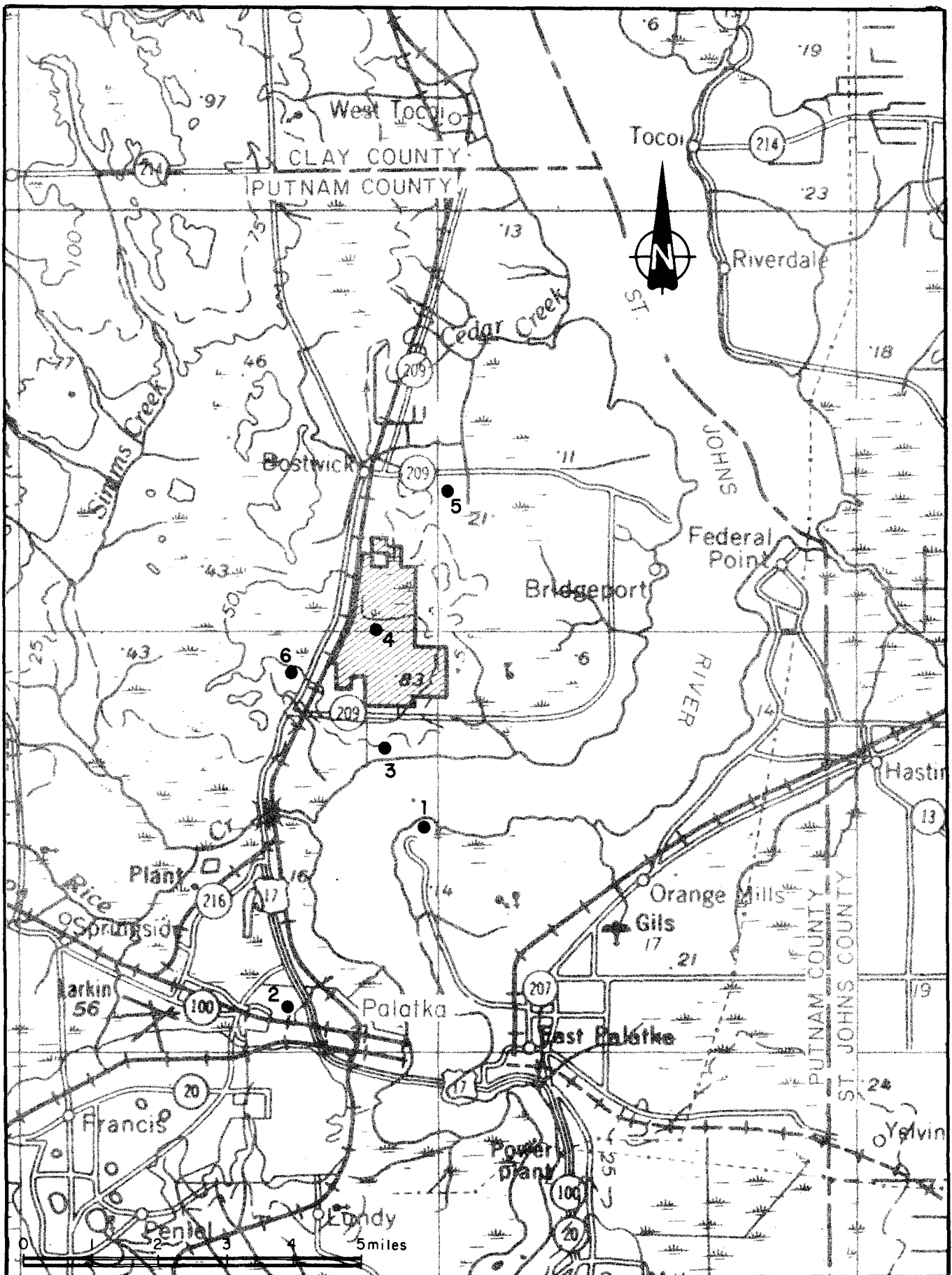


Figure 2.6-1. Ambient Sound Survey Measurement Locations.

2.7 ECOLOGY

2.7.1 Terrestrial Ecology

2.7.1.1 Introduction/Regional Description

The dominant natural feature in this region is the St. Johns River. The St. Johns River together with its tributary, the Oklawaha River, flows from the Central Highlands of Florida northward to the Atlantic Ocean. The Oklawaha River swamp is one of the most distinctive features of the predominately rural central regions of Florida (Carter, 1974). This region is noted for its abundant citrus production and numerous lakes. The St. Johns River is the main water course through the flat coastal plain region paralleling the coastline in the north-eastern section of Florida.

The coastal plain east of the Putnam Site is extremely flat, with an elevation less than 25 feet above sea level. The dominant vegetation type (wildlife habitat) is Pine Flatwoods. Pine Flatwoods are characterized by a rather open overstory of one of several pine species with a thick understory of gallberry and palmetto. Areas of slightly higher elevation are found in southern Putnam County and south. These areas exhibit rolling topography and deep sand soils. Vegetation is pine and xeric scrub oaks. Low areas along the St. Johns River and its tributaries are bottomland hardwood and cypress swamps. Non-forested wetlands are vegetated with various aquatic grasses, sedges, and rushes and are known as freshwater marshes. Swamps and marshes are very important recharge areas and highly productive wildlife habitats. The entire St. Johns River and its floodplain are classified as having little or no tolerance for development because of the delicate riverine environment (Carter, 1974). Areas not in close proximity to river have slight tolerance to development if it is well planned.

2.7.1.2 Vegetation

The floristic survey of the Putnam Site consisted of traversing the majority of the site and recording plant species observed (see Appendix A.1 for survey methods). On the Putnam Site, 35 tree species, 31 shrub

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species, 118 herbaceous species, 11 vine species, and 2 epiphyte species were recorded (see Appendix A.2, Vegetational Species List for the Putnam Site). The total number of plant species recorded was 207 indicating a diverse vegetation cover. Four major habitats were represented on the Putnam Site: the Sandhill Community, Pine Flatwoods, Bayhead Forest, and Hardwood and Cypress Swamp (Figure 2.7-1). Pine Plantations, Cypress Heads, and scattered Oak Hammocks were present on site to a lesser degree.

Sandhill Community

The Sandhill Community, as discussed by Monk (1960), may occur in three different forms or phases: 1) turkey oak phase (Quercus laevis); 2) southern red oak phase (Q. falcata); and 3) sand post oak phase (Q. margaretta). All three phases are found in combination with longleaf pine (Pinus palustris). In addition, all three phases occur in limited extent on the Putnam Site, but the turkey oak phase characterized the majority of the upland portion of the site which comprises 25 percent of the site. Due to extensive onsite lumbering activities which have removed the marketable pines, turkey oak dominates the overstory (Table 2.7-1). Turkey oak had an importance value three times greater than that of the longleaf pines. Longleaf pine was still present but had a sparse distribution. The pines were actively reproducing, evidenced by a number of individuals of these species observed growing in the "grass" stage. Grazing of the terminal buds of small longleaf pines by pigs has probably been deleterious to further growth of many of these plants. Large sandy areas devoid of any litter accumulation were often found where turkey oak dominated. Two types of foliose lichens were observed colonizing these areas, where they aid in consolidating surface soils and retarding soil erosion.

The Sandhill Community did not contain a well developed shrub layer or understory except for the presence of saw palmetto (Serenoa repens). Palmetto is commonly found in many of the drier Florida habitats, and in this study was sampled with the ground cover stratum (Table 2.7-2). Three-awn grass (Aristida sp.) was the dominant ground cover species with

lichen also abundant. Spanish moss (Tillandsia usneoides) was found growing on the majority of the turkey oaks in this community. Spanish moss, an epiphyte, belongs to the bromeliad family and it was found in all habitats on the Putnam Site. It is the most common bromeliad in Florida.

Considering its relatively large area, the Sandhill Community exhibited a very low diversity (number of species). This is due to a number of environmental factors including the rather sterile soils, the xeric edaphic conditions, and the inhibitory effects of the longleaf pine (i.e. shading and presence of tannins in needle litter).

Pine Flatwoods Community

Pine Flatwoods are found on the southeast and northeast portions of the Putnam Site (Figure 2.7-1) and comprise approximately 46 percent of the site. This habitat is an open subclimax forest of slash pine (Pinus elliottii), saw palmetto, and scattered hardwood shrubs. Three awn grass is generally the dominant ground cover. Slash pine is replaced by pond pine (P. serotina) on those flatwoods areas located on slightly lower elevations as is found on the slopes southeast of the Sandhill Community.

The Pine Flatwoods is an intermediate stage in succession from open field to hardwood forest. The Bayhead Forest is an onsite example of what much of the Flatwoods would become if not inhibited by factors such as fire and grazing which keep hardwoods from reaching a dominant status.

Pine Plantation

Portions of the site have been extensively managed for pine production. Approximately 8 percent of the site is Pine Plantation. These areas have been cleared of all vegetation and planted in slash pine. The southwest portion of the site has recently been clearcut and planted with pine seedlings while the northwestern side of the site is dominated by 10 to 15 year old planted pine. Grasses, forbs, and shrubs have vegetated the clearcut area, but no ground cover or understory is present in the older pine plantations (for the same reasons mentioned in the Sandhill Community).

Oak Hammock Community

A few Oak Hammocks occur along the southwestern corner of the site on areas that are fairly well drained. A hammock is defined as a fertile area that is usually higher than its surroundings and that is characterized by hardwood vegetation and deep humus-rich soil. The major overstory species in these areas is live oak (Quercus virginiana) which is strongly dominant. The only other noteworthy overstory components are southern magnolia (Magnolia grandiflora) and an occasional cabbage palm (Sabal palmetto). A very heavy accumulation of leaf litter in this area has possibly proven detrimental to the development of an appreciable herbaceous stratum.

Bayhead Forest Community

There is an extensive Bayhead Forest in the northwestern portion of the site. This community covers approximately 7 percent of the site. Based on PCQ data (Table 2.7-3) and field observations, this area was, in the not-too-distant past, a low Pine Flatwood. The suppression of fire as an influencing factor enhanced the development of the successional trend from pond pine (Pinus serotina) to Bayhead Forest. This is further substantiated by the combination of rather large, widely spaced pond pines now occurring in a matrix of very small broadleaved evergreen trees.

The understory stratum is dominated by a dense growth of palmetto (Sabal minor), but a complex mixture of young trees such as maple (Acer saccharum), red bay (Persea borbonia), Basswood (Tilia caroliniana) sweet bay (Magnolia virginiana), swamp red bay (Persea palustris), blackgum tupelo (Nyssa sylvatica) and dahoon holly (Ilex cassine) and a number of shrubs such as custard apple (Asimina parviflora), black haw (Viburnum obovatum), strawberry bush (Euonymus americanus), shiny blueberry (Vaccinium myrsinites), blueberry (V. fuscum), and tangleberry (Gaylussacia frondosa) also occur. Dense growth of holly (Ilex glabra), lyonia (Lyonia coriacea), and kalmia (Kalmia hirsuta) occur on the gradual slopes that lead to the Bayhead Forest.

The herbaceous stratum was strongly dominated by bracken fern (Pteridium aquilinum), although cinnamon fern (Osmunda cinnamonia) and southern clubmoss (Lycopodium adpressum) commonly occurred.

Hardwood and Cypress Swamp Community

A mixed hardwood and cypress swamp occurs in the northern portion of the property and covers 7 percent of the site. The soil in this low-lying area was either inundated or (partly to completely) saturated with water. Many large bald cypress (Taxodium distichum) stumps were observed indicating that this species was at one time dominant or at least codominant with the hardwood species prior to the extensive logging that occurred in this area. Dominant hardwood species found growing in the swamp were sweetgum (Liquidambar styraciflua), ash (Fraxinus caroliniana), water tupelo (Nyssa aquatica), and red maple (Acer rubrum) (Table 2.7-4). Presently sweetgum is strongly dominant as indicated by its much higher importance value.

The understory stratum is comprised mainly of young ash and maple, and some shrubby growth of chinquapin (Castanea alnifolia) and box elderberry (Sambucus canadensis) (Table 2.7-5).

The very wet soil was covered by a low layer of herbaceous growth. Occasional grasses or sedges were present although most of the ground cover consisted of water pennywort (Hydrocotyle sp.), ferns, and lizard's tail (Saururus cernuus). Areas of shallow standing water were usually occupied by pickerelweed (Pontederia cordata) and lizard's tail, while along the edges tangled mats of buttonweed (Diodia virginiana) and vegetative growth of pennywort predominated. The herbaceous species found in this wetland area, their percent cover and relative frequency are listed in Table 2.7-6. A common epiphyte in this habitat was wild pine (Tillandsia fasciculata). Wild pine is usually found attached to cypress trees and except for spanish moss is the most common bromeliad in Florida.

Cypress Head Community

A number of Cypress Heads occur throughout the Putnam County site. These cypress "domes," as they are sometimes called, are very small, seldom more than two or three acres in size. They comprise less than two percent of the site area. Pond cypress (Taxodium ascendens) is virtually monodominant in these stands. Peat moss (Sphagnum sp.) is also very common, as are a number of other species such as pitcher plant (Sarracenia minor) which are characteristically found in acid soil.

2.7.1.3 Amphibians and Reptiles

Twelve species of herpetiles were collected or observed on the site (Table 2.7-7). These included two species of salamanders, three species of frogs, two species of toads, three species of lizards, one species of tortoise, and one species of snake. These species were found in either the upland habitats or bottomland habitats on site. The upland habitats collectively include the Sandhill Community, Pine Flatwoods, Pine Plantation and Oak Hammocks. The bottomland habitats include the Bayhead Forest, Cypress Heads, and Hardwood and Cypress Swamp.

Upland Habitats

The upland habitats were occupied by the American toad (Bufo ameri canus), southern toad (Bufo terrestris), southern fence lizard (Sceloporus undulatus undulatus), ground skink (Leiolopisma laterale), green anole (Anolis carolinensis), gopher tortoise (Gopherus polyphemus), and southern black racer (Coluber constrictor priapus). The American toad occurs in a variety of habitats. They tend to prefer habitats which contain shallow bodies of water which are used as breeding sites in the early spring. This large toad is commonly observed on warm, rainy nights in the spring and fall but is encountered only occasionally during the hot summer months. This may be due to the toad's practice of estivating during much of the summer (Mount, 1975). The southern toad was active on the site throughout most of the summer, especially at night. However, during the hotter months, it confined its activities to the wetter portions of the Putnam Site.

The southern fence lizard is an abundant reptile in the dry, open habitats of northern and central Florida. This lizard was commonly seen scurrying along the ground in the Sandhill and Flatwoods. When approached, it rapidly seeks shelter in a nearby tree. Food items include insects, especially ants.

The green anole is a smooth skinned lizard commonly called the "chameleon" because of its ability to change color. The anole may be green, brown, or gray, depending on its "mood" or its environment. This lizard is chiefly arboreal, and is found in any habitat with abundant vegetation and shade. It was abundant in all the habitats on the Putnam Site.

The ground skink is seldom found in trees. It prefers to hunt among leaves and forest debris on the woodland floor for its insect food. The Pine Flatwoods and Sandhill Community are preferred over the more mesic bottomland areas by this skink. This secretive and elusive reptile was found in these dryer habitats under leaf litter and rotten logs.

The black racer was the only snake species found on the site. This alert and active snake is found in most terrestrial habitats and is most common in open woods and forest edges. It was found in the Pine Flatwoods on site. All of the toads and lizards already discussed are food items for the racer. It may also eat rodents, small birds, and other snakes when the opportunity arises.

The gopher tortoise is one of the better known residents of the Sandhill Community where they build their conspicuous gopher burrows. This species is becoming increasingly scarce due to overhunting and loss of habitat. The tortoise is discussed further in Section 2.7.1.6.

Bottomland Habitats

Five herpetile species found in the bottomland habitats on site included the southern leopard frog (Rana utricularia), squirrel treefrog (Hyla squirella), little grass frog (Limnaoedus ocularis), slimy salamander (Plethodon glutinosus), and dwarf salamander (Eurycea quadridigitata). The southern leopard frog is found in all aquatic habitats.

This alert, active frog is frequently found well away from water during the summer months when lush vegetation offers shade and protection. Leopard frogs were most common on site in the bottomland hardwoods area where there was an abundance of ground vegetation and pools of water in depressions, ditches, and tire tracks.

The squirrel treefrog is a small variable colored frog common to all habitat areas with lush vegetation. It is more likely to be heard than seen due to its loud distinctive call and secretive habits. These treefrogs are especially active after a rain shower when their voices can be heard in all mesic habitats. Specimens were frequently seen during the nightlighting surveys on site roads after showers.

The little grass frog is the smallest frog in North America (Conant, 1975). Adults are generally 1 to 1.5 centimeters in length. This tiny frog prefers the low grassy vegetation in Pine Flatwoods and Bayhead Forest but was most abundant in the cypress domes on site. This area afforded a wet habitat with grass and marsh plants available for cover.

The slimy salamander is abundant in moist terrestrial habitats in northern and central Florida. This rather large, dark salamander prefers to live in well rotted logs and stumps in areas in which the soil is frequently flooded. This salamander was found in the bottomland hardwood habitat on site. The smaller slender dwarf salamander was also found in this habitat. This salamander lives under logs, boards, and other debris in low Bayhead Forests and swampy areas. The ground skink, which is found in higher Pine Flatwoods, resembles this salamander in general shape and coloration.

2.7.1.4 Birds

Forty-four species of birds were observed on the Putnam Site (Table 2.7-8). As in the case of many wildlife groups, some birds are associated with specific habitats while others are found in a variety of habitats. The habitats on the Putnam Site can be divided into upland and bottomland habitats. The upland habitats are the Sandhill Community, Pine Flatwoods, Pine Plantations, and Oak Hammocks, while the bottomland

habitats are the Bayhead Forest, Cypress Heads, and Hardwood and Cypress Swamp. A description is presented of several of the major bird species observed in each of these habitats as well as those which occur in several or all habitats.

Upland Habitats

The Sandhill Community and Pine Flatwoods are attractive to those species that require open canopied, forested habitats. Birds likely to occur in these upland areas include the bobwhite (Colinus virginianus), pine warbler (Dendroica pinus), ground dove (Columbigallina passerina), kingbird (Tyrannus tyrannus), white-throated sparrow (Zonotrichia albicollis), savannah sparrow (Passerculus sandwichensis), field sparrow (Spizella pusilla), and loggerhead shrike (Lanius ludovicianus). The bobwhite is an especially important game species in the southeast. Preferred habitat is old field habitat, which is any open relatively clear area in an early successional stage where grasses, sedges and other seed producing ground cover are abundant. This habitat was available in the clearcut area on the southwest portion of the site. Bobwhite were also present in the Pine Flatwoods areas, including those areas with relatively thick understory growth.

The pine warbler is one of the more common birds in any pine habitat. They occur in the upper portions of pines where they search for insects in and on the pine bark. Also found in these upper levels of the pine habitats is the kingbird. This bird is a flycatcher and uses trees and overhead wires for perches from which to launch itself at passing flying insects.

The loggerhead shrike is another species which uses trees and overhead wires as perches. This interesting bird operates much like a tiny hawk and it can locate prey at an astonishing distance. Prey items include grasshoppers and other insects, lizards, frogs, small birds, and mice. Its peculiar habit of impaling prey on thorns or barbed wire, to be devoured later, has given rise to the shrike's nickname of "butcher-bird." Shrikes were present at scattered locations throughout the Flatwoods habitat on site.

The sparrows found on site are generally seed eaters and are found either on the ground or in low, thick vegetation. The white-throated sparrow is found in any habitat that contains thick hedgerows and field edges. It travels in groups and was especially abundant during the winter season in the clearcut portion of the site. The savannah sparrow and field sparrow are birds of fields, pastures, and brushy hedgerows. These species are mostly found feeding on or near the ground on grass seeds and occasionally on insects. These sparrows were most commonly observed in the open pinelands onsite.

The ground dove is a diminutive resident of sandy habitats throughout the deep south. It is generally observed on the ground feeding on grass and weed seeds. This dove was common in the Flatwoods and Sandhill Community on the Putnam Site.

Bottomland Habitats

These habitats contained bird species which require moist, lushly vegetated areas for food and cover. Some of the bottomland species observed on the Putnam Site include the yellow-rumped warbler (Dendroica coronata), black-and-white warbler (Mniotilta varia), brown thrasher (Toxostoma rufum), cardinal (Cardinalis cardinalis), white-eyed vireo (Vireo griseus), rufous-sided towhee (Pipilo erythrophthalmus), chuck-wills-widow (Caprimulgus carolinensis), and pileated woodpecker (Dryocopus pileatus). The warblers are abundant migrant visitors to Florida. The myrtle warbler is a low-ranging bird preferring bushes, hedgerows, and thickets rather than taller trees. It is fond of wax myrtle and redcedar, both of which are common in the Bayhead Forest in which it was seen on the Putnam Site. The black-and-white warbler prefers swampy areas, where it may be seen creeping along tree trunks and under limbs. Its diet consists almost entirely of insects.

The brown thrasher is a bird familiar to most residents of the South. It frequents thick, bushy places where it searches on or near the ground for seeds and insects. Small acorns make up a good portion

of its vegetable diet (Sprunt, 1954). Another bird commonly found scratching around the forest floor is the rufous-sided towhee. The towhee is essentially a ground bird and likes to search for fruits, seeds, and insects in heavy thickets of myrtle, honeysuckle, and holly.

The cardinal is possibly the best-known bird in the state (Sprunt, 1954). Its brilliant coloration and frequent co-existence with man make it an easily recognized species. Thickets and bushes are essential to its well-being; therefore, it is common in hedgerows, bottomland habitats, and swamps. It does not occur in pure pine stands or open prairies.

The white-eyed vireo is a common but seldom seen resident of dense, moist deciduous woods. This small bird frequents the tops of trees whose height and foliage make observation from the ground difficult. Its song usually identifies its presence. Like all warblers its food is largely insects.

One common summer resident in this area is the chuck-wills-widow. This large, nocturnal bird is rarely seen except on dark, rainy days or when swooping through car lights. Its distinctive call, which says its name, is commonly recognized. It feeds on flying insects at night, catching them in its over-sized mouth. This bird spends the day perched on the ground in deciduous woods where its mottled, dark brown coloration blends with the forest litter.

The largest and most spectacular of the several woodpeckers found in bottomland areas is the pileated woodpecker. This species is second only to the extremely rare ivory-billed woodpecker in size. The pileated, unlike the ivory-billed, has been able to adapt to changing environment and has actually extended its range into localities which were without it twenty years ago (Sprunt, 1954). It is found in any habitat having large dead or dying trees from which it extracts wood-boring insects which, together with various fruits and berries, make up its diet.

Non-Specific Habitat Preference

There are several birds which may be expected to occur in almost any habitat in Florida. Those observed onsite include the mockingbird (Mimus polyglottos), common crow (Corvus brachyrhynchos), blue jay (Cyanocitta cristata), and turkey vulture (Cathartes aura). The mockingbird is the State bird of Florida and no portion of the State is without it. Its food consists of fruits, berries, and insects. It is partial to shrubby areas but is common in any habitat from orange groves and residential areas to hedgerows and deep woods.

The common crow is a species readily identified either by its harsh call or its coal black color. It is a wide-ranging bird which has adapted well to man's taming of the land. Flocks of crows may be expected in any habitat. It is considered a pest by farmers for its depredations in almost all cultivated crops. Wild foods include fruit, acorns, berries, beetles, grasshoppers and other insects, crayfish, fish, amphibians, reptiles, young birds, small mammals, and dead skunks.

Another common bird found on the Putnam Site and throughout Florida is the blue jay. Like the crow, its call is quite distinctive, and its habit of scolding any intruder is well known to any hunter or woodsman. Its diet is quite varied, but acorns, nuts and wild fruit compose most of its food.

The turkey vulture is a common sight on a clear day in any region of the south. These large scavengers are constantly soaring, searching for carrion. They are quite important in the elimination of decomposing animal matter and garbage.

Several raptors were observed on the site. These include the red-tailed hawk (Buteo jamaicensis), screech owl (Otus asio), and the barred owl (Strix varis). The red-tailed hawk is the largest of the Florida hawks and is frequently seen soaring over any habitat which might harbor small mammals, its main prey. These hawks were seen flying over the site but were not observed feeding. The paucity of rodents on the site probably precludes this area as good feeding habitat (Section 2.7.1.5); however, rabbits may contribute to its diet here.

The screech owl is a tiny bird more widely known by its call than by sight. Open pinelands, palmetto scrub, and hammocks are its preferred habitat. It was heard calling from the bottomland habitats on site where it was probably able to locate small rodents during its nocturnal hunting.

The barred owl is a common resident of southern swamps and river bottoms. Its deep hoots are one of the characteristic sounds of the Florida night (Sprunt, 1954). The barred owl's diet is quite varied and includes mice, birds, frogs, lizards, crayfish, fish, and insects. One owl was heard calling in the hardwood and cypress swamp on the northern portion of the site.

Three important game bird species which occurred on the Putnam Site were the bobwhite (Colinus virginianus), mourning dove (Zenaidura macroura), and wild turkey (Meleagris galapavo). The bobwhite is considered by many to be the prince of game birds; this is certainly true in Georgia and Florida where it attracts thousands of hunters each year. As has already been discussed, its preferred habitat is sandy, open pineland and old fields.

The mourning dove is a common resident that is joined by an influx of migrants each winter. It is a bird of the open country, preferring pastures, cultivated fields, and sandy areas. It is primarily a seed eater and feeds on some of the smaller cultivated grains. It nests in bottomland forests and was frequently heard "cooing" in these areas on the site.

The wild turkey is a large, colorful resident of dense hammocks and the drier swamps. It may also be found in Pine Flatwoods and palmetto prairie where the thick scrub offers cover. This cautious, wily bird is seldom seen but is generally recognized by its tracks. Turkey tracks were quite numerous in the Hardwood and Cypress Swamp on the north portion of the site and were also common on roads through the Sandhill and Flatwoods. Turkeys have been hunted here in the past with moderate success (Hansford, personal communication).

No evidence of rare or endangered bird species was found on the Putnam Site. Much of the habitat in and around the site may be suitable to certain species and is further discussed in Section 2.7.1.6.

2.7.1.5 Mammals

Fourteen species of mammals were observed on the Putnam Site (Table 2.7-9). Of these species, the most abundant and obvious mammal on the site was the feral hog (Sus scrofa). Hogs are common in many areas of Florida as they are frequently released on a landowner's property, where they seek their own food and are available for recapture when the owner desires a hog for food. Hogs are found in all habitats, but because of their abundance in the Pine Flatwoods, they are commonly called "piney woods rooters." Here they forage for acorns, palmetto berries, and other mast and root for underground tubers and roots. Hogs will also eat the terminal buds of longleaf pine trees when they are in the "grass stage." Longleaf pine grows very little above ground for the first three to six years while it is establishing its deep taproot. At this time its terminal bud is only a foot or two off the ground, and if the bud is destroyed, the tree will not grow out of the grass stage. Evidence of hogs eating these buds was common in much of the Sandhill Community on site.

Hogs frequent bottomland habitats where they can easily dig roots in the moist soil and where mast from oaks, gums, ash, maple, and other bottomland species is abundant. Hogs are opportunistic feeders and will eat anything they can catch including frogs, lizards, snakes, birds, small mammals, and carrion. Tracks and evidence of rooting were abundant in all site habitats. No hogs were actually seen except in traps that the landowner had set to remove them from the site.

The whitetail deer (Odocoileus virginianus) is the only other large mammal found on the site. This familiar herbivore is found in any habitat forested enough to offer cover and food in the form of browse and

mast. Bottomland areas are productive habitats for deer due to abundant food. The Pine Flatwoods is the most common habitat in Florida and supports a substantial deer population on acorns, palmetto berries, woody plants and twigs, forbs, and mushrooms (Harlow and Jones, 1965). Deer were most common in the bottomland areas of the Putnam Site, but tracks were present in the upland areas as well. Deer were not seen during the nightlighting surveys but were flushed infrequently when working in the bottomland areas during the day. Local residents hunt deer extensively in this area (Hansford, personal communication). Hunting pressure and disruption on the site probably have caused the deer to move elsewhere for suitable habitat.

The primary carnivore found on the site is the bobcat (Lynx rufus). This cat is primarily nocturnal and solitary. It was identified by tracks and droppings in the bottomland habitats.

The gray fox (Urocyon cinereoargenteus) is another predator whose presence on site was common. This secretive animal feeds on small mammals, birds, fruit, acorns, eggs, and insects. It is an opportunistic feeder with an obviously omnivorous choice in food items. Tracks and droppings were found on all the roads through the site.

Two additional omnivorous species found on the Putnam Site are the raccoon (Procyon lotor) and opossum (Didelphis marsupialis). These animals prefer the wetter habitats where they can feed on frogs, salamanders, lizards, insects, birds, fruit, mast, and occasionally carrion. The raccoon and opossum are chiefly nocturnal but are occasionally abroad during the day. Signs of activity were especially abundant around any depressions and pools where amphibians might be found.

The armadillo (Dasypus novemcinctus) is a mammal which is now common to most of Florida. This species has extended its range into Florida from Texas and central America (Hall and Kelson, 1959). It is found in all but the wettest habitats where it digs in the leaf litter and soil for invertebrates. Armadillos dig underground burrows, usually located in palmetto thickets, for protection. Signs of digging were common in the Sandhill, Flatwoods, and Bayhead Forest habitats on site.

The only rabbit species observed on this site was the eastern cottontail (Sylvilagus floridanus). The cottontail is abundant in habitats containing heavy brush intermixed with open areas. One such area was the recently clearcut pine habitat in the southwest portion of the site. Here, brush piles and windrows offered good cover from predators such as hawks, owls, foxes, and bobcats; and the recently cleared land contained abundant newgrowth vegetation upon which the cottontail feeds.

The eastern gray squirrel (Sciurus carolinensis) is a resident of the bottomland areas. This squirrel is chiefly arboreal and prefers hardwood habitats where it feeds on a variety of nuts, seeds, fruit, and fungi. Gray squirrels generally jump from tree to tree and do not venture far from the protection of trees. The eastern fox squirrel (Sciurus niger) is found in open pine habitats such as the Flatwoods and Sandhill. The fox squirrel is roughly twice the size of the gray squirrel and is frequently seen running on the ground or along a road before taking refuge in the top of a nearby pine tree.

The only small rodent captured in 276 trapnights in various habitats during three seasons was the cotton mouse (Peromyscus gossypinus). Two mice were captured in the Bayhead Forest habitat; one young mouse was captured in the drift fence in the same habitat. Cotton mice prefer wooded habitats bordering fields or swampy areas. They feed on seeds and insects and frequently climb trees where they nest (Burt and Grossenheider, 1976).

Evidence of a subterranean mammal, the eastern mole (Scalopus aquaticus), was found in all habitats except those with standing water. This species is rarely seen as it spends most of its life tunneling just below the surface of the soil hunting for worms and insects. The Bayhead Forest contained the highest number of tunnels, but tunnels were also present in the more moist portions of the Pine Flatwoods habitat.

Two other mammals seen on site which deserve mention are the domestic dog (Canis familiaris) and cat (Felis domesticus). Hunting dogs were observed on the site from time to time. These dogs are usually used to tree raccoons or run foxes and bobcats. They may also be used to catch hogs. Dogs are generally ineffective predators and do little more than harass wild species. However, they may become more proficient at capturing small mammals if they are forced to live entirely on food available in the wild. Cats, on the other hand, are very efficient predators and will frequently capture birds, small mammals, and reptiles. Kittens were found abandoned on the site on one occasion and probably occur here on an infrequent basis.

No rare or endangered mammals were encountered on the Putnam Site. This site has been exposed to frequent disruption by logging, burning, and clearing as well as competition and general habitat destruction from the introduction of feral hogs. These factors have probably caused a noticeable lack of ground dwelling animals and make the area generally unattractive to species considered endangered or rare.

2.7.1.6 Endangered Species and Biologically Sensitive Areas

A historic lack of management practices and recent disturbances to the plant communities on the site have greatly reduced the possibility that a population of a threatened or endangered plant species may occur. No species presently on the Federal list of threatened and endangered plants are found in Florida. There are, however, several taxa listed on the Florida state list that potentially could occur in the Sandhill Community. However, none of these species were observed on the Putnam Site.

Florida has several vegetative communities which are endemic to the state and provide specific habitats to varied wildlife species. Many of these wildlife species are becoming more scarce as their habitats are lost to residential, industrial, or agricultural development, or as an effect of changes brought about in topography or surface and groundwater

flow. One such habitat, the Sandhill Community, is disappearing due to development because it is generally a well drained area of slightly higher elevation. Several wildlife species associated with the Sandhill are also disappearing due to this loss of habitat. These species include the Florida gopher frog, gopher tortoise, eastern indigo snake, short-tailed snake, Florida scrub lizard, Florida scrub jay, red-cockaded woodpecker, and Florida mouse. All but the scrub jay and red-cockaded woodpecker are directly associated with the gopher tortoise. This terrestrial turtle is an accomplished burrower and prefers to excavate its burrow in the deep sandy soil of the Sandhill. These burrows may be thirty feet or more in length and are usually as wide as the tortoise is long, enabling the tortoise to turn around in any portion of the burrow. The burrows provide shelter for a multitude of Sandhill inhabitants such as the ground dwelling species previously mentioned as well as pine snakes, coachwhips, diamondback rattlesnakes, burrowing owls, and numerous arthropods.

Currently, the eastern indigo snake is listed as a threatened species by the State of Florida and the U. S. Fish and Wildlife Service. The gopher tortoise, gopher frog, and Florida mouse are listed as threatened by the State (Suzanne Cooper, personal communication). The tortoise has had the distinction of being listed as a threatened species at the same time it is considered an official game species. Local residents consider the tortoise to be fine food, and frequently they will drive miles to hunt "gophers." The common means of capturing the tortoise is to push a garden hose into the burrow, pour a small amount of gasoline into the hose and blow the gas vapor into the burrow. This usually drives out most of the inhabitants.

This same technique is used to gas rattlesnakes out of burrows during the rattlesnake "round-ups" common in many of the southern states during the winter. The practice of "gassing" has recently been prohibited in Florida because gassing may kill indigo snakes (a threatened

species). The gopher tortoise itself is undergoing a status determination by the U. S. Fish and Wildlife Service. The fact that gopher tortoise burrows are relatively easy to locate due to their association with the Sandhill vegetation type has led to a problem of overhunting.

The Florida scrub jay does not depend on the Sandhill as its primary habitat. It utilizes many other so called "scrub" areas in which the more xeric oaks and sand pine, saw palmetto, myrtle, and gallberry are found.

The red-cockaded woodpecker is unique in that it nests almost exclusively in living pines infected with the fungus called "red-heart." This fungus weakens the tree's heartwood and enables the bird to excavate its cavity. The longleaf pine, when available, is preferred as a nesting site, and since longleaf pine is the dominant species in the longleaf pine-turkey oak community on the Sandhill, this woodpecker is commonly found in that habitat.

Investigations on the Putnam Site, however, revealed that of the listed endangered or threatened species only the gopher tortoise was present in the Sandhill Community. No other associated species mentioned previously were found. The site has been heavily impacted in the past. The larger longleaf pine has been removed years ago, thus making the site unattractive to the red-cockaded woodpecker. Smaller trees which were left, and have been cut in the past year, were too small to offer nesting opportunities to this species. No scrub jays were found during the survey onsite. Evidence of "gassing" (either for tortoises or rattlesnakes) was found at several tortoise burrows, so it is quite likely that many burrow inhabitants have been removed or perhaps destroyed by this technique. Also the presence of feral hogs on the site has probably adversely affected the residents due to habitat disruption, competition for food, and predation by the hogs.

Three tortoises of different sizes were found on the site. One tortoise was only 5.2 centimeters long (carapace); the other two were adults. The majority of the tortoise burrows observed were in use, but since tortoises may use more than one burrow, it is not possible to determine the number of tortoises present by the number of active burrows.

Other species of special concern have been noted on or near the Putnam Site. The southern bald eagle (Haliaeetus l. leucocephalus) the state and endangered by the U. S. Fish and Wildlife Service. Eagle populations in Florida have declined dramatically in the past 30 years (U. S. Forest Service, 1976).

However, Florida has been and still is a stronghold for the eagle. It is probably more abundant in Florida than anywhere else in the United States (Sprunt, 1954). The recent Cross Florida Barge Canal Restudy Report (U. S. Forest Service, 1976) surveyed eagle populations throughout the state and most specifically along the canal route, beginning in Palatka (5 miles south of the Putnam Site) and continuing south and west for 100 miles. Several active eagle nests were recorded in southern Putnam County.

Habitat requirements for the eagle include living slash pine and cypress for nest sites. Some scattered slash pines large enough to support an eagle's nest were present on the northern portion of the site and cypress was present along the St. Johns River directly south of the site. The site and adjacent areas were flown at low altitude in a single-engine airplane during September, 1977 and February and April, 1978 for the purpose of searching for large raptor nests. None were observed on the site or along the St. Johns River from Palatka to Federal Point.

A forester working on the site reported seeing an eagle nest on the northern portion of the site in a tall slash pine during the winter of 1976-77. No eagle was actually seen, but the forester did hear it

call from the nest as he approached the tree. This area was logged during the Fall of 1977 and Spring of 1978, and all large pines and cypress were removed. This area was thoroughly searched for evidence of either a nest tree or the remains of a nest in cut pine tops. No evidence of such a nest was found. An eagle nest is possible on the site, although the site does not represent prime nesting habitat. The Rodman Reservoir, fifteen miles southwest of the site, is much more attractive due to the abundance of old pines and cypresses and its proximity to a large body of water. Active eagle nests were observed there during the Cross Florida Barge Canal Restudy.

The osprey (Pandion haliaetus) is listed as a threatened species by Florida. It was observed feeding in the St. Johns River near the Putnam Site. The aerial survey previously mentioned, and an additional ground survey, failed to locate any osprey nests in cypress trees along the St. Johns River at any of the areas under consideration for sites for water intake/discharge structures. The osprey prefers to nest in the tops of dead trees; few of the trees in these areas were dead, as most were located on residential property from which any dead tree would have been removed. More suitable nesting habitat was probably located in the Rice Creek swamp area south of the site, although no nests were actually observed there either. The Cross Florida Barge Canal Restudy located numerous osprey nests south of Palatka.

2.7.1.7 References

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2.7.2 Aquatic Ecology

2.7.2.1 Introduction

This section discusses the aquatic ecology of the St. Johns River adjacent to the proposed Putnam Site and its alternative intake/discharge locations. The material addresses the various biotic communities of the St. Johns River both regionally and specific to the site alternatives.

This material was developed to comply with, among others, requirements of the National Environmental Policy Act, especially Section 102(2) (C); Section 316(B), PL 92-500; the Endangered Species Act; Section 10 River and Harbor Act; Section 404, PL 92-500; Florida Electrical Power Plant siting Act; and Chapter 17-3, Pollution of Waters, Florida Administrative Codes.

The plan of study had been structured to:

1. Document existing conditions of the aquatic environment in the vicinity of the proposed plant utilizing the literature to determine the amount and relevancy of site-specific information available and to fill any gaps in such information by site-specific sampling.
2. Then, utilizing the information obtained from site-specific sampling and other sources, to direct the design and location of intake and discharge facilities.
3. Develop an information base upon which reasonable predictions can be made of the impact that may occur as a result of construction and operation of an intake/discharge facility.

This section principally addresses items 1 and 3 and provides the background for analyses on which intake siting and impact analyses are based.

The St. Johns River emerges from marshes in east central Florida and flows northward for some 300 miles before reaching the Atlantic Ocean at Jacksonville. The northern two-thirds of the river is tidally affected

and has dissolved solids content due to ground water input from the Floridan Aquifer (Bayley and Odum, 1973). The southern one-third of the river contains generally high quality fresh water. Agricultural runoff, ground water discharge, and natural organic impurities progressively lower the water quality downstream. There are many intermittent ponds, swamps, and marshes and a few permanent lakes in the level plains of the upper St. Johns River Basin. Most of these wet areas are connected by sluggish streams or by wide shallow sloughs which drain into the tributaries of the St. Johns River. Several lakes occur along the river to the south; these lakes affect both the water quality and quantity in the St. Johns River in the vicinity of the site.

Site Characteristics

The site is considered to be in the lower basin of the St. Johns River; at this point the river is approximately 1800 meters wide and the average depth slightly more than 3 meters. Net velocity is on the order of 0.2 foot per second (fps) with a maximum on the order of one fps. The river in the vicinity of the site is influenced by tidal changes. The normal tidal range affects river flow to Deland, Florida; this is approximately 140 miles upstream from the mouth at Jacksonville. The entire 140 mile reach may be considered an estuary (Reynolds, Smith, and Hills, 1974). A detailed discussion of hydrological characteristics is presented in Section 2.3.1 and in Appendix C.

Man's influence is noticeable due to the effluent coming from Rice Creek which is located immediately upstream of the site (Figure 2.3-3). During the September 1977 collecting period, when taking bottom samples, a strong odor of hydrogen sulfide, indicative of anaerobic decomposition, was evident along the area. In addition, bottom characteristics include the presence of wood filings. The combination of these characteristics and the lack of aquatic vegetation does not make this a very desirable habitat for aquatic species. Farther downstream along the west bank of the river there are several homes. Most of these have boat docks and watercraft which are used primarily for sport fishing and/or pleasure

boating. Approximately 750-900 meters offshore of the west bank, in the site vicinity, commercial fishing is much in evidence by the presence of gill and pound nets and crab traps. The most sought after species include several species of catfish, eels during certain times of the year, and blue crabs. The commercial fish catch from the St. Johns River, Putnam County, amounts to approximately 1 to 2 million pounds per year (Florida Game and Fresh Water Fish Commission [FG&FWFC], 1977).

Although transparency limits the euphotic zone, primary production, temperatures, and nutrient supplies are generally high enough to support a fairly high standing crop of biota year-round.

Several biological studies have been conducted on the St. Johns River. At least one of these is ongoing at the present time. The FG&FWFC has 31 collection points on the St. Johns River, including station number 30 which is located at the confluence of Rice Creek and the St. Johns River (Figure 9.3-2). The study monitors physiochemical characteristics, phytoplankton, zooplankton, macroinvertebrates, and fish. Tagatz (1968) studied the distribution of fishes on the St. Johns River as a follow-up of McLane's work discussed below. A recent biological study of the St. Johns River was conducted approximately seven miles upstream of the site (Applied Biology, 1976) in conjunction with 316 demonstrations for a Florida Power and Light Company (FP&L) fossil-fired plant.

Aquatic biota of the upper St. Johns River Basin are typical of the fresh water habitats of Florida and as characterized by Goolsby and McPherson (1970) include: green and blue-green algae, generally in low concentrations that dominate the phytoplankton; zooplankton, most commonly represented by rotifers and copepods; vascular hydrophytes including the water hyacinth and various sedges; and benthic macroinvertebrates including mussels, various crustaceans, dipteran larvae, and oligochaetes.

The fish fauna of the St. Johns River consists of 174 species which include 57 fresh water forms and 117 marine invaders (McLane, 1955). Considerable commercial fishing is conducted on much of the St. Johns River. Some of the more important species harvested include American eel, mullet, several species of catfish, and American shad. Angling is a popular sport on the St. Johns River with some of the important sought-after species being the largemouth bass, and other species of centrarchids.

Sampling Station Locations

Sampling transects and stations were chosen to systematically allow sampling of the alternate intake and discharge sites and to assess various components of the aquatic ecosystem in the St. Johns River in the site vicinity (Figure 9.3-2).

Each of the sampling transects was chosen on the basis of three alternative locations for the intake/discharge facilities in addition to one control transect. These locations of the intake/discharge facilities on the river were considered in relation to (1) the use of pipeline corridors between the plant and the river placed to have the least adverse impact on residential developments and wetland habitat in the area, and (2) competing uses of the navigational channel of the river to cause least apparent interference with river traffic.

Transects B, C, and D coincide with the proposed intake/discharge facilities location alternatives. Transect A is designated a "control transect" and was not an alternative intake/discharge site. It was located upstream from Rice Creek. Two collection points were utilized along each transect, located nearshore and offshore to allow comparison of habitats for intake/discharge placement and to establish overall baseline conditions at each location.

The location of transects and individual collection points were selected to allow the collection of information pertinent to compliance

with Section 316(b), PL 92-500 through directing the engineering decisions required for the siting and operation of discharge and to optimize intake type and configuration to minimize entrainment and impingement of fish, fish eggs, larvae, and other biota.

Transect A

Transect A was the control transect. During the September 1977 collection period, this transect was located approximately 610 meters upstream of the confluence of Rice Creek and the St. Johns River (Figure 9.3-2).

Station 1 was located approximately 150 - 175 meters offshore. Bottom composition was primarily detritus and organic matter. Water depth was approximately 2.0 - 2.5 meters.

Station 2 was located approximately 20 meters offshore. Bottom composition was primarily detritus, organic matter, and a few wood chips or fillings. Water depth was approximately 1.0 - 1.5 meters.

During the January 1978 collection period, and for all subsequent collections Transect A was relocated approximately 1525 meters downstream of Hog Eye Point and approximately 25 meters downstream of the overhead transmission line crossing the St. Johns River. The transect was relocated so that it would not be influenced by the spoil area that was approximately 275 meters from the west bank of the river and 100 meters upstream of the confluence of Rice Creek and the St. Johns River. Spoil area dimensions were approximately 640 x 110 meters (Figure 4.4-2).

Station 1 at the new location, was approximately 150 meters offshore. Bottom composition was primarily silt and detritus. Water depth was approximately 2 meters.

Station 2 at the new location was approximately 15 - 20 meters offshore. Bottom composition was primarily silt and detritus. Depth was approximately 1.0 - 1.5 meters.

Transect B

Transect B was located approximately 2000 meters downstream of Rice Creek in Section 18, Township 9S 26E. This corresponded to pipeline Corridor A.

Station 1 was located approximately 150 meters offshore. The bottom conditions consisted primarily of detritus and organic matter. Water depth was approximately 2.0 - 2.5 meters.

Station 2 was located approximately 20 meters offshore. Bottom composition was primarily detritus, organic matter, and some wood chips. During September 1977, bottom substrate smelled of hydrogen sulfide; this odor was also noted during the benthic macroinvertebrate sampling. Water depth was approximately 1.0 - 1.5 meters.

Transect C

Transect C was located immediately north of Verdiere Point. This corresponded to pipeline Corridor B.

Station 1 was located approximately 100 - 125 meters offshore. Bottom composition was predominately sand and some detritus. Water depth was approximately 3.0 - 3.5 meters.

Station 2 was located approximately 50 meters offshore. Bottom composition was primarily organic matter with some sand. Water depth was approximately 1.0 - 1.5 meters. The adjacent shoreline was a sandy beach.

Transect D

Transect D was located at Bodine Point. This corresponded to pipeline Corridor C.

Station 1 was located about 125 meters offshore. Bottom composition was primarily sand and some detritus. Water depth was about 3.0 - 3.5 meters.

Station 2 was located 50 meters offshore. Bottom composition was silt, detritus, and some sand. Water depth was approximately 2.0 meters.

2.7.2.2 Aquatic Flora

2.7.2.2.1 Phytoplankton

Phytoplankton consist of small, photoautotrophic algae of open waters, having limited powers of locomotion and, therefore, more or less dependent upon water currents for their distribution. Their occurrence in a stream or river is often a result of breaking loose from algal communities attached to a substratum or entering a stream from the outflow of a lake, although slow moving rivers may support an actively growing community. They usually have relatively short life spans measured in days (Wetzel, 1975; Odum, 1971).

Temporal and spatial distribution of these organisms is dependent on several environmental factors. In addition to the basic roles of light and temperature, they require a means of remaining in the euphotic zone for sufficient lengths of time to permit photosynthetic activity to promote growth and reproduction. A number of nutrients are also required, particularly compounds of inorganic nitrogen and phosphorous and often members of the major classes of organic molecules including certain vitamins. Biological limitations may also be imposed on the growth of phytoplankton populations. For example, growth inhibiting secretions may be produced by some species or selective predation or grazing may reduce one or more populations from the community.

The community of phytoplankters provides the major mechanism for energy transfer from sunlight to non-photosynthetic members of the aquatic ecosystem. The position of these algae, therefore, is at the base of the food web. Phytoplankton are consumed by zooplankton and other primary consumers which in turn provide food for large animals. Thus, phytoplankton abundance, in part, determines the quality and quantity of larger organisms which depend upon them for food. Within the physical and biological limitations of the environment these autotrophs may provide the highest gross productivity in the community. Although seasonal fluctuations in density and diversity of algal communities often appear, the number of species generally remains constant from year to year excepting the occurrence of outside perturbations (Wetzel, 1975).

Visible, sometimes extensive, accumulations of algae at or near the surface are designated as "blooms." The changes in water quality that induce excessive growths of certain species of algae are often the result of organic or inorganic pollutants added to the ecosystem (Wetzel, 1975). Many algal species die from the addition of these pollutants but some algae are tolerant of these changes and, lacking competition from less tolerant forms, rapidly grow and reproduce. Algae that show this response to pollutants are known as indicators of these conditions. If these algae occur in sufficient numbers, their respiratory activity, or that of bacteria involved in their decomposition, may reduce the oxygen in the water to levels low enough to produce large fish kills (Palmer, 1968; Zawnecki, 1968).

Those phytoplankton most commonly occurring as tolerant organisms and considered characteristic of eutrophic conditions are representatives of the Cyanophyta or blue-green algae (Palmer, 1968). The blue-greens most commonly identified as typical of eutrophic conditions are Anabaena, Anacystis, Aphanizomenon, and Oscillatoria (Cole, 1975; McNaughton and Wolf, 1973; Colinvaux, 1973; Kormondy, 1976). In addition to forming large, mucous secreting mats, some of the blue-greens release toxins into the water (Odum, 1971; Zawnecki, 1968; Cole, 1975) and very few are of significant nutritional value (Cole, 1975). Being selectively avoided by grazing herbivores, such as the zooplankton, may also account for their ability to reach very high densities. The blue-greens are also very responsive to thermal effects in aquatic ecosystems, readily out-producing other algal groups (Colinvaux, 1973).

Algae, other than blue-greens, that form significant populations in the phytoplankton are the Chlorophyta, or green algae; the Chrysophyta, or golden-brown algae; the Bacillariophyta, or diatoms; and several flagellates, mostly unicellular forms, such as the euglenoids, dinoflagellates, and cryptomonads. The most important members of the phytoplankton are usually the diatoms, although many diatoms are sessile

and appear as plankton only when broken loose from the periphyton. All diatoms have siliceous cell walls and many form colonies or filaments. The euglenoids are not always planktonic but do occur in very great numbers under proper conditions, particularly in shallow water with high ammonia and/or organic materials in solution (Wetzel, 1975). Many of the dinoflagellates have very specific requirements with narrow tolerances for calcium, pH, dissolved organic nutrients, and temperature.

The phytoplankton of the St. Johns River have been sampled extensively since the 1960's (FG&FWFC, 1970; Applied Biology, Inc., 1976). Other studies conducted by the FG&FWFC (1977) included phytoplankton surveys near Rice Creek; and a recent study by Applied Biology, Inc. (1976) included stations near Palatka, upstream from Rice Creek. These studies have documented a decrease in species diversity along the river, particularly around the outflow of major lakes. It is commonly recognized that high rigor or stress in an ecosystem is accompanied by low community diversity, that is, dominance by few species (Odum, 1971). In developed areas this reduced diversity is often indicative of excessive pollution (Wilhm and Doris, 1968). In the St. Johns River studies, low diversity was commonly associated with high numbers of organisms with tolerance to organic pollution, particularly populations of euglenoids and blue-green algae. Some seasonal variation was observed, with low population densities and dominance by diatoms or blue-greens, especially Anacystis, in the winter; euglenoids, lesser populations of diatoms, and green algae in the spring; and high populations dominated by blue-greens in the summer and fall (FG&FWGC, 1970; 1977; Applied Biology, 1976). The dominance of blue-green algae in this riverine/lake/estuarine system may indicate a trend towards eutrophication resulting from increased organic pollutants, such as detritus, sewage wastewater, and runoff from agricultural areas. Also, greater light availability, due to removal of water hyacinths and higher temperatures, promoting growth of thermophilic algae may contribute to this trend.

Surveys conducted by Dames & Moore in September 1977 and January 1978 documented species composition, density, diversity, and spatial distribution of the phytoplankton community.

The phytoplankton collections of the lower St. Johns River, based on previous studies (FG&FWFC, 1970) and the current investigations were represented by 193 species (Appendix B, Table B-1), including 55 diatom species, 39 species of blue-green algae, and 99 species of other algae (green, gold, and miscellaneous other groups). The findings of the present report were consistent with the other studies in this region of the St. Johns River.

Table B-2 illustrates the number of taxa identified at each station and Table B-3 compares the numbers of taxa found at offshore and near-shore sampling sites. Although no substantive differences seem apparent between offshore and nearshore stations, there is an obvious decrease in the number of taxa present in September from those found in January, especially at Transect D where the mean number of taxa decreased from 81.5 in January to 26 in September (Table B-2). Generally, the change in number of taxa seems to occur less among the blue-green than among other algae.

All algal groups were represented by higher populations at the various transects in September (mean of 25.2×10^6 cells/liter) than in January (mean of 9.2×10^6 cells/liter) with blue-green algae dominating all sampling stations during both seasons sampled (Tables B-4, B-5, B-7 through B-12). Diatoms were next highest in density although their concentration was always less than half that of the blue-greens. The greatest seasonal changes were noted at Transect B, with an increase in blue-greens from 3.1×10^6 to 19.5×10^6 cells per liter, and Transect

A where the blue-greens increased from 6.8×10^6 to 19.1×10^6 cells per liter between the January and September samplings. Overall, the blue-greens comprised 62 percent of the January collection and 64 percent of the phytoplankton obtained in September, while diatoms made up only 23 percent and 20 percent in January and September, respectively. The green, gold, and other algae comprised only about 15 percent of the phytoplankton during both surveys. Table B-5 compares the offshore and nearshore collecting sites for all transects for both seasons surveyed. The algal densities at offshore sampling stations were generally similar to those collected at onshore stations for January. However, onshore stations demonstrated consistently higher densities than offshore sites during the September sampling period, a time when overall population densities were at their highest. These differences in September were most obvious at Transect A where 83 percent of the blue-green algae and 84 percent of the diatoms were obtained from the nearshore sample. The other phytoplankton exhibited no apparent pattern of difference between offshore and onshore samplings (Table B-5).

An organism comprising 15 percent or more of the total cells of a major group (i.e., blue-greens, diatoms, or other algae) was considered a dominant species. Those species of algae indentified for this investigation that met this criterion of dominance are noted in Table B-6.

The dominant blue-green algae at all transects in January were Oscillatoria acutissima (49-57 percent of all blue-greens) and Spirulina laxissima (16-19 percent of all blue-greens). In September, however, this species of Oscillatoria (O. acutissima) was replaced by two others; an unidentified species (16 percent of blue-greens at Transect A and 52 percent of the blue-greens at Transect D) and O. limnetica (29 percent at Transect C). It is of importance to note that Oscillatoria is listed by Palmer as the second most pollution tolerant genus of algae (Palmer, 1969). Additionally, Anacystis, another blue-green of importance because of its association with fish kills, was found to be dominant at Transect C in September.

The diatoms with dominant populations in January were an unidentified species of Navicula (20-27 percent) and Nitzschia gracilis (23-41 percent) found at all transects. An unidentified species of Nitzschia was also reported as a dominant from all transects except Transect B (Table B-6). Shifts in dominance among the diatoms were evident in September when two species of centric diatoms, Cyclotella meneghiniana and Melosira italica, were dominant species, along with unidentified species of Nitzschia and Cocconeis. Melosira is a filamentous diatom and its prevalence in a population, like that of many filamentous blue-greens, may be a result of being selectively avoided by herbivorous zooplankton which find filaments difficult to ingest (Wetzel, 1975). Representatives of Nitzschia, Navicula, and Cyclotella are listed among the top 15 most pollution tolerant algae (Palmer, 1969).

Of the other algae identified in this survey, the dominant species in January was Selenestrum minutum recognized as dominant at all transects except B, although it composed 14 percent of the population at this transect. In September, S. minutum was replaced as dominant by four other algal species (Table B-6) including Senedesmus quadricauda and Ankistrodesmus falcatus, representative of genera listed by Palmer as among the top 10 of pollution tolerant algae (Palmer, 1969).

The species diversity indices obtained in this study (Table B-13) are consistent with similar values obtained in this same region of the St. Johns River (Demort, 1978).

Summary

The eutrophic state of the St. Johns River observed in earlier surveys (FG&FWFC, 1970; Applied Biology, 1976) is supported by present findings of this report. Pollution-tolerant, blue-green algae were dominant at every transect during both sampling periods, a generally recognized characteristic of eutrophic conditions. Further, the low nutritional value of these blue-green algae, as well as their association with production of fish toxins and anoxic conditions contribute to the degradation of the river.

2.7.2.2.2 Aquatic Macrophytes

The term macrophyte applies to rooted and floating vascular plants that can be easily seen with the unaided eye. This will be considered synonymous with "higher plants" as defined by Hynes (1970). Hynes divides higher plants into three ecological categories:

1. plants attached to solid objects,
2. those with roots penetrating the substratum, and
3. the free-floating plants.

Aquatic macrophytes perform several important functions in aquatic ecosystems. First, they are primary producers in that they contribute to the supply of oxygen in the water by withdrawing carbon dioxide during photosynthesis and giving off oxygen. Secondly, by competing with phytoplankton for available nutrients, they may be potentially important in the control of algal blooms (Fitzgerald, 1969). In addition, they provide habitat, cover, and food for many species of animals including amphipods, crayfish, and larvae of many species of aquatic invertebrates, and several species of fish.

The flushing of floating plants and plant nutrients, characteristic of fast-moving streams, is absent in the St. Johns River and other Florida Streams. Hence, these streams are often eutrophic (rich in nutrients) resulting in an overabundance of aquatic weeds, particularly water hyacinth (Eichornia crassipes), hydrilla (Hydrilla verticillata), eurasian watermilfoil (Myriophyllum spicatum), and alligator weed (Alternanthera philoxeroides) (U. S. Corps of Engineers [COE], 1973). These four aquatic plant species are included on the list of species reported in the St. Johns River Basin (Table B-14).

Factors other than nutrient availability also influence the presence or absence of aquatic macrophytes in a lotic ecosystem. Haslam (1971) pointed out that the absence of aquatic plants was usually due to a combination of factors, such as unsuitable substrate, high water velocity, or toxic substances in the water. One of the most limiting factors for submerged plants in the St. Johns River may be light penetration. Westlake (1966) indicated that water depth and turbidity were

very important factors in reducing light penetration. He found that in large turbid rivers only one percent of surface irradiance reached 1 meter water depth. Therefore, the relatively low Secchi Disc transparency value (0.35 - 0.66 M) found at each transect in the present study may be a major factor limiting the growth of submerged aquatic vegetation. Other physical, chemical, and biotic factors also influence the presence and abundance of vegetation on the St. Johns River. Additionally, the COE has an aquatic weed control program that includes most of this length of the St. Johns River (COE, 1977). Nevertheless, the abundance of aquatic vegetation recorded in other areas of the St. Johns River (COE, 1973) suggests that much of this river is suitable for vigorous vegetation propagation.

Previous investigations of aquatic macrophytes on the St. Johns River include the waterway control studies for the State of Florida (COE, 1973, 1977) and studies of the FG&FWFC (1976). Representative organisms identified in these studies are listed in Table B-14.

The results of present studies showed that aquatic macrophytes were only found in Transects C & D (Figure 9.3-2).^{*} The species common to both of those transects included water celery (Vallisneria americana), common water nymph (Najas guadalupensis), and stonewort (Chara sp.) (Table B-15). At Transect D, spatterdock (Nuphar luteum) and filamentous algae were present. The vegetation was generally scarce throughout the transect and none was found at depths greater than 1 meter. These macrophytes are described as follows:

Vallisneria americana (water celery) - This aquatic submerged plant occurs frequently in lakes and beds of flowing streams. Its range extends throughout the eastern half of the United States from north Dakota and Texas. It is ecologically important in that it provides an excellent food source for wildfowl, which eat all parts, especially winter buds and rootstocks. It attracts marsh birds, wildfowl, and shorebirds. It supports insects, harbors minute animals, provides shade and shelter, and is a valuable food for fish (Fasset, 1957).

Note: See page B-2, Appendix B.

Najas guadalupensis (common water nymph) - This submerged aquatic plant occurs abundantly in ponds, lakes, and quiet waters chiefly in the outer Coastal Plain. N. guadalupensis is often used by wildfowl as a source of food (Correll and Correll, 1972).

Chara sp. (muckgrass, stonewort) - This alga always occurs in hard water. This is consistent with water quality data (See Section 2.3.1) which indicate a total hardness of 196 mg/liter. This species provides habitat for minute aquatic animals which in turn provide an often important food source for wildfowl (Fasset, 1957).

Nuphar luteum (Spatterdock) - This aquatic perennial, closely related to the water lily, is commonly found in water or in mud of shallow lakes, streams, or ponds. Vegetative propagation of this aquatic plant often becomes so extensive that other plant species are crowded out. It is a source of food for animals, the stems and leaves being eaten by deer and the seeds by wildfowl. The lower surface of the leaves provide a habitat for numerous aquatic invertebrates (Fasset, 1957).

2.7.2.3 Aquatic Fauna

2.7.2.3.1 Zooplankton

The zooplankton are the assemblage of small animals of open waters that are incapable of moving against a current and, therefore, depend in large part upon water flow for their distribution. They are generally secondary (or higher) consumers in the community deriving their nutrition either as predators, feeding on other zooplankton; herbivores, feeding on organic breakdown products of plants and animals; or omnivores, feeding on more than one energy source (Wetzel, 1975).

Most zooplankton are filter feeders, removing particulate matter from the water. The feeding effectiveness of herbivorous zooplankton is dependent upon algal density. At low densities insufficient food is caught and at high densities the algae may clog the filter apparatus and inhibit ingestion rates. Some species of algae may release toxins that inactivate the feeding apparatus of the zooplankton (Wetzel, 1975). Direct cropping of the phytoplankton by the zooplankton as well as selective grazing may influence the fluctuations of phytoplankton populations (Winner, 1975). Additionally, much of algal productivity enters

the detrital pathway and so transfer of food is "short circuited" through bacteria and particulate detrital organic matter which can then be utilized by filter feeders. All zooplankton populations in turn regulate and are regulated by populations of planktivorous fish and other aquatic animals. Zooplankton are the crucial link in the food web between the phytoplankton and most other consumers, such as young fish and shellfish. The common freshwater macrozooplankton that occur are Rotifera and two subgroups of Crustacea, the Cladocera and the Copepoda.

The most significant fluvial zooplankton are usually the Rotifera (rotifers), which include both omnivorous and sessile forms. The size of the majority of food consumed by rotifers is small (under 12 mm in diameter) and so large algae or other plankton may not be eaten or be of reduced value. Factors affecting seasonal fluctuations in rotifers, include both food availability and temperature with highest populations occurring during mid or late summer. It has been generally accepted that the presence of several closely related species within one genus or the occurrence of several dominant genera may be indicative of an eutrophic system (Winner, 1975).

The Cladocera (commonly known as "water-fleas") are almost all filter feeders and feed upon particles as small as bacteria. The Copepoda (copepods) are variable in their feeding. Some are selectively predatory, but most others are true filter feeders. Although most copepods are littoral benthic species, the few that are planktonic may form a major part of the zooplankton community of a lotic ecosystem with their main diet being phytoplankton (Barnes, 1974).

Both cladocera and, to a lesser extent, copepods, have an ability to select food, with many small algae being ingested and gelatinous green algae or large unpalatable species being rejected. Where these algae dominate, the filtering rates of these zooplankton are usually reduced; and if blue-green algae dominate the phytoplankton, the rates of ingestion, assimilation, survivorship, and reproduction of cladocera are known to decrease (Wetzel, 1975).

Zooplankton in the lower St. Johns River have been surveyed near Palatka by Applied Biology, (1976) and near Rice Creek by the FG&FWFC (1977). The Applied Biology 1975 survey was conducted during February, May, August, and November, 1975 and recorded a cyclic fluctuation in zooplankton with a dominance of rotifers in August (206 per liter), cladocera in May (216 per liter) and copepods and copepod larvae in February (44 adults and 314 nauplii per liter). The lowest zooplankton density was in November (Table B-17).

The 1976-1977 investigation of the FG & FWFC identified 10 species of zooplankton at the Rice Creek station during June 1977, which was the highest number among all samples collected. Additionally, this station produced the highest frequency of occurrence of rotifers and the lowest frequency of cladocera. The dominant zooplankton at the Rice Creek station were cladocera, making up 71 percent of the zooplankton collected (Table B-17), whereas copepods were dominant at all other upstream stations. Although the stations near Rice Creek and Green Cove Springs, downstream from Rice Creek, produced 11 to 12 percent of the total zooplankton collected along the St. Johns River, the population densities were higher at the upstream collections.

Surveys conducted by Dames & Moore in September 1977 and January 1978 provided site specific information on the composition of the zooplankton community near Rice Creek. The analysis of these collections emphasized the distribution, density, and diversity of planktonic animals among stations and among transects.

Collections made by Dames & Moore at the four transects near Rice Creek produced 30 species of zooplankton (Table B-16), more than twice that found by the FG & FWFC for June of 1977.

As a whole, January and September collections produced almost the same mean number of taxa per station and per transect. Differences were noted, however, between these sampling periods for a specific station or

transect (Tables B-18 through B-20). No pattern was apparent for these differences. Diversity indices showed little difference among stations for each sampling period but measurable difference between periods; the mean index for January was 1.74 while that for September was 2.57. A low diversity index usually denotes a stressed system. This stressed, probably eutrophic, state was further substantiated by the finds, especially during September, of: (1) several dominant genera (Brachionus, Keratella, and Trichocerca) as well as, (2) the presence of several species of the same genus (Brachionus), either condition considered to be indicative of a eutrophic ecosystem (Wetzel, 1975; Winner, 1975).

A substantive difference was noted in the number of organisms sampled during the two seasons investigated. January sampling produced a mean of 570 organisms/liter while September sampling showed an average of 2087 zooplankters per liter. The general variation in zooplankton densities between offshore and onshore sampling stations is illustrated in Tables B-21 and B-22. Although little difference in population densities during January was observed between offshore and nearshore stations (Table B-21), the offshore samples in September produced almost 2500 organisms per liter more than nearshore collections. When compared by transect (Table B-22), the offshore samples were higher at Transect B in January and lower at Transect C than the onshore stations, but all transects had higher offshore densities during September. There was little nearshore vegetation and this was located only at Transects C and D (see Section 2.7.2.2.1), resulting in little protection or suitable substrate for zooplankton.

There were several zooplankton taxa identified in this study with interdependent roles in the aquatic ecosystem. The dominant rotifer in the January sample was a species of Asplanchna. This organism is a first level carnivore that preys especially on rotifers of the genus Brachionus (Wetzel, 1975). The population dynamics of these two genera, therefore, are probably mediated by a predator-prey interaction. This may account, in part, for the low populations of Brachionus spp. when Asplanchna was

present in January (Table B-19) and the high populations of Brachionus when Asplanchna was absent in September (Table B-18). Keratella was another rotifer that dominated the zooplankton in September. Keratella sp., along with the rotifer Filinia, are warm water organisms with reproductive rates closely related to temperature (Wetzel, 1975; Winner, 1975). Thus, the warmer waters of the September sampling period (29.1°C mean) correlate with high densities for these two organisms, in contrast to the reduced population of Keratella and the absence of Filinia during the cooler January collections (8.6°C mean).

Seasonal fluctuations of zooplankton densities suggested a positive correlation with densities of the phytoplankton. Population increases of Polyarthra, for example, are reported to show a positive correlation with population increases of the euglenoid, Cryptomonas. In the current study, the highest concentrations of Polyarthra were found in September at Station 1, Transects A, C, and D (Table B-18), the same sampling sites where Cryptomonas was obtained (Table B-11).

Summary

In summary, characteristics of high densities of rotifers in the zooplankton were reported in earlier studies along the lower portion of the St. Johns River. These reports were substantiated by data collected by Dames and Moore. The identification of 6 rotifer genera in this survey from 9 rotifer genera proposed as indicative of eutrophic conditions (Winner, 1975) suggests an aquatic system under considerable environmental stress.

Effects of season on zooplankton distribution were apparently more important than effects due to variation in station location or proximity to shore. Fall zooplankton increases, however, were greater in offshore populations. This implied possible influences nearshore from increased planktivore activity, increased blue-green algae populations, or absence of suitable substrates.

The site specific information developed in this study illustrated the influence of season and location on the zooplankton community. Thus,

the total number of organisms collected was highest in September, at Station 1, Transect D while the lowest number were obtained in January at Station 2, Transect A. The greatest number of taxa were found at Station 2, Transect D (15) in January while the lowest number (8) were at Station 2, Transect B in January and C in September.

The highest indices of diversity and equitability were at Station 2, Transect A in September. The lowest values for these two indices were at Station 2, Transect B in January.

2.7.2.3.2 Benthic Macroinvertebrates

Benthic macroinvertebrates are bottom dwelling organisms which live all or part of their life cycles in and upon various underwater substrates. These organisms are large enough to be retained by a U. S. Standard Number 30 seive and may be recognized by the unaided eye (EPA, 1973).

Benthic macroinvertebrates are important in the aquatic ecosystem because of the very diverse nature of their trophic relationships. Macroinvertebrates occupy virtually all levels of the trophic web. They include carnivores, herbivores, and omnivores as well as deposit and detritus feeders, scavengers, parasites, grazers, and predators.

Macroinvertebrates play an important role in the recycling of nutrients in the aquatic system and in supplying a food source for other organisms in the food web. Macroinvertebrates represent an important food source for fish and often included among these invertebrates are both commercial and recreational species (EPA, 1973).

The makeup of the macroinvertebrate community varies in response to both the biotic and abiotic factors of its environment. Variations in this community occur both spatially and temporally. Factors such as water temperature, velocity, substrate type, presence of chemical substances, presence of other biota (especially habitat forming macrophyte plants), and water quality all affect macroinvertebrate distribution. Examination of the macroinvertebrate community requires analysis of species presence, density, and community structure. Species presence is

simply the examination of a community to determine if a species is present or absent. The presence of a species may be controlled by any of the factors mentioned above or, in addition, by tolerance to chemical conditions, competitive interactions with other organisms, or simply by the lack of opportunity to invade a particular habitat.

The density or abundance of a particular species is indicative of the relative fitness of an organism for a particular environment and a measure of its success in utilizing community resources.

In addition to the examination of individual species populations, the structure of an aquatic community, in this case the benthic macroinvertebrates, may also be examined. The community is important since it represents a metabolically interrelated level of organization (Odum, 1971). The community level of an ecosystem has both diversity and structure which may be examined in part through the use of diversity indices. These indices take into account two prime components of community structure: richness of species and the distribution of individuals among species.

The literature (EPA, 1973) has generally associated high diversities with unpolluted, unstressed communities. Low diversities have been associated with stressed or polluted communities.

Macroinvertebrates in the St. Johns River have been studied FG&FWFC (1976) which also reviewed earlier work by the USGS. In the vicinity of the plant site, other studies were by Applied Biology (1978) made for FP&L near Palatka, upstream of the proposed site; and by the Florida Department of Environmental Regulation (DER, 1974) near the confluence of Rice Creek with the St. Johns River. Many of the species of macroinvertebrates collected during these studies were also sampled by Dames & Moore (Table B-23). Since it is well documented that the presence and abundance of macroinvertebrates reflects their sensitivity to edaphic factors, especially the substrate type (Scott, 1958) and presence of aquatic vegetation (Pettee and Gifford, 1964; FG&FWFC, 1976) these factors were to be addressed in site-specific sampling of the Putnam Site.

Forty-three taxa of macroinvertebrates were collected during September 1977 and January 1978, representing 21 insect taxa and 22 non-insect taxa. During both of the collecting periods, the major taxa collected were dipterans, crustaceans, and oligochaetes. Of these, the dipterans (the chironomids, in particular) were dominant (Tables B-25 and B-26). Data collected by personnel from DER (1974) in the vicinity of Rice Creek and the confluence of the St. Johns River also indicated that chironomids were the dominant benthic forms.

As pointed out in an earlier study (Applied Biology, 1976), many of the benthic macroinvertebrates in the St. Johns River are estuarine species and these include a number of those species found at the site, among them Corphium sp., Cyathura polita, and Mysidopsis bigelow.

Only one aquatic organism, Procladius sp., occurred at all stations and transects (January 1978). The next most widely distributed macroinvertebrates a Bythiniid snail and Limnodrius spp., occurred at 7 of the 8 stations and at all transects (September 1977). Gammarus sp., Limnodrilus hoffmeisteri, and immature tubificid worms (no hair setae) were well distributed at 6 of the 8 stations (January 1978). Organisms showing limited distribution, occurring at 4 to 5 stations, were Hyalella azteca, Cyathura polita, Coelotanypus condinnus, a Bythiniid snail and Limnodrilus spp. during January 1978.

As classified for tolerance to organic wastes (EPA, 1973), these major taxa were all either tolerant or facultative in response to decomposable organic wastes. The presence and wide distribution of pollution tolerant macroinvertebrates at the site generally agrees with results of other studies.

The spatial distribution of taxa were also investigated. The greatest abundance of taxa was found along the control transect (Transect A, both Stations 1 and 2 combined). Fewest taxa were found at Transect B (Corridor A) in September 1977 and Transect D (Corridor C) during January 1978 (Tables B-25 and B-26). More taxa were collected at inshore than at

offshore stations. Also, there were greater numbers of organisms collected nearshore than offshore (Tables B-25 and B-26). The difference between nearshore and offshore locations was statistically significant during the September study but not during the January survey. The higher numbers of taxa and organisms found inshore may be related to the shallowness of that area; greater penetration of light; less water movement nearshore, and at some locations, the presence of macrophytes providing a more suitable habitat.

Seasonal trends in the numbers of benthic macroinvertebrates were observed during the January survey period, there was a total of 37 species collected, compared to 28 species during the September period. This may be due, in part, to the typically cyclical emergence patterns most benthic macroinvertebrates. Seasonal changes in the benthos are also shown by data collected near the FP&L Plant upstream of the study area. In contrast to the overall stability of oligochaetes and crustacean populations annually, insect species were least abundant during warmer months, but increased during the colder months (FP&L, 1975).

Numbers of macroinvertebrates varied with each transect as well as seasonally. Statistical examination of total numbers of macroinvertebrates at each transect showed no significant differences. Due to the highly variable and seasonal nature of many of the macroinvertebrates, and the large numbers of replicates required for precision, detailed analysis of each individual taxon was not justified. Macroinvertebrates were also collected at the site incidentally with gear primarily used in the collection of nekton, particularly fish (Table B-24). Collections consisted of grass shrimp, blue crab, and one unidentified species of crab. The overall distribution of blue crab was fairly uniform but not the distribution of grass shrimp. The greatest numbers of grass shrimp were found at Transects C and D (Corridors B and C), where 116 and 189 total individuals were collected, respectively. Only one grass shrimp was collected at Corridor A (Transect B) and none at the control (Transect A).

Two indices of community structure, species diversity, and equitability (Tables B-25 and B-26), were used describe combined components of species richness and define community patterns within the study area.

Values for species diversity ($\bar{d}$) fell between those values reported for unpolluted waters and those reported for pollution stressed waters (EPA, 1973). During the September sampling, values were higher nearshore than offshore. In January, the distinction was much less clear with each transect displaying differences. Since water quality conditions were not severe, and a fairly large number of taxa tolerant to moderate and high levels of pollution were found, it was not unexpected that diversities might be high.

Equitability (e) was also fairly high, generally greater than expected under conditions of moderate pollution (EPA, 1973). This may be more related to the lack of overwhelming dominance by any particular species than any other factor. Both species diversity and equitability were within values found at the Palatka Plant (Applied Biology, 1976).

In summary, the macroinvertebrate community in the St. Johns River at the site area is similar to communities in other sections of the river in terms of species present, levels of abundance, species diversity, and equitability. Organisms were identified as tolerant to moderate or high levels of pollutants. No statistically significant differences were found among any of the potential intake/discharge transects with the exception of grass shrimp distribution. Grass shrimp were far lower in abundance at Corridor A. No unique species, habitats, or associations were noted among the macroinvertebrates.

2.7.2.3.3 Fish and Ichthyoplankton

Introduction

Fish are among the most important organisms in the aquatic ecosystem, both to man and to the aquatic system itself. Fish species occupy a wide variety of trophic levels as consumers and predators as

well as detrital feeders and herbivores. Fish also have the longest reproductive cycle of any of the major aquatic organisms and are also generally the most fragile.

The St. Johns River system supports an important fishery resource, well documented by many authors including the FG&FWFC (1970 and 1976), McLane (1955), Moody (1961 and 1963) and Tagatz (1968). This review is intended to summarize existing data for the river system and correlate it with recent field surveys conducted in the vicinity of the Putnam Site.

The distribution of fish species along coastal rivers is largely determined by salinity. Because of the unusual pattern of salinity in the St. Johns River, both marine and freshwater species occur for more than 103 miles upstream. Tributary creeks and coves along the lower 25 miles provide areas of intermediate salinity where fish can undergo gradual transition from salt to fresh water (Tagatz, 1968). The range of marine species is further extended upriver by mineral springs that increase dissolved solids along the river from Palatka to Lake George (Beck, 1965).

McLane (1955) characterized the fish species of the St. Johns River by salt tolerance and used the following categories:

1. Primary Freshwater Species - those species that spend their entire life history in freshwater. The most important family in this category is the sunfish. Shad and gar are also included, but they are also found in brackish water.
2. Marine Invaders - forms that enter both fresh and saltwater during part of their life history.
 - a. Anadromous - marine forms that return to freshwater to spawn. The most important group is the shad (American shad, hickory shad).
 - b. Catadromous - those fish that live generally in freshwater but migrate to coasts or open sea to spawn. The American eel is the most notable species in this group, while striped mullet could be placed between catadromous and the following amphidromous category.

c. Amphidromous - species that migrate but not for breeding purposes. Species included in this category are ladyfish, bay anchovy, and sturgeons.

d. Non-migrating - euryhaline species. Striped bass and stingrays are included in this category.

The St. Johns River system supports a diverse fish fauna of at least 174 species (Table B-27); 57 freshwater and 117 marine invaders. The sport and commercial fisheries of the system were valued at \$20 million in 1970 (FG&FWFC, 1970). Recently (1973-1976) the commercial fishery alone, in the vicinity of Palatka (Putnam County), was conservatively estimated to have an annual value of more than \$1.2 million from the landing of 1 to 2 million pounds of fish (FG&FWFC, 1977).

A 1970 (FG&FWFC) study, however, indicates that game and food fish production in the river could be much greater, citing a period of 20 years of declining landings. The depressed game and food fish resources of the river system are characterized by FG&FWFC (1970) data which show the percentage decline by weight for landings of the following fish: largemouth bass, 40; black crappie, 46; bluegill, 68; redear sunfish (shellcracker) 42; redbreast sunfish, 98; channel catfish, 48; and white catfish, 27 percent. However, the FG&FWFC (1970) data also show that total fishery productivity increased by a factor of more than two. The increase was attributed primarily to non-game fish which had the following percent weight increase in landings: longnose gar, 2640; gizzard shad, 477; Florida gar, 100; and various estuarine and marine fish, 109.

The commercial fishery of the river is dominated by catfish (White and Channel catfish) landings; however, the American eel, white mullet, striped mullet, red drum, and American shad are also important components of the landings. In 1974, nearly 90 percent of the commercial American shad and 98 percent of the American eel landings in Florida were from the St. Johns River. Blue crabs are also an important commercial fishery resource in the St. Johns River and are sought as far upstream as Lake George.

The causes of changes in the fish community structure of the St. Johns River are complex. Major factors which may contribute to these changes include municipal and industrial waste, watershed development and decay of water hyacinths, which contribute to eutrophic conditions. Other factors include run-off of pesticides, dredging, waterfront development, and restricted commercial fisheries operations.

Some of the more important game and/or sport fish include American shad and white and channel catfish, which are also major commercial species. Other important sport fish include largemouth bass, black crappie, striped bass, bluegill, redear sunfish, and several other species of sunfish (bream).

Recent field surveys revealed 59 species of fish from the St. Johns River in the vicinity of Palatka (Table B-28). During September 1977 and January 1978, two field surveys were conducted to gather site specific fisheries data. During these surveys, 37 species of fish were collected (Table B-28), 33 in September and 23 in January (many were common to both collections). Nearly half of the fish species collected may be classified as marine invaders. A total of 181 pounds and 142 pounds of fish (including shrimp and blue crabs), respectively were collected during the two surveys.

Game and food fish (including freshwater catfish, bass, crappie, bream, American shad, mullet, and flounder) accounted for 18 percent by number and 42 percent by weight of fish collected during the survey (Tables B-29 through B-36). By weight, the game and food fish were most abundant at downstream Transects C and D where they made up 45 and 56 percent of the catch, respectively. The abundance of game and food fish at Transects C and D may be due in part to the abundance of submerged aquatic vegetation. Transects near Rice Creek had a somewhat reduced game and food fish population of 32 and 37 percent by weight at Transect A and B, respectively. The reduced game and food fish at these transects

may be due in part to the poor water quality (including high nitrogen, specific-conductance and low D.O.) of Rice Creek (Section 2.3.1.4) and lack of submerged aquatic vegetation.

Blue crabs, bluegill, redear sunfish, largemouth bass, and striped mullet were collected at all transects. White catfish and black crappie were common but not taken in collections at Transect D. Non-game fish such as the gizzard shad and Florida gar were also collected from all transects. Largemouth bass of more than 3 pounds were collected at all transects and an 8 pound specimen was collected at Transect C.

Larval fish net surveys were conducted in February, March, and April 1978 to identify spawning and/or nursery areas and to determine their relative spatial and seasonal variation in the vicinity of the site. A total of 11 species of fish was collected during the three month larval fish survey (Table B-37). Approximately 99 percent of the fish were collected at night. The large night catches may be due in part to diurnal activity patterns of the small fish and net avoidance behavior during the day. No night collection was made during february.

Densities of fish from larval net collections were generally higher nearshore than offshore except for one case at Transect C and one at Transect D. Studies by Applied Biology Inc. (1976) indicated that larval fish densities in the St. Johns River near Palatka were very low from October through March; significantly higher in April and May and at their highest densities between June and September. During recent Dames & Moore studies, fish collected in larval net tows were least abundant at Transect B in March while the second smallest collection was made at the same transect in April (Table B-37). Similar trends were noted during the March seine surveys (Table B-38) at Transects A and B where the smallest collections were made. No statistically significant differences in abundance were found comparing total nearshore versus offshore collections.

The larval fish net collections were characterized by marine invaders with the exception of the gizzard shad (Table B-37). The bay anchovy was the most abundant fish collected, dominating at all stations except Station A-2 during the April survey. The blueback herring was the second most abundant fish in March and the Atlantic croaker, although not quite as abundant, was collected at most of the stations. The only valuable game and food fishes collected during the survey were the American eel, striped bass, and striped mullet which were never reported in large densities (Table B-37). Similarly the March seine collections were dominated by non-game fish, primarily the blueback herring, bay anchovy and an unidentified shiner (Table B-38). The species composition of the fish during the survey was significantly different from that found in studies by Applied Biology Inc. (1976), upstream. The threadfin shad, gizzard shad, naked goby, and hogchoker (all non-game fish) comprised more than 82 percent of all the fish collected during their survey. This difference may be attributed to several factors including water quality, seasonal variation, and significant differences in habitat between the two survey areas.

In summary, the submerged beds of aquatic vegetation at Transects C and D seem to contribute the most desirable habitat of the transects sampled for food and game fish. The most abundant game and food fish collected during the survey included the catfish, bass, bream, and mullet; while the non-game fish were generally dominated by shad and gar. Data from the larval fish net survey indicated that the most suitable habitat and highest densities of fish were nearshore in the vicinity of Transects C and D. However, there were no indications of either significant spawning grounds or nursery areas at any transect. Few food and game fish were collected during the larval net survey. The species found did not include threatened or endangered species (USDI, 1973, 1977) and were fairly typical of the species found in the St. Johns River.

2.7.2.4 Endangered Species

2.7.2.4.1 Fish

The only fish species listed as endangered which has been reported from the St. Johns River system is the shortnose sturgeon (Tech. Adv. Comm. on Endangered Species, 1977). This fish is very rare and only two specimens have been reported since 1949; the most recent collections being south of Palatka in 1977 (McLane, 1955, FG&FWFC, 1977). The decline in abundance of this fish has been attributed to pollution, overfishing (U. S. Department of Interior, 1973) and loss of spawning habitat due to navigation and flood control projects. The life history of the fish is not well known, but, it is believed that they reach sexual maturity in about five years and spawns in late April (Whitworth and others, 1968). McLane (1955) reported that it was not likely that this fish breeds in the St. Johns River system. Typical spawning habitats of turbulent waters in deep pools and over hard rocky bottoms are not found in the St. Johns River near Palatka.

Two species of fish reported from the St. Johns River system have been given a "threatened status" by the State of Florida (Tech. Adv. Comm. on Endangered Species, 1977) and the Florida Committee on Rare and Endangered Plants and Animals (1975). The threatened fish are the Atlantic sturgeon and the Lake Eustis minnow. The Lake Eustis minnow is the only fish endemic to the St. Johns River system; however, it is not known on the main stem of the river. The Atlantic sturgeon is as rare as the shortnose sturgeon in the St. Johns River system. The most recent collection of this fish in the St. Johns River system was in 1949 during a shad seining operation in Crescent Lake, Flagler County (McLane, 1955). The reasons for the decline in abundance of this fish are similar to those for the shortnose sturgeon. Its life history is now well known, although it is believed to reach sexual maturity after 10-12 years and spawn in early spring (Whitworth and others, 1968). McLane (1955)

reported that it was also unlikely that this fish breeds in the St. Johns River system. Typical spawning habitats of turbulent waters in deep pools and over hard rocky bottoms as, noted above, are not located in the St. Johns River near Palatka.

Several species of fish reported from the St. Johns River system have been designated as rare or "of special concern" by the Florida Committee on Rare and Endangered Plants and Animals (1975). The species designated as rare include the sea lamprey, shortnose sturgeon, eastern mudminnow, snail bullhead, opossum pipefish, mud sunfish, blackbanded sunfish, mountain mullet, and the river goby. The dusky shiner and bluenose shiner are designated as "species of special concern". The shortnose sturgeon is the only fish on this list which is also listed by Federal or State Agencies (Florida threatened and endangered species list, 1977; U. S. Department of Interior, 1977). All of these fish are considered to be rare in the St. Johns River system with the exception of the snail bullhead (Table B-27) and none of these fish have been reported recently from the St. Johns River near Palatka (Table B-28) nor have they been collected in sampling conducted at the site.

2.7.2.4.2 Aquatic Mammals

The West Indian (Florida) manatee (Trichechus manatus latirostris) is a large aquatic mammal that is currently listed as a threatened species by the state and an endangered species by the U. S. Fish and Wildlife Service. The manatee once ranged extensively throughout the southeastern coastal areas of the United States (Husar, 1974). The current population is around 1000 individuals, most of which are in Florida. Population decline was primarily due to overhunting by man for meat; more recently they have been totally protected, and poaching is a minor problem (Peterson, 1974). Current mortalities are due to collisions with boats and barges (Campbell, 1976).

U. S. Fish and Wildlife Service laboratory manatee records for 1974-75 show scattered manatee sightings from Rice Creek south to Palatka (Campbell, 1976). Concentrations of ten or more individuals were found at Palatka. The mammals feed on aquatic macrophytes which are generally scarce in the areas nearest the Putnam Site. Therefore, the manatee may be expected to travel in the St. Johns River near the Putnam Site but probably does not stay in this area for long periods of time due to a general lack of forage food.

2.7.2.5 References

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Table 2.7-1

Mean Basal Area, Relative Frequency, Relative Density, and
Relative Dominance for Trees Comprising the Overstory of the
Sandhill Community (Turkey Oak Phase)

<u>Scientific Name</u>	<u>Common Name</u>	<u>Mean Basal Area Per Tree</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Relative Dominance</u>	<u>Importance Value</u>
<u>Quercus laevis</u>	Turkey oak	59.4	66.7	82.5	86.9	236.1
<u>Pinus palustris</u>	Longleaf pine	42.1	33.3	17.5	13.1	63.9

Table 2.7-2

Herbaceous Ground Cover
(Sandhill Community)

<u>Scientific Name</u>	<u>Common Name</u>	<u>Percent Cover</u>	<u>Absolute Frequency</u>
<u>Aristida</u> sp.	Three awn grass	18	90
<u>Agrostis perennans</u>	Bent grass	>1	20
<u>Aster</u> sp.	Aster	>1	10
Lichen	Lichen	14	40
<u>Serenoa repens</u>	Saw palmetto	17	50
<u>Cassia</u> sp.	Partridge pea	>1	20
<u>Andropogon</u> sp.	Brown sedge	>1	10

Table 2.7-3

Relative Frequency, Relative Density, and Relative Dominance
for Trees Comprising the Overstory of the
Bayhead Forest Community

<u>Scientific Name</u>	<u>Common Name</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Relative Dominance</u>	<u>Importance Value</u>
<u>Pinus serotina</u>	Pond pine	50	70.0	63.3	183.3
<u>Pinus elliottii</u>	Slash pine	10	10.0	23.2	43.2
<u>Persea borbonia</u>	Red bay	25	12.5	11.3	48.8
<u>Ilex coriacea</u>	Gallberry	10	5.0	1.5	16.5
<u>Magnolia virginiana</u>	Sweetbay	5	2.5	0.7	8.2

Table 2.7-4

Mean Basal, Relative Frequency, Relative Density, Relative Dominance, and Importance Values for Trees Comprising the Overstory of the Hardwood and Cypress Swamp Community

<u>Scientific Name</u>	<u>Common Name</u>	<u>Mean Basal Area Per Tree</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Relative Dominance</u>	<u>Importance Value</u>
<u>Liquidambar styraciflua</u>	Sweetgum	92.4	26.5	35.7	40.2	162.0
<u>Fraxinus caroliniana</u>	Pop ash	92.3	13.3	14.3	16.0	73.2
<u>Nyssa aquatica</u>	Water tupelo	150.78	13.3	10.7	19.7	73.3
<u>Persea borbonia</u>	Redbay	13	4.4	3.6	0.6	18.7
<u>Acer rubrum</u>	Red maple	64.7	13.3	10.7	8.4	62.0
<u>Taxodium distichum</u>	Bald-cypress	56	8.8	7.1	4.9	40.6
<u>Quercus nigra</u>	Water oak	77	4.4	3.6	3.3	21.2
<u>Magnolia virginiana</u>	Sweetbay	32	7.3	7.1	2.8	38.5
<u>Ulmus americana</u>	American elm	64	4.4	3.6	2.8	20.7
<u>Quercus phellos</u>	Willow oak	31	4.4	3.6	1.3	19.2

Table 2.7-5

Understory
(Hardwood and Cypress Swamp)

<u>Scientific Name</u>	<u>Common Name</u>	<u>Density (plants/acre)</u>	<u>Relative Frequency</u>
<u>Fraxinus caroliniana</u>	Pop ash	121	22.5
<u>Castanea alnifolia</u>	Chinquapin	2,308	22.5
<u>Acer rubrum</u>	Red maple	688	22.5
<u>Sambucus canadensis</u>	Elderberry	1,943	10.9
<u>Taxodium distichum</u>	Bald cypress	81	10.9
<u>Liquidambar styraciflua</u>	Sweetgum	81	10.9

Table 2.7-6

Herbaceous Ground Cover
(Hardwood and Cypress Swamp)

<u>Scientific Name</u>	<u>Common Name</u>	<u>Percent Cover</u>	<u>Relative Frequency</u>
<u>Carex</u> sp.	Carex	2.2	3.5
<u>Rhus radicans</u>	Poison ivy	0.06	14.4
<u>Centella asiatica</u>	Centella	0.01	3.5
<u>Osmunda regalis</u>	Royal fern	0.37	7.1
<u>Hydrocotyle</u> sp.	Pennywort	22.09	14.4
<u>Gratiola neglecta</u>	Hedge hyssop	2.2	3.5
<u>Diodia virginiana</u>	Buttonweed	2.2	3.5
<u>Carex stricta</u>	Carex	0.01	3.5
<u>Polypodium</u> sp.	Fern	4.45	14.4
<u>Saururus cernuus</u>	Lizard's tail	5.8	10.6
<u>Panicum</u> sp.	Panic grass	0.01	3.5
<u>Parthenocissus quinquefolia</u>	Virginia creeper	0.03	7.1
<u>Pontederia cordata</u>	Pickernelweed	2.26	3.5
<u>Rubus</u> sp.	Brier-berry	0.36	3.5
<u>Sphagnum</u> sp.	Peat moss	0.36	3.5

Table 2.7-7

Amphibians and Reptiles Observed on the Putnam Site

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>UPLAND HABITAT</u>	<u>BOTTOMLAND HABITAT</u>
Testudinidae	<u>Gopherus polyphemus</u>	Gopher Tortoise	C	-
Iguanidae	<u>Anolis carolinensis</u>	Green Anole	C	U
	<u>Sceloporus undulatus</u>	Fence Lizard	C	-
Scinidae	<u>Leiopisma laterale</u>	Ground Skink	U	-
Colubridae	<u>Coluber constrictor priapus</u>	Southern Black Racer	U	-
Plethodontidae	<u>Plethodon glutinosus</u>	Slimy Salamander	-	U
	<u>Eurycea quadridigitata</u>	Dwarf Salamander	-	U
Bufonidae	<u>Bufo americanus</u>	American Toad	C	U
	<u>Bufo terrestris</u>	Southern Toad	C	U
Hylidae	<u>Hyla squirella</u>	Squirrel Treefrog	-	C
	<u>Limnaeodius ocularis</u>	Little Grass Frog	-	U
Ranidae	<u>Rana utricularis</u>	Southern Leopard Frog	-	C

Notes: Upland Habitats: Sandhill Community, Pine Flatwoods, Pine Plantations, Oak Hammocks.
 Bottomland Habitats: Bayhead Forest, Cypress Heads, Hardwood and Cypress Swamp.
 A = Abundant, C = Common, U = Uncommon

Taxonomic Source: Conant, 1975.

Table 2.7-8

Birds Observed on the Putnam Site

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>UPLAND HABITAT</u>	<u>BOTTOMLAND HABITAT</u>
Cathartidae	<u>Cathartes aura</u>	Turkey Vulture	A	A
	<u>Coragyps atratus</u>	Black Vulture	C	C
Accipitridae	<u>Buteo jamaicensis</u>	Red-tailed Hawk	C	C
Meleagrididae	<u>Meleagris gallopavo</u>	Turkey	-	C
Phasianidae	<u>Colinus virginianus</u>	Bobwhite	C	-
Columbidae	<u>Zenaidura macroura</u>	Mourning Dove	C	-
	<u>Columbigallina passerina</u>	Ground Dove	C	-
Cuculidae	<u>Coccyzus americanus</u>	Yellow-billed Cuckoo	-	C
Strigidae	<u>Otus asio</u>	Screech Owl	-	U
	<u>Strix varis</u>	Barred Owl	-	U
Caprimulgidae	<u>Caprimulgus carolinensis</u>	Chuck-will's-widow	-	C
Apodidae	<u>Chaetura pelagica</u>	Chimney Swift	C	-
Picidae	<u>Colaptes auratus</u>	Common Flicker	C	-
	<u>Dryocopus pileatus</u>	Pileated Woodpecker	U	C
	<u>Centurus carolinus</u>	Red-bellied Woodpecker	C	C
	<u>Dendrocopos villosus</u>	Hairy Woodpecker	U	U
	<u>Dendrocopos pubescens</u>	Downy Woodpecker	U	U
Tyrannidae	<u>Tyrannus tyrannus</u>	Eastern Kingbird	U	C
	<u>Sayornis phoebe</u>	Eastern Phoebe	U	-

Table 2.7-8 (Continued)

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>UPLAND HABITAT</u>	<u>BOTTOMLAND HABITAT</u>
Corvidae	<u>Cyanocitta cristata</u>	Blue Jay	A	A
	<u>Corvus brachyrhynchos</u>	Common Crow	A	A
	<u>Corvus osifragus</u>	Fish Crow	U	U
Paridae	<u>Parus bicolor</u>	Tufted Titmouse	U	A
Troglodytidae	<u>Thryothorus ludovicianus</u>	Carolina Wren	U	U
Mimidae	<u>Mimus polyglottos</u>	Mockingbird	A	A
	<u>Dumetella carolinensis</u>	Gray Catbird	C	C
	<u>Toxostoma rufum</u>	Brown Thrasher	C	C
Turdidae	<u>Turdus migratorius</u>	American Robin	U	U
	<u>Catharus guttatus</u>	Hermit Thrush	-	U
Sylviidae	<u>Poliophtila caerulea</u>	Blue-gray Gnatcatcher	U	C
Bombycillidae	<u>Bombycilla cedrorum</u>	Cedar Waxwing	U	-
Laniidae	<u>Lanius ludovicianus</u>	Loggerhead Shrike	A	-
Vireonidae	<u>Vireo griseus</u>	White-eyed Vireo	-	C
Parulidae	<u>Mniotilta varia</u>	Black-and-white Warbler	U	U
	<u>Dendroica coronata</u>	Yellow-rumped Warbler	U	U
	<u>Dendroica dominica</u>	Yellow-throated Warbler	U	U
	<u>Dendroica pinus</u>	Pine Warbler	C	-
	<u>Setophaga ruticilla</u>	American Redstart	-	U
Thrapidae	<u>Piranga rubra</u>	Summer Tanager	U	-

Table 2.7-8 (Continued)

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>UPLAND HABITAT</u>	<u>BOTTOMLAND HABITAT</u>
Fringillidae	<u>Cardinalis cardinalis</u>	Cardinal	C	C
	<u>Pipilo erythrophthalmus</u>	Rufous-sided Towhee	C	C
	<u>Passerculus sandwichensis</u>	Savannah Sparrow	U	-
	<u>Spizella pusilla</u>	Field Sparrow	U	-
	<u>Zonotrichia albicollis</u>	White-throated Sparrow	U	-

Notes: Upland Habitats: Sandhill Community, Pine Flatwoods, Pine Plantations, Oak Hammocks.
 Bottomland Habitats: Bayhead Forest, Cypress Heads, Hardwood and Cypress Swamp.
 A = Abundant, C = Common, U = Uncommon

Taxonomic Source: Robbins et. al., 1966

Table 2.7-9

Mammals Occurring on the Putnam Site

<u>FAMILY</u>	<u>SCIENTIFIC NAME</u>	<u>COMMON NAME</u>	<u>UPLAND HABITAT</u>	<u>BOTTOMLAND HABITAT</u>
Didelphiidae	<u>Didelphis marsupialis</u>	Opposum	C	C
Talpidae	<u>Scalopus aquaticus</u>	Eastern Mole	C	-
Procyonidae	<u>Procyon lotor</u>	Raccoon	A	A
Canidae	<u>Urocyon cinereoargenteus</u>	Gray Fox	U	C
	<u>Canis familiaris</u>	Domestic Dog	C	C
Felidae	<u>Lynx rufus</u>	Bobcat	-	U
	<u>Felis domesticus</u>	Domestic Cat	U	U
Sciuridae	<u>Sciurus carolinensis</u>	Gray Squirrel	-	C
	<u>Sciurus niger</u>	Fox Squirrel	U	-
Cricetidae	<u>Peromyscus gossypinus</u>	Cotton Mouse	-	U
Leporidae	<u>Sylvilagus floridanus</u>	Cottontail	C	-
Suidae	<u>Sus scrofa</u>	Hog	A	A
Cervidae	<u>Odocoileus virginianus</u>	Whitetail Deer	C	C
Dasypodidae	<u>Dasypus novemcinctus</u>	Armadillo	A	A

Notes: Upland Habitats: Sandhill Community, Pine Flatwoods, Pine Plantations, Oak Hammocks.
 Bottomland Habitats: Bayhead Forest, Cypress Heads, Hardwood and Cypress Swamp.
 A = Abundant, C = Common, U = Uncommon

Taxonomic Source: Burt and Grossenheider, 1976.

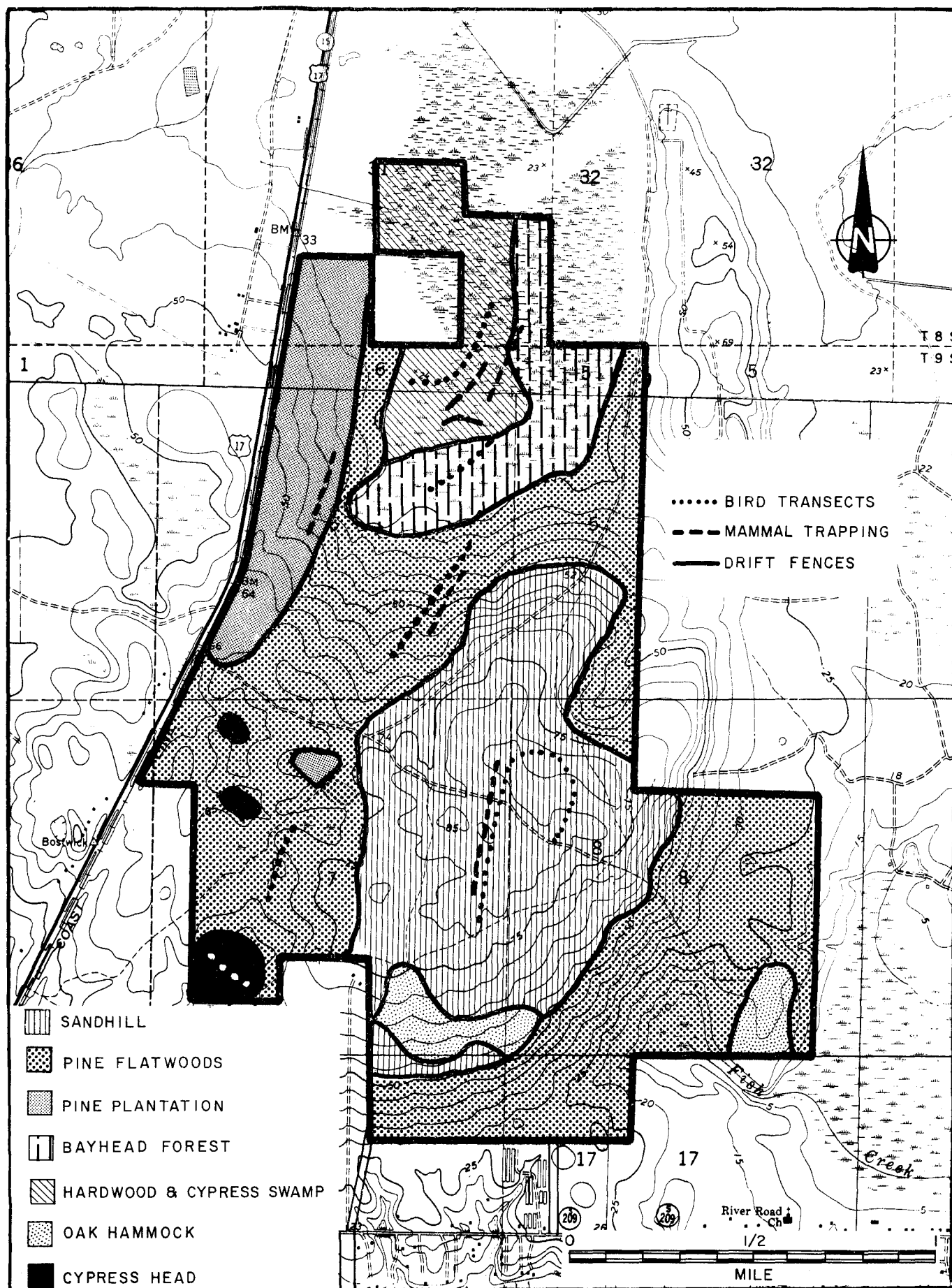


Figure 2.7-1. Vegetation and Habitat Map

2.8 LAND USE

2.8.1 Regional Overview

The Putnam Site lies within the Southern Florida Flatwoods land resource region, an area of approximately 17,900 square miles. The eastern portion of this area extends along the coast of Florida (north to south) from Jacksonville to Miami and extends inland (east to west) from 10 to 50 miles. The nearly level sandy coastal plain of the area varies in elevation from sea level along the coast to 100 feet inland. Prominent landscape features of swamps, marshes, lakes, and streams occur extensively throughout the area (Austin, 1967).

Approximately 90 percent of the southern Florida Flatwoods region is in private ownership with the remainder in State and National forests, game refuges and military facilities. Many of the land holdings are large with minor areas organized into operating farm units. More than 25 percent of the area is in forests which are used extensively for grazing purposes. Approximately 50 percent of the area is used for pasture although only about 25 percent of this pasture has a high carrying capacity for livestock. The remaining area consists of mixed managed and native rangeland vegetation. About 5 percent of the total area is cropped, with citrus fruits and winter vegetables important cash crops (Austin, 1967).

2.8.1.1 Putnam County Land Use

Land use in Putnam County in 1972 was dominated by forest and wetland area classifications (Table 2.8-1). Upland forests covered approximately 40 percent of Putnam County and 25 percent of the county was classified as forested wetlands; thus almost 65 percent of the county is in forest cover. Agricultural and water areas were next most widespread in the county, comprising approximately 13 and 10 percent of total land use, respectively. Most of the agricultural classifications were cropland and pasture acreages, with rangeland classification comprising only 2 percent of the county's land area. Urban and developed land,

mainly residential, was 5 percent of the county area. Barren land, was 4 percent of the county and was composed mainly of areas in transition to other uses such as subdivisions, cropland, and planted pine plantations.

2.8.1.2 Soils

Soil characteristics are a good indicator of potential uses of land and provide an insight into current land use alternatives. In many cases urban development patterns and agricultural activities are closely related to soil types. County soil maps indicate that approximately 45 percent of Putnam County is suitable for urban and community development of a general nature. However, much of the development area is not suitable for sanitary facilities such as septic tanks and sewage lagoons normally associated with residential units, therefore limiting development potential for this use (Division of State Planning, 1973). Agricultural development potential of the soils in the county is only moderate, with 57 percent of the soils suitable for improved pasture uses and 37 percent suitable for cropland uses. The Division of State Planning's general soils atlas of the county indicates that improved pasture uses appear most suitable in the county since a larger percentage of the soils possess characteristics necessary for this use. Approximately 46 percent of the counties' soils have high to moderate potential for pine forest production (Division of State Planning, 1973).

2.8.1.3 Agriculture

Agriculture in Putnam County is diminishing in importance relative to other economic sectors (Kellum, Patterson, and Bell, Inc., 1977). The losses in the agricultural sector are manifest in changes in land use by agricultural activities, such as the total number of farms in the county and the amount of land in farms. Table 2.8-2 presents significant agricultural characteristics of the county for the years 1969 and 1974. The table reveals that land used for agricultural activities declined during the five year period with the total land in farms declining by 42

percent and the average size of farms decreasing by 40 percent. Similarly, the amount of cropland, pasture, and woodland on farms decreased as did the amount of livestock in the county.

2.8.1.4 Land Ownership

Putnam County is dominated by large single ownerships of land. A 1970 study found that 21 owners controlled approximately 60 percent of the rural land in the county (Alleger, 1970). Much of the land is owned by pulpwood and paper companies who manage the land for longterm returns on forestry products. It is likely that future expansion of these companies would entail the conversion of more land into tree farming plots.

2.8.2 Land Use Within 5 Miles of the Site

Land use within 5 miles of the site is depicted in Figure 2.8-1. Analysis of the areal extent of the land uses with the five mile radius is shown in Table 2.8-3. Over 60 percent of the land is forested in evergreens or wetland hardwood types. Cropland and pasture uses covered 6285 acres or about 12.5 percent of the area. Only about 1400 acres was in urban development and the majority of this, 1100 acres, was residential in nature. There are no military facilities of major importance within 5 miles of the site.

Land uses/cover in the immediate site vicinity (Figure 2.8-2) are generally similar to those found throughout the county. Residential areas along the St. Johns River, south of the site, and along U.S. Route 17 are the most notable concentrations of urban development. Some intensive agricultural operations occur in the site vicinity. These uses include poultry and fishing operations along the southern site boundary, improved pasture uses east and south of the site, and a planted pine forest east of the site.

2.8.2.1 Industrial Development

The county's largest industrial concern, the Hudson Pulp and Paper Company, is located approximately 3.4 miles southwest of the site. The

pulp mill covers approximately 275 acres with 90 acres of associated water treatment reservoirs nearby. Rail connections to the plant include spurs to the Seaboard Coast Line Railroad (north-south) and the Southern Railway (east-west), as well as spurs to the St. Johns River Barge Port. Rice Creek also provides barge access to the plant from the St. Johns River.

Florida Power & Light's Putnam and Palatka plants, located on the St. Johns River approximately 7 miles south of the proposed site, are the nearest electric power generating facilities. Both plants are oil-fired, but only the Putnam plant is operational. The old Palatka plant has been retired.

2.8.2.2 Recreation

The St. Johns River is a significant recreational attraction of Palatka and Putnam County. Palatka is known as the "Bass Capitol of the World" and has been the site of many bass fishing tournaments. Fishing camps are numerous on the river, but the heaviest concentration occurs south of Palatka rather than in the Putnam Site vicinity. Only about 3 camps are located along the river in the site vicinity. The river also provides recreational opportunities for other water sports such as pleasure boating and water skiing. Residential and second-home development along the river is prominent, and the area is expected to remain an attractive locale for such development. No other significant recreational attractions are found within the site vicinity.

Discussion of dedicated lands may be found under Section 2.8.4 - Historic, Scenic, Cultural and Natural Landmarks.

2.8.2.3 Onsite Land Use

Historically, the site has never been used intensively for agricultural activities or urban development, but has generally served as rangeland or timberland. Existing land uses and land cover in the

immediate site vicinity are shown in Figure 2.8-2. The site is presently used for foraging operations and has recently been timbered. No urban uses or intensive agricultural operations occur on the site.

Figure 2.8-3 displays rural land use potential ratings for food crop production, forage for livestock, and timber production for areas on the site. Most of the site has a good potential for forage and timber production, while potential food crop suitability appears lowest. No prime or unique agricultural land is found on the site (Florida Department of Administration, Division of State Planning, 1974).

2.8.3 Future Land Use

2.8.3.1 Zoning and Ownership Influences

Land use in the site vicinity is expected to remain much as it is at present. Putnam County is not expected to experience development pressures as intensely as other counties in the coastal zone. Much of the land in the county is owned by pulp and paper companies, assuring perpetuation of this land in a forested state. However, this land may be considered as being unavailable for development, forcing development of acreage now in private ownership. Most of the area north and southwest of the plant is held by private individuals rather than companies or corporations. Those companies owning land east of the site vicinity are mainly concerned with cattle operations, so large scale development of the property is unlikely.

Since much of the area in the site vicinity is zoned as agricultural or open rural land, rezoning would be necessary for its development. Zoning of the area, then, gives the county the opportunity to control development and to prevent conflicting uses.

Ownership density of lands in the site vicinity and along the St. Johns River is depicted in Figure 2.8-4. The figure also shows which lands have been platted and are under development for residential uses. It is likely that these areas will be the first lands in the site vicinity to be developed. In general, these areas are sufficiently distant from the site to avoid conflicts.

2.8.3.2 Land Use Planning Activities

The Coastal Zone Management effort in Florida has produced development criteria on lands within the Coastal Zone in which the site is located. Figure 2.8-5 indicates three classifications: Development, Conservation, and Preservation of land on the site.

The following nine factors are considered before any area is classified:

- Present land and water use
- Geological factors
- Water classifications
- Ecological significance and tolerance to alteration
- Susceptibility to flooding
- Soils suitability
- Archeological and historical significance
- Unique environmental factors
- Legal constraints

The preservation area is 11 percent of the site while conservation and development areas comprise 43 percent and 46 percent of the site, respectively.

The area designated for preservation on the site is a resource subcategory, freshwater swamp or marsh. Priority uses of this area are designated as open space, wildlife habitats, freshwater retention, possible water recharge, and water quality functions. General state policy on these areas is to discourage development unless the development is not contrary to the public interest (Jacksonville Area Planning Board, 1975).

The lands of conservation status on the site are of resource subcategorized marginal lands, areas that, due to soil characteristics or other physical restrictions, require special treatment in order to be made suitable for urban development. The priority use of this land is recreation, wildlife habitat, open space, timber production, and

agricultural or grazing activity not requiring drainage or pumping. Development is permitted when no other alternatives are available. The state's objective is to ensure that adequate precautions and corrective measures are undertaken before development is allowed to occur.

Land categorized for development on the site is undeveloped land suitable for intensive development. No restrictions are placed on the area other than that suitable environmental safeguards are realized during the development. Further descriptions of biophysical categories are contained in Figure 2.8-5.

2.8.4 Historic, Scenic, Cultural, and Natural Landmarks

2.8.4.1 Public Lands

The nearest State Park, Ravine Gardens, is south of the city of Palatka and 7 miles south of the site (Figure 2.8-6). The park is 182 acres in area and features picnic facilities and nature trails in ornamental gardens. Park attendance for the year 1976-1977 totalled 148,296 visitors (Department of Natural Resources, 1976).

The Hudson Wildlife Management Area and the Rice Creek Sanctuary comprise 13,000 acres approximately 4.7 miles southwest of the site. The 2,000-acre Rice Creek Sanctuary contains a section of the Florida Trail, a hiking path running from Gold Head State Park to the Ocala National Forest, and the remaining of a Revolutionary-period rice and indigo plantation. The Sanctuary is surrounded by the 11,000-acre Hudson Wildlife Management Area. This is a cooperative public hunting (deer and small game) area managed jointly by the Hudson Pulp and Paper Company and the Florida Game and Fresh Water Fish Commission (Florida Game and Fresh Water Fish Commission, 1965).

2.8.4.2 Archeological and Historical Resources on Site

Between November 1977 and May 1978 a survey was conducted to identify, locate, and assess cultural resources on the Putnam Site in accordance with 36 CFR 800, "Procedures for the Protection of Historic and Cultural Properties." The survey area comprised some 2,380 acres and included the Putnam Site proper as well as three potential outfall corridors to the St. Johns River (Figure 9.3-2).

Archeological field work involved surface survey and subsurface testing for cultural resources based upon existing knowledge of pre-historic and historic site distribution in terms of natural landscape features. Data derived from study of previously known site locations recorded in the literature and the Florida Master Site File at the Division of Archives, History, and Records Management were compared with information about the tract taken from contour, soil, and vegetation maps, as well as recent large-scale aerial photographs to suggest likely site locations. The resulting locations were examined by surface survey and posthole testing.

Concurrently, a historic documents study was conducted to reveal information about human habitation or utilization of the tract in the past 500 years. Published historical studies, travellers' accounts, federal and state land records, Spanish land grants, county property and tax records, and historical maps and plats were examined in Tallahassee and Palatka. Little activity of historical significance has been recorded for the study area, and no sites of National Register importance were indicated by the documents. During the field survey, several areas on the tract showed evidence of late historic period habitation, consisting of two or three farmstead sites dating to the late nineteenth and early twentieth century. Probable dates of occupation and names of owners of these sites were established.

Two prehistoric shell middens were found on the bank of the St. Johns River in outfall Corridor B (Figure 9.3-2). These middens were small, partially eroded, but otherwise undisturbed. These sites contain intact stratigraphy and, being likely to yield information important in prehistory, must be considered eligible for inclusion in the National Register of Historic Places.

The Putnam Site and outfall Corridors A or C could be used for the proposed purpose without adverse impact upon existing or potential National Register or otherwise significant sites.

Appendix J contains the complete archeological and historical resources survey report.

There are several public boat ramps on the St. Johns River in the vicinity of the site. The locations of these ramps are depicted in Figure 2.8-7. In addition, the Riverdale County Park and Recreation area on the eastern shore of the St. Johns River in St. Johns County is approximately 7 miles northwest of the site.

2.8.4.3 National Register Sites

The nearest National Register sites are located in Palatka, approximately 5 miles south of the Putnam Site. The two sites, the Bronson-Mulholland House and the St. Marks Episcopal Church, located on 2nd Street in Palatka, were nominated to the Register in 1972 and 1973, respectively.

2.8.5 References

- Alleger, H. F., 1970, Florida's land ownership. University of Florida, Gainesville.
- Austin, M. E., 1972, Land resource regions and major land resource areas of the United States. Soil Conservation Service, Washington.
- Florida Department of Administration, Division of State Planning, 1974, Land use potential maps, Daytona SW., Gainesville.
- Florida Department of Natural Resources, 1976, Park attendance figures. Tallahassee.
- Florida Game and Fresh Water Fish Commission, 1965, Hudson Game Management Area. Department of Natural Resources, Tallahassee.
- Jacksonville Area Planning Board, 1975, Coastal zone management atlas. Jacksonville.
- Kellem, Patterson and Bell Inc., 1977, Putnam County comprehensive plan. Putnam County, Florida.

Table 2.8-1
Putnam County Land Use, 1972

<u>Level I Classification</u>	<u>Percent of County</u>	<u>Predominant Level II Classification</u>
Urban or Builtup Land	5.3	Residential
Agriculture	13.1	Cropland/Pasture
Rangeland	2.2	Herbaceous
Forest Land	39.9	Evergreen
Water	10.4	Streams/Lakes
Wetland	25.1	Forested
Barren Land	4.0	Transitional Area

Source: Analysis of 1972 Florida Land Use Development Analysis
Maps (LUDA) State of Florida Division of State Planning.

Table 2.8-2

Agricultural Characteristics of Farms With Sales over \$2500,
Putnam County, Florida

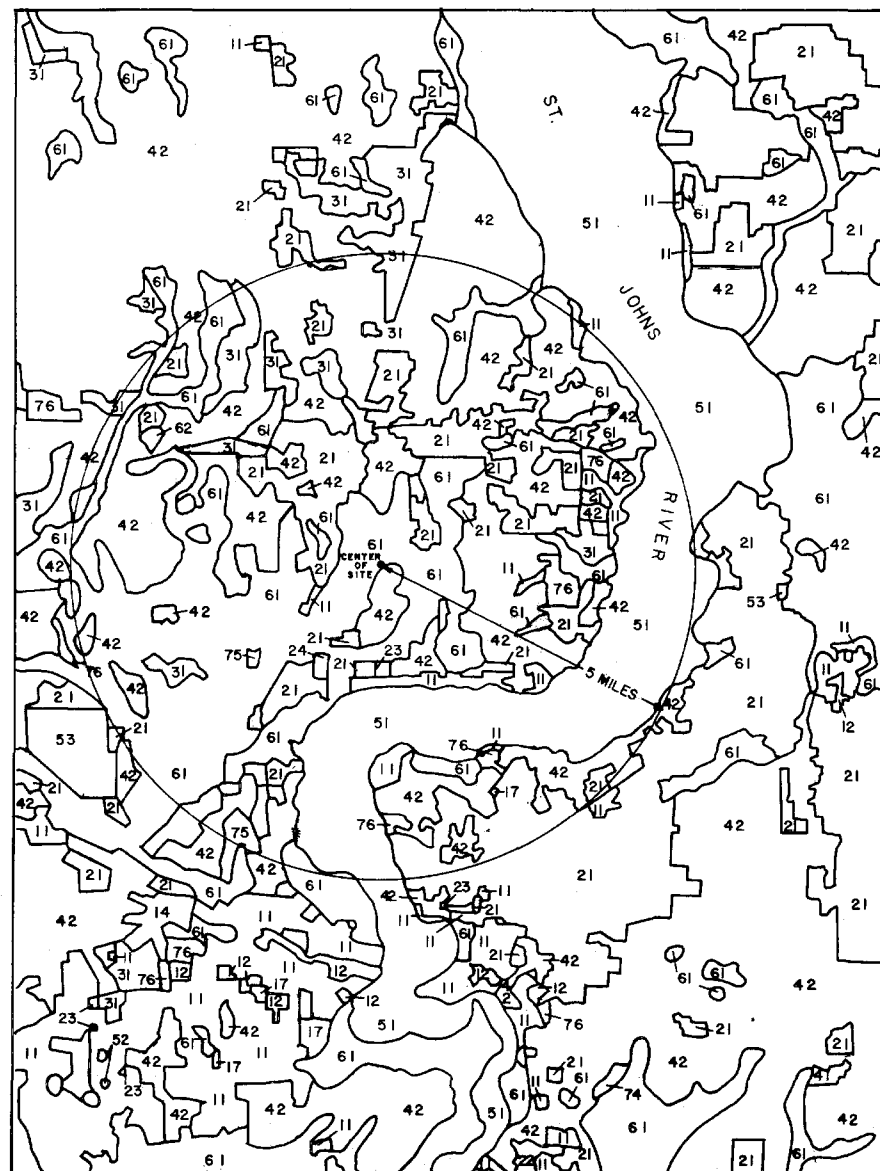
	<u>1974</u>	<u>1969</u>	<u>Percent Change 1969-1974</u>
Number of Farms	212	220	-4
Land in Farms (A)	148,380	256,640	-42
Average Size of Farm (A)	700	1,167	-40
Total Cropland	21,635	24,579	-12
Harvested Cropland	11,362	13,514	-16
Cropland Use for Pasture	8,854	7,970	+11
All Other Cropland	1,419	3,095	-54
Woodland and Woodland Pasture	107,185	176,080	-39
Irrigated Land	4,239	9,116	-54
Number of: Cattle and Calves	14,782	20,261	-27
Hogs and Pigs	415	1,909	-78

Source: U. S. Department of Commerce, Bureau of the Census.
1974 Census of Agriculture, Florida.

Table 2.8-3
Land Use Within 5 Miles of the Site

<u>Mapping Unit</u>	<u>Classification</u>		<u>Percent of 5 Mile Area</u>	<u>Acreage</u>
	<u>Level I</u>	<u>Level II</u>		
11	Urban & Builtup	Residential	2	1,100
12	Urban & Builtup	Commercial Services	1>	130
13	Urban & Builtup	Industrial	1>	140
17	Urban & Builtup	Other	1>	55
21	Agricultural	Cropland/Pasture	13	6,285
23	Agricultural	Confined Feeding Operations	1>	40
24	Agricultural	Other	1>	65
31	Rangeland	Herbaceous	4>	1,880
42	Forest	Evergreen Forest	32	15,785
51	Water	Streams & Canals	17	8,755
61	Wetland	Forest Wetland	31	15,415
75	Barren Land	Quarries/Gravel Pits	1>	140
76	Barren Land	Transitional Areas	1>	445

Source: Analysis of 1972 Florida Land Use Development Analysis Maps (LUDA).
State of Florida Division of State Planning.



CLASSIFICATION CATEGORIES

1 URBAN OR BUILT-UP LAND

- 11 Residential
- 12 Commercial and Services
- 13 Industrial
- 14 Transportation, Communications and Utilities
- 15 Industrial and Commercial Complexes
- 16 Mixed Urban or Built-up Land
- 17 Other Urban or Built-up Land

2 AGRICULTURAL LAND

- 21 Cropland and Pasture
- 22 Orchards, Groves, Vineyards, Nurseries, and Ornamental
- 23 Confined Feeding Operations
- 24 Other Agricultural Land

3 RANGELAND

- 31 Herbaceous Rangeland
- 32 Shrub and Brush Rangeland
- 33 Mixed Rangeland

4 FOREST LAND

- 41 Deciduous Forest Land
- 42 Evergreen Forest Land
- 43 Mixed Forest Land

5 WATER

- 51 Streams and Canals
- 52 Lakes
- 53 Reservoirs
- 54 Bays and Estuaries

6 WETLAND

- 61 Forested Wetland
- 62 Nonforested Wetland

7 BARREN LAND

- 71 Dry Salt Flats
- 72 Beaches
- 73 Sandy Areas Other than Beaches
- 74 Bare Exposed Rock
- 75 Strip Mines, Quarries, and Gravel Pits
- 76 Transitional Areas
- 77 Mixed Barren Land

SOURCE: U.S.G.S. LAND USE AND LAND COVER, 1972.
DAYTONA BEACH, FLORIDA IN CONJUNCTION
WITH FLORIDA DIVISION OF STATE PLANNING.

2 1 0 3
SCALE IN MILES

Figure 2.8-1. Land Use within 5 Miles of the Site.

REVISED 3/15/79



SOURCE: LAND USE/COVER ANALYSIS, JACKSONVILLE AREA PLANNING BOARD

LEGEND:

- 1-Low Density Residential
- 2-Med. Density Residential
- 3-Improved Pasture
- 4-Planted Pine
- 5-Confined Feeding Operation
- 6-Forest
- 7-Borrow Pit
- 8-Transitional Area

Figure 2.8-2. Selected Land-Use and Land Cover Designations.

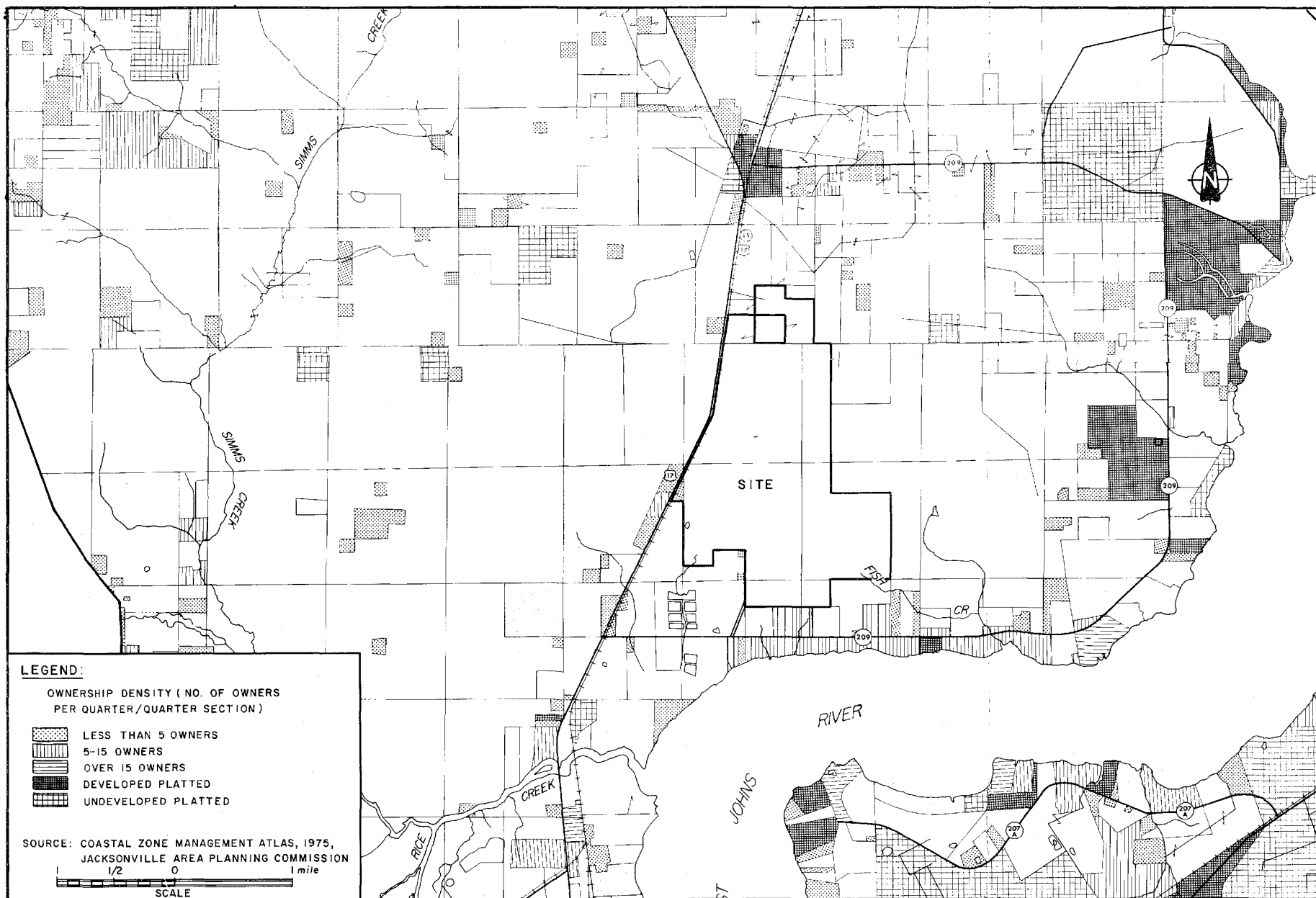
REVISED 3/15/79



SOURCE: LAND USE / COVER ANALYSIS, JACKSONVILLE AREA PLANNING BOARD

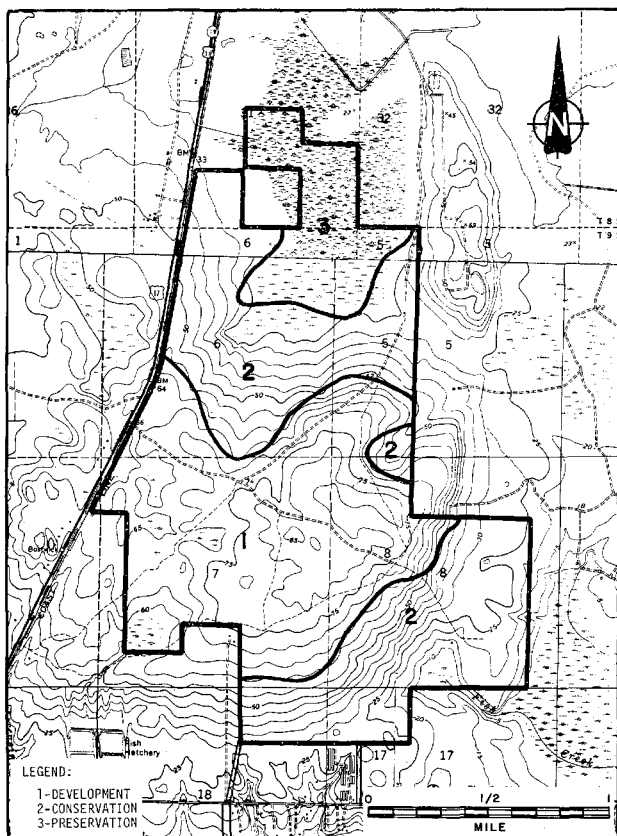
LEGEND	
SUITABILITY	CATEGORY
1-Good	Foodcrops
2-Fair	3 2 2
3-Poor	Pasture
	Woodland

Figure 2.8-3. Rural Land Use Potentials.



REVISED 3/15/79

Figure 2.8-4. Ownership Density - Site Vicinity.



1 Development Category

Undeveloped Lands Suitable for Intensive Development

Priority Use: Development, according to local desires and needs, utilizing environmental safeguards.

Description: Land which, if they are required for development, needs little or no modification prior to such development. These areas have elevations, soils, topography and other physical conditions favorable for development (with the addition of proper sanitary facilities).

State's Objectives: To assist local planning and zoning officials, developers and landowners in determining those areas best suited to development and assure that development occurs in a fashion that is compatible with the physical environment.

Regulatory Agencies: County and Local Governments.

2 Conservation Category

Marginal Lands

Priority Use: Recreation, greenbelts/open space, timber production; extensive agriculture/grazing, if these activities do not require draining or pumping; wildlife habitat, development when no other alternative areas exist.

Description: Land, which due to soil characteristics, drainage problems, or other physical restrictions, require special treatment in order to be made suitable for urban development.

State's Objectives: To assure that development in these areas adequately considers the physical limitations involved and does not result in direct or indirect consequences harmful to the public health, safety, and welfare.

General State Policy: State policy shall be to encourage local government to adopt adequate policies regulating development in these areas, to require the use of central sewage systems where feasible, and to assure that appropriate precautions are taken during landscape modifications.

Regulatory Agencies: Florida Department of Community Affairs (Federal Flood Insurance Program)

3 Preservation Category

Selected Freshwater Marshes & Selected Freshwater Swamps

Priority Use: Open Space, wildlife habitat, freshwater retention, possible water recharge, water quality functions.

Description: Low, poorly-drained areas characterized by water tolerant vegetation. Included are swamps and marshes adjoining rivers as well as those having predominantly internal drainage.

State's Objectives: To protect the basic natural functions served by freshwater swamps and marshes.

General State Policy: State policy shall be to discourage development in these areas except in cases shown to be not contrary to the public interest.

Regulatory Agencies: Florida Department of Environmental Regulation
St. Johns' Water Management District

Note: See Figure 3.1-16 for delineation of site categories.

Source: Florida Department of Natural Resources, 1975. Coastal Zone Management Atlas, Region 4, Northeast Florida.

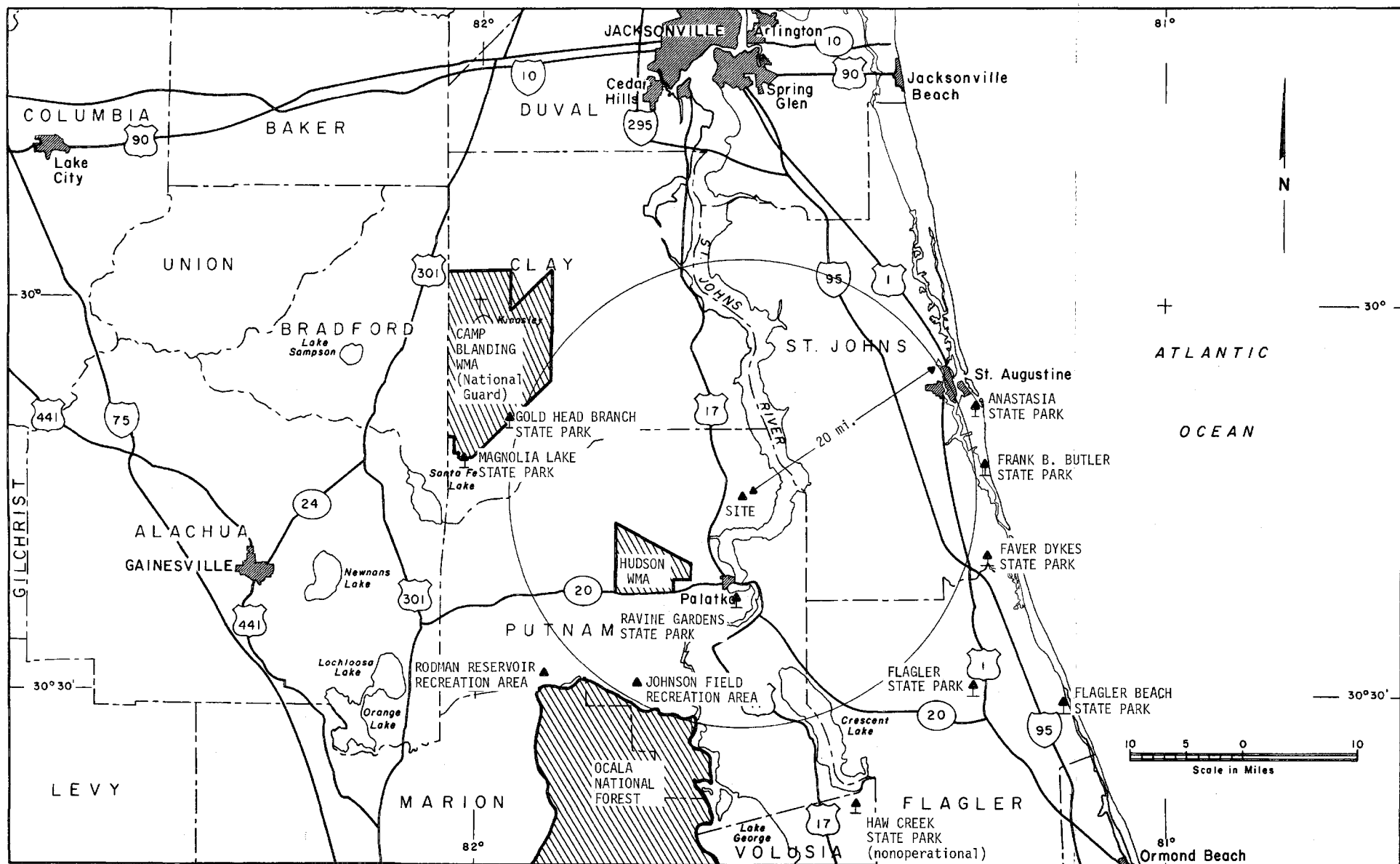


Figure 2.8-6. Public Lands.

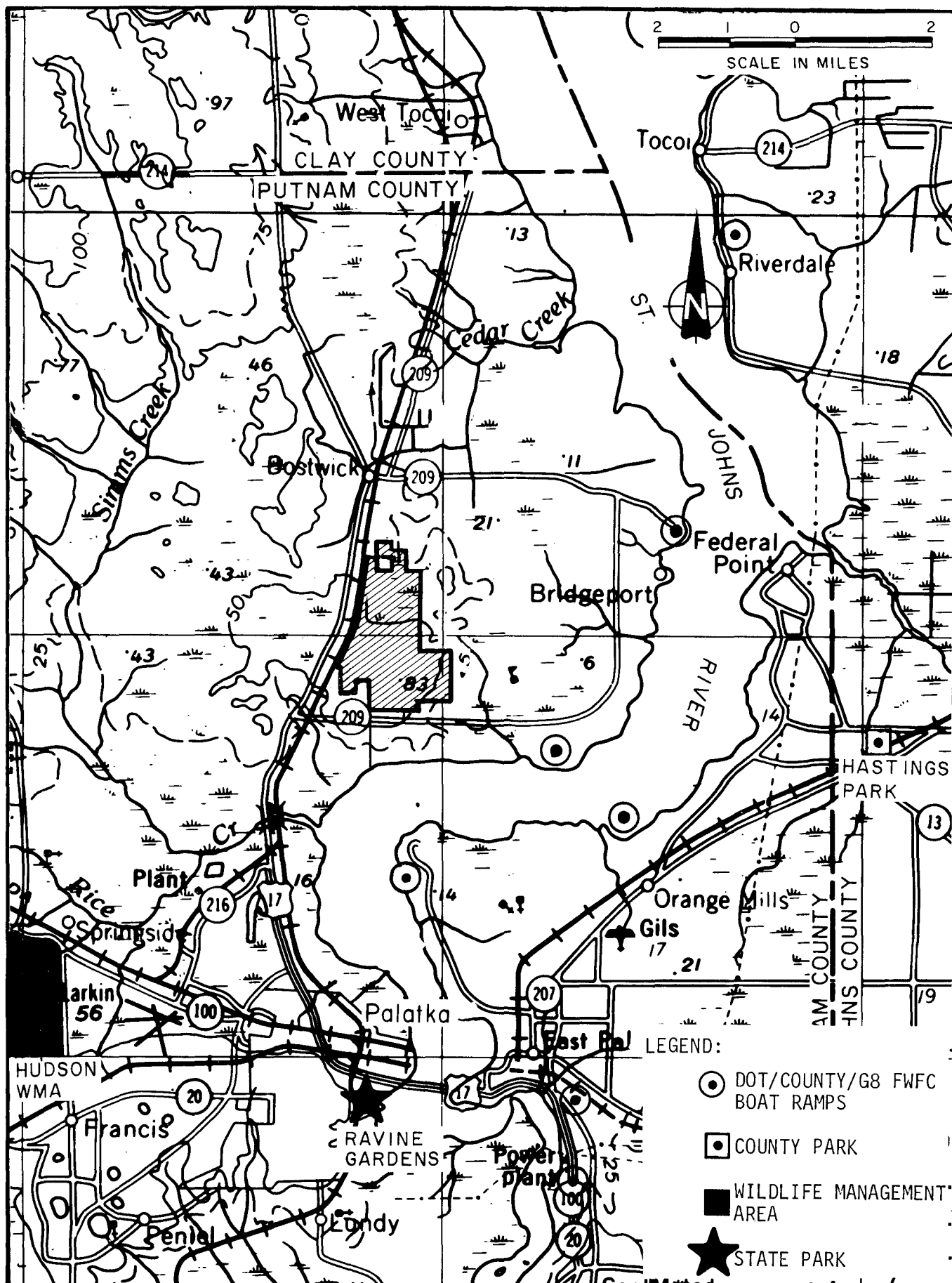


Figure 2.8-7. Public Lands in the Immediate Site Vicinity.

2.9 DEMOGRAPHIC CHARACTERISTICS

Since World War II, Florida has been one of the fastest growing states in the nation. The growth of Florida has not been confined to the beaches of the south. Much population growth has also occurred in the urban areas of the northern portions of the state.

2.9.1 General Population Characteristics

In 1970, the nine counties within 50 miles of the Putnam Site varied in size from Duval County's population of 528,865 to Flagler County's population of 4,454 (Table 2.9-1). Duval County, which consists of the City of Jacksonville, has developed into one of the southeast's most diversified urban centers. With a population density of 690 persons per square mile (the statewide average is 126), Duval County is by far the most densely populated county in the study area. At the other end of the spectrum, Flagler County has a population density of only 9 persons per square mile and no major urban area. Putnam County, with a density of 47 persons per square mile, is the second least densely populated county in the study area.

From 1960 to 1970, Clay County experienced the most rapid population growth with an average annual 6.4 percent (Table 2.9-1). Over this same time period, Putnam County experienced an average annual population growth rate of 1.3 percent, substantially below the statewide average of 3.7 percent. The only county to experience a decline in population was Flagler County, which saw a 0.3 percent average annual decline in its population.

Migration into Florida has traditionally played a large role in the growth rate. Out of a 3.7 percent average annual growth rate for the state as a whole from 1960 to 1970, over 72 percent of this change was due to a positive net migration (Table 2.9-1). Many of these new residents have been older citizens in search of retirement housing. In the study area, with the exception of Clay and Volusia Counties, net migration has been below the state average. Clay County has experienced high

rates of positive migration apparently due to its proximity to Jacksonville, while Volusia County's growth rate appears to be due, in part, to the attractiveness of the Daytona Beach area.

For the State of Florida as a whole, 80.5 percent of the population was classified as urban in 1970 (Table 2.9-1). Only Duval County (Jacksonville) exceeded the state average with 97.9 percent of its population classified as urban. Putnam County, the primary impact area, had only 25.7 percent of its population classed as urban.

2.9.2 Age Distribution of the Population

For the census year 1970, Florida's population had a median age of 32.5 years (Table 2.9-2). Of the study area counties, only Flagler and Volusia Counties had a median age exceeding the state average. Clay County, with a median age of 25.5 years, had the youngest population in 1970, which reflects the large numbers of young families living in the southern suburbs of Jacksonville. Alachua County had the highest percentage of population in the 18 to 64 year age group with 62.2 percent as compared to a state average of 54.2 percent. This high percentage reflects the large number of students (28,000) who attend the University of Florida in Gainesville (University of Florida, 1978).

Putnam County had a relatively young population in 1970. With 28.8 percent of its population in the 5- to 17-year age group, Putnam County exceeded the state average of 23.7 percent and trailed only Clay County, which had 30.2 percent of its population in this age group (Table 2.9-2). In general, it can be said that the population of Putnam County area is younger than that of the State of Florida as a whole.

2.9.3 Educational Characteristics of the Population

In 1970, for persons 25 years or older in Florida, the median number of school years completed was 12.1 (Table 2.9-3). Within the Seminole impact area, the range for the median number of school years completed

varied from lows of 10.3 years in Bradford County, and 10.7 years in Putnam County, to a high of 12.4 years in Alachua County, where the University of Florida is located. For the state as a whole, the percent of population 25 years or older with four years of college or more was 10.3 percent. But within the Seminole impact area, only Alachua County (23.1 percent) and Volusia County (10.7 percent) exceeded the state average in this category. In general, the educational attainment level in Putnam County is below that of the State of Florida as a whole.

2.9.4 Population Trends and Baseline Projections

Population projections for the State of Florida and the Seminole impact area counties for the period 1976 through 2020 are presented in Table 2.9-4. For the State of Florida and for each county, three projections are presented for each year - a high projection, a medium projection, and a low projection. The basic assumption behind these three projections is that feasible variations in fertility do not have a major impact on Florida's population growth. Since migration has accounted for more than 90 percent of Florida's population growth between 1970 and 1976, the University of Florida, Bureau of Economic and Business Research, has assumed that net migration will continue to be the prime mover behind population growth (University of Florida, 1977). Therefore, while only one set of fertility and mortality assumptions were used, three sets of migration assumptions were used, which in turn gave rise to the high, medium and low population growth projections.

Over the period 1976 to 2020, the annual rate of population growth in Florida for the medium projection is expected to be about 1.6 percent per year (Table 2.9-4). Of the Seminole impact area counties, only Clay, Flagler and Marion Counties are expected to grow at a faster annual rate than the state as a whole. Flagler County, with a projected annual growth rate of 2.2 percent in the medium case, leads all counties in the study area. This relatively high projected growth rate is due in part to the expected impact of ITT's Palm Coast community development project in Flagler County (Florida Department of Natural Resources, 1976a).

Currently, Flagler County is a rural county with an economy based on agricultural and timber products. Although Flagler County has vast sandy ocean beaches, the tourist and retirement industry has not been a key growth factor in the past due to the ability of Daytona Beach to absorb much of the tourist and retirement trade. This is expected to change, however, as the ITT Palm Coast community development project progresses. The target of the Palm Coast development is the group of upper middle class retirees who have, in the past, settled in the St. Augustine and Daytona Beach area of St. Johns and Volusia Counties. When completed in the 1990's, the Palm Coast development, according to some estimates, is expected to add over 600,000 people to Flagler County (Florida Department of Natural Resources, 1976a), which in 1970 had a population of 4,454. Recent building activity in Flagler County has been extensive, with apartments, condominiums and mobile homes parks springing up throughout the county. This development is also expected to have a significant impact on the rate of population growth in southern St. Johns County, which currently relies on tourism in St. Augustine as its primary impetus to growth.

Clay County, with a medium projected annual growth rate of 2.1 percent, currently supplies over 5,000 commuting employees to various businesses in Duval County (Florida Department of Natural Resources, 1976a). Clay County's rate of population increase is expected to remain relatively high.

Only Alachua, Duval, Putnam, and Volusia Counties have medium projected population growth rates lower than the state average.

2.9.5 Population Within 5 Miles of the Site

Population distributions and densities within 5 miles of the site are depicted in Figure 2.9-1. The highest density levels in the vicinity of the site occur in Palatka and East Palatka. Density levels along

the St. Johns River tend to be greater than those inland except for urban areas. Densities outside Palatka and East Palatka range up to 568 persons per square mile. Since approximately 2,585 persons live within 5 miles of the site, average density for the area surrounding the site is calculated to be approximately 33 persons per square mile.

The ownership maps shown in Figure 9.3-2 indicate areas plotted and subdivided for residential development. Much of the area on the east bank of the St. Johns River and in the Orange Mills vicinity has been subdivided for residential development. The most significant future residential area near the site is a platted and partially developed subdivision along State Route S209 about 2.5 miles east of the site boundary.

Much of the growth in Putnam County since 1970 has occurred around the City of Palatka and the general East Palatka area. It is likely that much of the projected population increase will occur in these areas. Some residential development can be expected along State Route S209. Certain areas of planned community facilities are also expected to concentrate populations.

2.9.6 References

Florida Department of Natural Resources, June 1976a, Florida regional coastal zone economic analysis, Region 4, northeast Florida. Division of Resources Management, Bureau of Coastal Zone Planning, Tallahassee.

University of Florida, 1977, 1978-2020 projections of Florida population by county. Bureau of Economic and Business Research, Gainesville.

Table 2.9-1

General Population Characteristics - 1970

<u>State or County</u>	<u>Total Population</u>	<u>Population Per Square Mile</u>	<u>Average Annual Percent Population Change (1960-1970)^a</u>	<u>Average Annual Percent Migration (1960-1970)</u>	<u>Percent Urban Population^b</u>
United States	203,212,877	57	1.3%	1.7%	73.5%
Florida	6,789,412	126	3.7%	2.7%	80.5%
Alachua	104,764	114	4.1%	2.2%	69.0%
Bradford	14,625	50	1.8%	0.8%	33.3%
Clay	32,059	54	6.4%	4.6%	50.2%
Duval	528,865	690	1.6%	0.1%	97.9%
Flagler	4,454	9	-0.3%	1.2%	0.0%
Marion	69,030	43	3.4%	2.0%	40.4%
Putnam	36,290	47	1.3%	0.0%	25.7%
St. Johns	30,727	51	0.3%	-0.4%	40.2%
Volusia	169,487	160	3.5%	3.4%	70.4%

^aComputed by dividing the percent decade growth rate by 10.

^bUrban population includes all persons living in communities of 2500 or greater.

Source: U. S. Department of Commerce, 1972. _

Table 2.9-2
Age Distribution of Population - 1970

<u>State or County</u>	<u>Total Population</u>	<u>Percent 0-4 Years Old</u>	<u>Percent 5-17 Years Old</u>	<u>Percent 18-64 Years Old</u>	<u>Percent 65 Years Old or Over</u>	<u>Median Age</u>
United States	203,212,877	8.4	16.1	65.6	9.9	28.3
Florida	6,789,412	7.5	23.7	54.2	14.6	32.5
Alachua	104,764	8.5	23.0	62.2	6.3	23.2
Bradford	14,625	7.9	26.7	56.8	8.6	27.5
Clay	32,059	9.9	30.2	51.3	8.6	25.5
Duval	528,865	8.6	26.6	57.3	7.5	26.1
Flagler	4,454	8.0	25.7	50.5	15.8	33.7
Marion	69,030	8.1	26.1	52.6	13.2	30.9
Putnam	36,290	8.3	28.8	50.6	12.3	28.7
St. Johns	30,727	7.3	27.1	51.3	14.3	32.1
Volusia	169,487	6.0	21.0	50.7	22.3	40.2

Sources: U. S. Department of Commerce, 1972; County and City Data Book, and Dames & Moore, 1977.

Table 2.9-3
Educational Characteristics of Those Persons
25 Years Old and Over - 1970

<u>State or County</u>	<u>Median School Years Completed</u>	<u>Percent with Less than 5 Years of School Completed (%)</u>	<u>Percent with 4 Years of High School or More (%)</u>	<u>Percent with 4 Years of College or More (%)</u>	<u>Total Population 25 Years old and Over</u>
United States	12.1	5.5	52.3	10.7	109,899,359
Florida	12.1	5.9	52.6	10.3	3,967,881
Alachua	12.4	8.1	59.8	23.1	46,861
Bradford	10.3	10.5	36.5	4.5	7,837
Clay	12.1	5.7	53.5	9.8	16,226
Duval	12.0	6.3	51.6	8.9	271,623
Flagler	11.2	10.6	44.6	4.7	2,594
Marion	11.6	7.6	47.2	7.4	39,099
Putnam	10.7	10.0	40.0	6.2	19,559
St. Johns	11.7	6.9	48.0	8.5	17,375
Volusia	12.2	4.1	56.9	10.7	107,898

Source: U. S. Bureau of the Census, 1972, County and City Data Book.

Table 2.9-4
Baseline Population Projections
(Thousands of People)

County or State		Actual 1976	1978	1980	1985	1990	1995	2000	2010	2020	Annual Growth Rate 1976-2020
Florida	Lo		8,799.	9,041.	9,741.	10,506.	11,141.	11,744.	12,600.	13,326.	1.0%
	Med	8,552.	8,908.	9,432.	10,538.	11,722.	12,634.	13,572.	15,271.	16,994.	1.6%
	Hi		9,200.	9,853.	11,340.	12,929.	14,351.	15,728.	17,986.	20,121.	1.9%
Alachua	Lo		133.5	135.5	141.8	152.9	162.1	170.9	183.4	193.9	0.9%
	Med	131.6	135.1	141.4	153.4	170.6	183.9	197.5	222.3	247.3	1.4%
	Hi		139.6	147.7	165.	188.2	208.9	228.9	261.8	292.8	1.8%
Bradford	Lo		16.8	17.4	19.1	20.6	21.8	23.0	24.7	26.1	1.1%
	Med	16.3	17.0	18.1	20.6	23.0	24.7	26.6	29.9	33.3	1.6%
	Hi		17.5	18.9	22.2	25.3	28.1	30.8	35.2	39.4	2.0%
Clay	Lo		53.7	58.2	70.5	76.0	80.6	85.0	91.2	96.4	1.5%
	Med	49.3	54.4	60.7	76.2	84.8	91.4	98.2	110.5	123.0	2.1%
	Hi		56.2	63.4	82.1	93.5	103.8	113.8	130.1	145.6	2.5%
Duval	Lo		582.8	583.7	589.3	635.6	674.0	710.5	762.2	806.2	0.7%
	Med	579.7	590.0	608.9	637.5	709.1	764.3	821.0	923.8	1,028.0	1.3%
	Hi		609.3	636.1	686.0	782.1	868.1	951.5	1,008.0	1,217.0	1.7%
Flagler	Lo		8.1	8.0	10.9	11.8	12.5	13.2	14.2	15.0	1.6%
	Med	7.4	8.2	9.2	11.8	13.2	14.2	15.3	17.2	19.1	2.2%
	Hi		8.5	9.7	12.7	14.5	16.1	17.7	20.2	22.6	2.5%
Marion	Lo		104.6	110.6	127.6	137.6	145.9	153.8	165.0	174.0	1.3%
	Med	98.4	105.9	115.4	138.0	153.5	165.4	177.7	200.0	222.5	1.9%
	Hi		109.3	120.6	148.5	169.3	187.9	206.0	235.5	263.5	2.2%
Putnam	Lo		43.9	44.1	44.9	48.4	51.3	54.1	58.0	61.4	0.8%
	Med	43.7	44.4	46.0	48.5	54.0	58.2	62.5	70.3	78.2	1.3%
	Hi		45.9	48.1	52.2	59.5	66.1	72.4	82.8	92.6	1.7%
St. Johns	Lo		41.4	42.6	46.1	49.7	52.7	55.6	59.7	63.1	1.0%
	Med	40.3	41.9	44.4	49.9	55.5	59.8	64.3	72.3	80.5	1.6%
	Hi		43.2	46.4	53.7	61.2	67.9	74.5	85.2	95.3	2.0%
Volusia	Lo		217.4	221.6	234.4	252.8	268.0	282.5	303.1	320.6	0.9%
	Med	212.9	220.0	231.2	253.5	282.0	304.0	326.5	367.4	408.9	1.6%
	Hi		227.3	241.5	272.8	311.1	345.3	378.4	432.7	484.1	1.9%

Source: University of Florida, Bureau of Economic and Business Research, July 1977,
1978-2020 PROJECTIONS OF FLORIDA POPULATION BY COUNTY, and Dames & Moore, 1977.

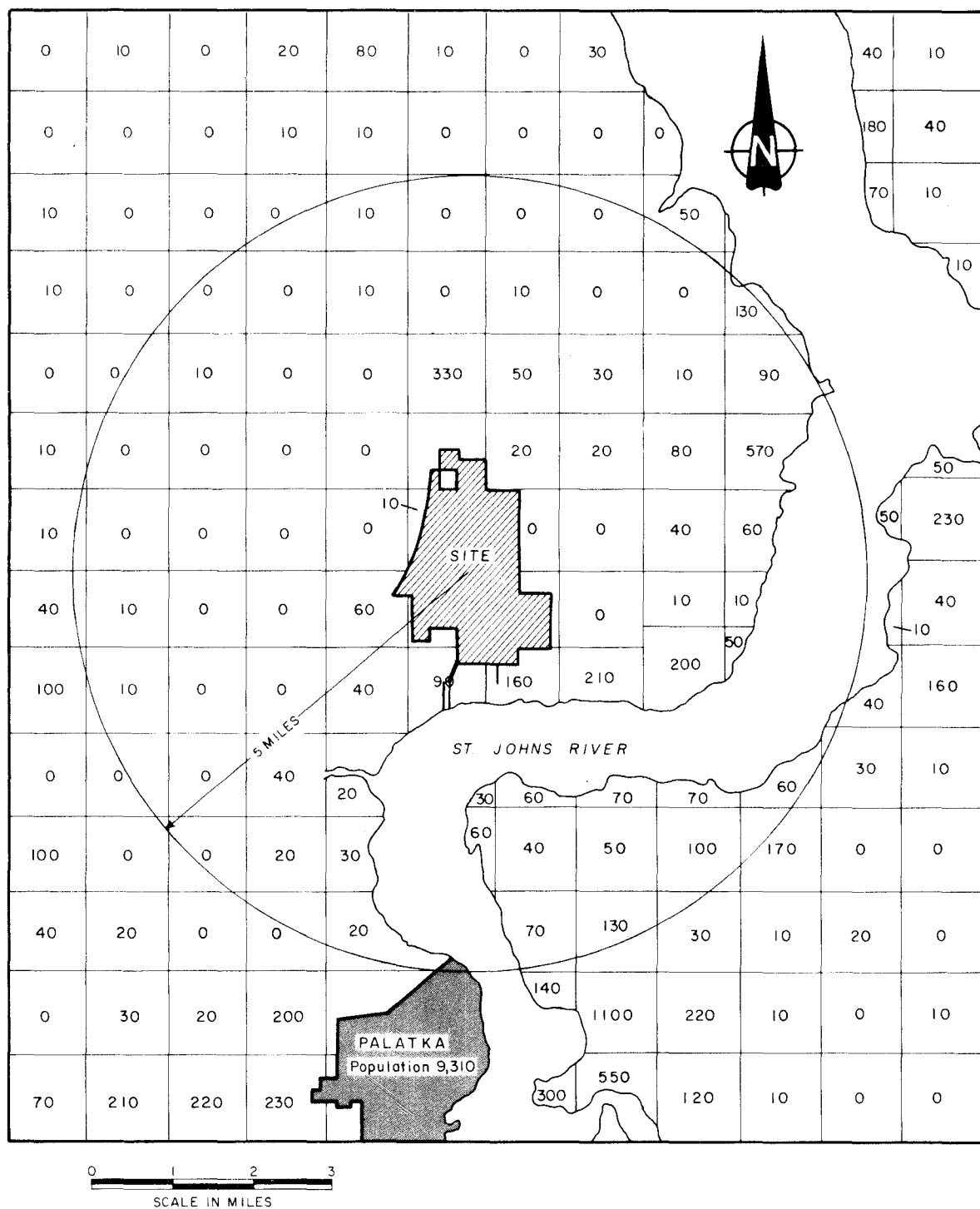


Figure 2.9-1. Estimated Population Distributions within 5 Miles of the Site.

2.10 SOCIAL AND ECONOMIC CHARACTERISTICS

Preliminary estimates by SECI indicate that the proposed plant, once all construction is completed in 1986, will require 140 permanent employees receiving an annual gross payroll of over \$4,126,533 in 1986 dollars (SECI, May 2, 1978).

This socioeconomic study consists of two sections. The first section describes the existing socioeconomic environment around the proposed Putnam Site, and presents projections of socioeconomic activities in the baseline case of no construction of new electric power generating facilities. The second part of this study analyzes the socioeconomic impact that may be expected to occur as a result of the construction and operation of a new steam-electric generating station in Putnam County. The socioeconomic impact analysis is included in Section 4.0.

2.10.1 Delineation of Study Area

The site is near Bostwick in Putnam County, Florida (see Figure 2.10-1). Since most of the activities involving construction and operation of the power plant are expected to occur in Putnam County, the primary impact area for the purpose of this study is defined as Putnam County. Palatka, the Putnam County seat, is the major urban center within the primary impact area. Many other smaller communities in Putnam County, such as Interlachen, Crescent City, Pomona Park, Welaka, and Florahome are also part of the primary impact area.

The impacts of plant construction and operation will not be confined to Putnam County. Therefore, a secondary impact area, consisting of the nearby counties of Alachua, Bradford, Clay, Duval, Flagler, Marion, St. Johns and Volusia have been studied as well. The secondary impact area includes a number of major urban centers such as Gainesville in Alachua County, Jacksonville in Duval County, St. Augustine in St. Johns County, and Daytona Beach in Volusia County. Since all of these urban areas are within approximately 50 miles of the site, it is expected that much of the skilled labor required for plant construction will come from these urban areas. Table 2.10-1 briefly summarizes the population characteristics of the study area.

2.10.2 Economic Base of the Impact Area

This section of the socioeconomic baseline study examines the characteristics of the impact area with regard to employment and income. Major industrial sectors will be identified, with special emphasis placed on the primary impact area of Putnam County.

As a whole, the State of Florida has a relatively narrow economic base. In general, Florida is weak in manufacturing, but strong in tourism, trade and services, and construction. The agricultural sector is strong in certain regions of Florida, but is characterized by highly seasonal employment. Although construction has contributed much income to the State of Florida, employment within the construction industry has fluctuated widely from year to year. This may be due to the patterns of land speculation that have occurred in Florida over the years

2.10.2.1 Labor Force Characteristics

The size of the civilian labor force in the impact area counties in 1970 varied from a high of 199,101 in Duval County to a low of 1458 in Flagler County, with Putnam County falling in between with 13,049 (Table 2.10-2). In the same year, unemployment rates varied from a high of 4.4 percent in Putnam County to a low of 1.4 percent in Flagler County, as compared to the Florida average of 3.8 percent. Of the nine impact area counties, only three, (Bradford, Putnam, and Volusia) experienced unemployment rates higher than the state average.

Employment by Occupation

In 1970, 14.1 percent of the labor force in Florida was classified as being employed in manufacturing (Table 2.10-3). Within the Putnam impact area, Alachua was at the low end of the range with only 7.5 percent employed in manufacturing, while Putnam County had by far the largest percentage with 28.7 percent employed in manufacturing (Table 2.10-3). Putnam County's large percentage of employees in manufacturing occupations is a result of Putnam County's heavy reliance on pulp and paper product manufacturing for its primary source of income. For the study area as a whole, however, only two counties, Clay and Putnam, exceeded the state average of 14.1 percent (Table 2.10-3).

Wholesale and retail trade involved 23.5 percent of the labor force on the state level and ranged from a low of 17.3 percent in Putnam County to a high of 25.2 percent in Duval County (Table 2.10-4). These facts tend to support the contention that Putnam County's economic base is less diverse than many of other study area counties due to its heavy reliance on manufacturing.

The percent of the total Florida state labor force employed in service occupations was 11.5 percent in 1970. The impact area counties ranged from 6.4 percent employed in services in Bradford County to 15.0 percent in Flagler County, where services are in relatively high demand due to the high percentage of older citizens.

Educational services involved 7.4 percent of the labor force statewide, and ranged from a low of 6.5 percent in Duval County to a high of 26.6 percent in Alachua County where the University of Florida is located.

Construction employment in 1970 ranged from a low of 4.9 percent of the labor force in Putnam County to a high of 8.9 percent in Volusia County. The state average in that year was 8.5 percent.

Government jobs occupied 16.0 percent of the labor force on a statewide basis, while the study area counties varied from a low of 14.1 percent in Volusia County to a high of 42.9 percent in Alachua County.

In the professional and managerial occupations, Alachua County led the way with 33.9 percent of its labor force employed in this area, while Putnam County was the low county in the study area with 16.9 percent. The state average was 23.3 percent.

Duval County had 31.7 percent of its labor force employed in sales and clerical positions in 1970, the highest in the study area. Flagler County occupied the low end of the range with only 14.2 percent as compared to the state average of 26.6 percent.

Craftsmen and foremen involved 14.5 percent of the labor force on a statewide basis while the Seminole impact area counties ranged from a high of 17.8 percent in Clay County to a low of 10.3 percent in Alachua County.

Basic and Non-Basic Employment by Industrial Sector

In conducting economic baseline and impact studies, it is often convenient to analyze the economy of the primary impact area in terms of basic industries, which generate basic employment and basic income, and non-basic industries, which generate non-basic employment and non-basic income. Basic industries are those industries that produce output for the export (or non-local) market. Export market, in this framework, refers to those markets outside of the primary impact area. Non-basic industries, on the other hand, produce goods and services for the markets within in the primary impact area. Non-basic industries are often associated with activities of local commercial enterprises, while basic industries are associated with larger manufacturing and processing enterprises.

The first step in conducting an economic base study is to define the area of concern in geographic terms. For the Seminole Plant project, the area of concern is defined as Putnam County, the primary impact area.

Many methods exist by which the local economy could be divided into its basic and non-basic components (Tiebout, 1962). The approach utilized in this report is explained in detail in Appendix H.1. The following discussion relates the findings of the analysis.

Three sectors appear to constitute Putnam County's economic base: the agricultural sector with a basic employment of 577 (see Appendix H.1, Table H-1), the manufacturing sector with a basic employment of 440, and the state and local government sector with a basic employment of 429.

The two major crops in the Putnam County agricultural sector are potatoes and cabbage. In addition, many other types of vegetable farms exist. Flower and ornamental plant nurseries for the export market also employ a significant number of people in Putnam County. A few of the more popular Putnam products in this sector include cut flowers such as gladioli, iris, and gypsophila, and ferns such as leather leaf fern and plumosa fern. Citrus and peach orchards and ranches with beef cattle, dairy cows, and horses are numerous in Putnam County.

The manufacturing sector in Putnam County is by far the most important single sector for generating employment. In 1974, this sector accounted for nearly 25 percent of total county employment. A more detailed breakdown of the manufacturing sector is shown in Table 2.10-4. In this table, it is evident that manufacturers of paper and allied products supply the bulk of the jobs in the manufacturing sector. The county's abundant forest and timber resources support this industry, which produces for a large market throughout the southeast. In 1974, paper and allied products accounted for 2454 jobs in Putnam County, or approximately 77 percent of all manufacturing jobs.

The largest single employer in Putnam County in 1974 was the Hudson Pulp and Paper Company with 2,400 employees. The plant accounted for nearly 19 percent of total Putnam County employment in that year (Florida Dept. of Natural Resources, 1976a).

The second largest employer in Putnam County in 1974 was Central States Diversified, Inc. a producer of paper bags and disposable hospital items, with about 300 employees. Florida Furniture Industries, Inc., a manufacturer of wooden bedroom suites, employed about 275 persons in 1974. Florida Power and Light Company (FP&L), the fourth largest employer in the county, employed approximately 220 people in 1974 (Putnam County Chamber of Commerce, no date).

The importance of the Hudson Pulp and Paper Company to the economy of Putnam County is illustrated in Table 2.10-5, "Putnam County Employment Characteristics." In 1973 the Hudson Pulp and Paper Company employed 2650 people. By the end of 1974, owing to recession conditions, Hudson had laid off 250 workers, thus reducing employment to 2400 (Florida Dept. of Natural Resources, 1976a). From Table 2.10-5, it can be seen that Putnam County's unemployment rate jumped from 3.7 percent in 1973 to 6.2 percent in 1974, an increase of 67.6 percent. During the same two-year period, unemployment for the State of Florida jumped from 4.3 percent to 6.3 percent, an increase of 46.5 percent, while unemployment for the nation as a whole increased from 4.9 percent to 5.6 percent,

a change of 14.3 percent. It is thus evident that the overall economy of Putnam County is very sensitive to those factors which might affect operations at a single manufacturing plant, Hudson Pulp and Paper Company.

Baseline Employment Projections

Baseline employment projections for Putnam County, as prepared by the Jacksonville Area Planning Board, are presented in Table 2.10-6. These projections represent what is likely to happen to employment in Putnam County in the baseline case in which the Seminole Plant is not constructed. In Section 6.0 of this report, a different set of employment projections will be presented, which will represent the expected employment situation with the Seminole project.

It should be noted that the specific values of the projections represent a mid-point of a range of possible values. See Appendix H.2 for a discussion of this point.

From Table 2.10-6, it can be seen that all sectors are expected to grow in terms of employment in the baseline case except for the agriculture and mining sectors.

Manufacturing employment is expected to increase at an annual rate of about 1.5 percent over this 30 year period while total employment is expected to increase at a rate of 1.6 percent per year (Table 2.10-6). The sectors with the largest projected employment growth rates are transportation, communication, and public utilities, with a projected annual growth rate of 2.7 percent; and finance, insurance, and real estate with 3.1 percent. Looking at Appendix H.1, it can be seen that these two sectors were among the weakest in Putnam County in 1974. Therefore, it may be reasonable to assume that they will experience the most rapid growth over the next 30 years as Putnam County begins the process of diversifying its economic base.

2.10.2.2 General Income Characteristics

Table 2.10-7 presents data for total personal income and per capita personal income for the nine Putnam Site impact area counties for the years 1974 and 1975. Putnam County had the highest growth rate in both total personal and per capita personal income between 1974 and 1975 of the nine counties. This increase can be partially attributed to the income generated by construction of FP&L's new generating units in East Palatka. Despite the increases, however, Putnam County still experienced an extremely low 1975 per capita personal income of \$4,018. Only Bradford County, at \$3,722, trailed Putnam. These figures are far below the 1975 state average of \$5640 and the impact area high of \$5,646 in Duval County.

In Table 2.10-7, percentage increases in per capita personal income for project area between 1974 and 1975 is rather misleading since income is measured in nominal terms in Table 2.10-7. When inflation is taken into consideration, and real income changes are measured, the results change drastically due to the extreme inflation during 1974 (Appendix Table H-2). Wholesale prices jumped by 20.9 percent in 1974 while consumer prices jumped 12.2 percent. When Putnam County income data is deflated to constant values by the implicit price deflators (Appendix Table H-3), it becomes apparent that real per capita personal income increased by only 2.4 percent from 1974 to 1975, while per capita personal income increased a nominal 12.3 percent.

Sources of Income

Personal income is often classified according to the source of the income. Table 2.10-8 presents time series data to illustrate the trends of personal income composition in Putnam County and throughout Florida. With regard to wage and salary disbursements and proprietor's income, Putnam County appears to be within a few percentage points of the state average. It is in the dividend, interest, rent, and transfer payment categories, however, that Putnam County differs significantly.

From 1970 to 1974, Putnam County's income from dividends, interest, and rent was, on the average, 38 percent below the state level. This evidence further supports the contention that Putnam County's economy shows very little diversity and points out the weakness of the finance, insurance, and real estate sectors within the county. On the other hand, over this same time period, Putnam County's income from transfer payments averaged 31 percent above the state level. Since transfer payments include welfare to unemployed persons and pensions for retired citizens, it becomes apparent that an unusually high percentage of Putnam County's income is derived from federal and state sources.

Average Wage and Salary Income, by Sector

As pointed out previously, the manufacturing sector constitutes the bulk of the economic base in Putnam County. Table 2.10-9, which provides data on average wage and salary income by industrial sector in 1974, further illustrates the importance of the manufacturing sector in the Putnam economy. In all industrial sectors, except manufacturing, Putnam County's average wage and salary income was below both the Florida and national averages. In the manufacturing sector, however, Putnam County's average wage and salary income of \$10,547 exceeded both the state and national averages.

The importance of the Hudson Pulp and Paper Company to the economy of Putnam County is further illustrated in Table 2.10-10, where average wage and salary income is disaggregated within the manufacturing sector for the years 1973, 1974, and 1975. In all manufacturing sectors except paper and allied products, Putnam County's average wage and salary income is below the state average for all years. The importance of the paper and allied products sector is so great in Putnam County that Putnam County's average wage and salary income in paper and allied products not only exceeds the state averages for all years, it exceeds the average strongly enough to offset the weaknesses of the other sectors and enables the overall manufacturing wage average and salary income in Putnam

County to exceed the state average for all years shown. In fact, Putnam County's 1975 average wage and salary income of \$11,790 in the manufacturing sector was a full 16.9 percent higher than the state average of \$10,089.

Basic and Non-Basic Income by Industrial Sector

Location quotient analysis, as described in Appendix H.1, was used to derive the estimates of basic and non-basic income in Putnam County for 1973, as shown in Table 2.10-11. (This is in contrast to the analysis in Subsection 2.10.2.1, which characterized the basic and non-basic sectors in terms of employment rather than income.)

The importance of manufacturing in the Putnam County economic base is clearly illustrated once again in Table 2.10-11. In 1973, out of a total Putnam County income of \$90.2 million, approximately \$9.8 million worth of effort was devoted to producing manufactured products for the export market.

The other two major sources of basic income in Putnam County during 1973 were the agriculture and state and local government sectors. This confirms the conclusion that the economic base of Putnam County consists primarily of three sectors - manufacturing, agriculture, and state and local government.

Baseline Income Projections

Table 2.10-12 contains baseline income projections for Putnam County as prepared by the Bureau of Economic Analysis and the U.S. Corps of Engineers. As stated in Subsection 2.10.2.1 in which baseline employment projections were presented, these projections also represent only one of many possible scenarios for growth in Putnam County. Care must be taken not to attach any great relevance to the point estimates for specific years. The statements made in Appendix H.2 regarding projection assumptions, methodology, confidence intervals, and significance levels apply to this section as well.

Over the period 1980 to 2020, the finance, insurance, and real estate sector and the transportation, communication, and public utilities sector are expected to experience the most rapid real income growth with annual growth rates of 4.7 percent and 4.0 percent, respectively. One of the major factors influencing Putnam County's growth pattern will be the outward expansion of Jacksonville's urban area, which is expected to lead to more diversity in the economic base of Putnam County.

The agriculture, forestry and fisheries sector and the mining sector are expected to grow at the slowest rates over this time period, with annual growth rates of 1.7 percent and 2.7 percent, respectively. This is consistent with employment projections that indicate an absolute decrease in employment in these two sectors over time. Labor productivity gains in these two sectors are expected to be high enough to maintain real income growth despite decreases in employment.

Overall, the growth rate of real total personal income for Putnam County over the years 1980 to 2000 is projected at an annual rate of 3.7 percent. From Table 2.10-6, the total employment growth rate over the same period is projected to be 1.3 percent per year.

2.10.3 Housing

In this section of the baseline study, the existing housing situation in the Putnam impact area was investigated. This provides a basis for estimating the potential housing pressures that may develop during the proposed station construction and operation phases.

Existing Housing Stock

As of 1970, Duval County had the largest number of year-round housing units in the Seminole impact area, with 174,149 units, as shown in Table 2.10-13. In the same year, Flagler County had the smallest number of units, with only 1,841, while Putnam County had 12,900 units.

In a more recent survey of housing, conducted in November 1976 for the Putnam County Planning Commission, it was reported that there were 17,220 dwelling units in Putnam County, 15,540 of which were in

unincorporated areas. Of these 17,220 units, 59 percent were classified as single family structures, 38.6 percent were classified as mobile home residences, and the remaining 2.4 percent were classified as apartment-type structures (Kellum, Patterson, and Bell, 1977c).

In this recent survey, the housing stock were divided into four classifications:

1. Standard/Sound - This category includes all structures considered to be safe and adequate shelter.
2. Standard/Minor Deterioration - This group includes all structures considered to be safe and adequate although they are in need of some minor repair work.
3. Substandard/Major Deterioration - This classification includes all structures considered to be unsafe and inadequate due to the need for major repair work.
4. Substandard/Dilapidated - This category includes all structures that should be condemned and demolished due to their extreme degree of deterioration.

Of the 17,220 dwellings in Putnam County, 93 percent of these were placed in the first two categories of standard/sound and standard/minor deterioration. All the remaining dwellings in the county were classified as substandard, 50 percent of which were considered dilapidated and suitable for demolition (Kellum, Patterson, and Bell, 1977c).

Recent years have seen a trend toward the use of permanent dwellings and mobile homes for recreational or vacation purposes in Putnam County. As a result, many dwellings in Putman County are vacant for much of the year. Approximately 3,250 units are being utilized in such a manner. Therefore, only 13,970 units out of the county total of 17,220 should be considered as being available for the use of permanent residents (Kellum, Patterson, and Bell, 1977c).

Vacancy Rates

Table 2.10-13 gives data for vacancy rates in the nine Seminole impact area counties for the year 1970. St. Johns County had the highest homeowner vacancy rate at 3.2 percent, while Flagler County had the highest rental vacancy rate at 15.3 percent. In comparison with the state averages of 1.8 percent for the homeowner vacancy rate and 10.7 percent for the rental vacancy rate, the impact area counties in the aggregate appear to have higher vacancy rates than the state for both categories. In the homeowner category, five of the nine impact area counties had vacancy rates higher than the 1.8 percent state average, while in the rental category, six of the nine impact area counties had vacancy rates higher than the 10.7 percent state average.

Data from the recent Putnam County Planning Commission survey of November 1976 indicates that there was an overall 12.3 percent vacancy rate for the 13,970 permanent dwelling units in Putnam County in 1976. In other words, out of 13,970 dwelling units, 12,252 were occupied and 1,718 units were vacant. Of the 12,252 occupied units, 10,108 were owner occupied and 2,144 were renter occupied. Of the 10,108 owner occupied units, 630 were classified as substandard in quality and 336 of the 630 were considered suitable for rehabilitation. Of the 2,144 renter occupied units, 355 were classified as substandard of which 189 were considered suitable for rehabilitation. Finally, 151 of the 1,718 vacant units were classified as substandard. Of the 151 substandard vacant units, 78 were considered suitable for rehabilitation (Kellum, Patterson and Bell, 1977c). Thus, in 1976 there were approximately 1567 standard dwelling units available for occupancy in Putnam County alone.

Building Activity

Table 2.10-13 indicates that Clay County experienced the largest percentage increase in housing stock of the nine Seminole impact area counties between 1960 and 1970, with a 64.2 percent increase in the

number of housing units. This increase is clearly related to the rapid growth of Clay County as a suburb of the Jacksonville area. The only other two counties that experienced a change in housing stock greater than the state average of 45.4 percent were Alachua County with a 55.0 percent increase and Marion County with a 54.1 percent increase over the ten year period 1960 to 1970.

In July of 1973, Putnam County began to issue building permits for new housing in the county. Since record keeping began in July 1973, 93 single family unit building permits and 487 mobile home permits were issued through December 1973. From January to December of 1974, Putnam County issued 112 permits for single family units and 1012 permits for mobile homes. In 1975, the number of single family unit permits jumped to 285 while the number of mobile home permits jumped to 1022 (Florida Dept. of Commerce, 1976).

According to the Putnam County building codes, mobile homes can be placed in any appropriately zoned area of the county, subject to two conditions. First, a septic tank must be installed to service the mobile home (Bennett, 1977). Second, as required by the State of Florida, the lot size must be at least one-half acre in size in order to accomodate the installation of the mandatory septic tank and a well (which is optional) (Kellum, Patterson, and Bell, 1977c).

Housing Costs

Median gross rents for the nine county impact area for 1970 are indicated in Table 2.10-13. Although the data are somewhat outdated, they do indicate that rents in Bradford County, Flagler County, and Putnam County were extremely low in 1970. With the exception of Alachua County, the entire impact area experienced rents which were far below the state average of \$114 per month in 1970 dollars.

June 1976 data for Putnam County from the Florida Department of Commerce indicate that the average rent for efficiencies was \$100 per month. For one bedroom apartments, rents averaged \$125 to \$150 per month; for two bedroom apartments, \$185 to \$200 per month; and for 3

bedroom apartments, \$210 to \$225 per month (Florida Dept. of Commerce, 1976). The Florida Department of Commerce also indicates that the availability of two and three bedroom apartments in Putnam County appears to be greater than the availability of efficiencies and one bedroom apartments.

Purchase prices of existing homes in Putnam County ranges from \$15,000 for a two bedroom middle income home to \$35,000 for a 4 bedroom middle income home. The availability of small middle income homes and all sizes of low income homes for purchase is rated as very low (Florida Dept. of Commerce, 1976). Only three and four bedroom middle income homes appear to be in reasonable supply. Rental prices for the larger middle income homes range from \$160 to \$200. The smaller middle income and all low income homes rent for anywhere from \$100 to \$150 per month (Florida Dept. of Commerce, 1976).

Florida Department of Community Affairs data indicates that the average rent for a 4-bedroom apartment in 1974 ranged from \$165 per month in Clay County to \$103 per month in Flagler County (Kellum, Patterson, and Bell, 1977c). For 1976 in Putnam County, monthly rents ranged from under \$50 a month to over \$150 per month (Kellum, Patterson, and Bell, 1977c). During 1976 there were an estimated 106 renter occupied units in the under \$50 per month price range, in 1976, 411 renter occupied units in the \$50 to \$99 per month range, 79 renter occupied units in the \$100 to \$124 per month price range, 13 units in the \$125 to \$149 range, and 23 units in the \$150 and over range (Kellum, Patterson and Bell, 1977c).

The early years of 1970 saw high levels of residential building activity in Jacksonville and nearby urban areas. Although rents of \$150 to \$250 per month for one and two bedroom apartments are much higher in the Jacksonville area than the rents for comparable housing in Putnam County, the availability of these one and two bedroom apartments appears to be fairly high.

2.10.4 Public Services

Since Putnam County has been defined as the primary impact area for purposes of this socioeconomic baseline study, the discussion of existing public services in this section will focus on Putnam County. Information involving counties of the secondary impact area will be presented only in cases deserving special attention.

Education

Enrollment and capacity data for the Putnam County School District for the academic year 1977-1978 is presented in Table 2.10-14 (Putnam County School District, 1977). The Putnam County School District consists of eight elementary schools (Kindergarten through fifth grade), four middle schools (grades six to eight), and 3 high schools (grades nine to twelve). The combined student capacity of these fifteen schools is 11,952, which exceeds the 1977-1978 combined estimated enrollment of 10,448.

Table 2.10-14 indicates that five schools, Beasley Middle, Interlachen Community, Price Middle, Long Elementary, and Palatka High, are expected to experience 1977-1978 enrollments in excess of their capacity. Nevertheless, all schools in the district meet the Florida State Department of Education's recommendations that the classroom area per pupil must be at least 35 square feet for Kindergarten through second grade, 30 square feet for grades three through six, 28 square feet for grades five to eight, and 25 square feet for grades nine through twelve (Kellum, Patterson and Bell, 1977c). Additionally, from Table 2.10-14 it can be seen that all schools in the district meet the Florida State Department of Education's recommendations that the student teacher ratio not exceed 25 for elementary school students and 30 for middle and high school students (Kellum, Patterson, and Bell, 1977c).

Projected enrollments for the Putnam County School District through the academic year 1981-1982 are presented in Table 2.10-15. The general trend for the entire school system is for decreasing enrollment from 10,567 total students in 1976-1977 to an expected 10,333 total students

in 1981-1982. Only the kindergarten through fifth grade category is expected to experience an increase in students, with a peak occurring in the 1979-1980 school year. The implication of increasing enrollments in the lower grades is that eventually enrollments in the higher grades will begin to increase in the years beyond 1982. There are no enrollment projections beyond 1982.

Putnam County also has a few private elementary and secondary schools, all of which are located in Palatka. As of 1975, there was the Briarwood School for grades one through twelve with 17 teachers, the Christian Independent Private School for grades one to nine with 5 teachers, and the Palatka Seventh Day Adventist Church School for grades four to eight with one teacher (Florida Dept. of Commerce, 1976).

Five libraries are available for public use in Putnam County. The major library is the Palatka Public Library with 25,000 volumes. A public library also exists in Interlachen. Three private libraries allow public access and are found in Crescent City, Welaka, and Melrose (Kellum, Patterson, and Bell, 1977c).

Many colleges and universities are located within the overall impact area. St. Johns River Junior College, located in Palatka, provides an undergraduate curriculum for approximately 1400 students (Florida Dept. of Commerce, June 1976). As one of 27 junior colleges in Florida, St. Johns River Junior College is also the site of the recently organized Florida School of the Arts (Putnam County Chamber of Commerce, 1977).

The University of Florida is located in Gainesville, while Jacksonville is the home of the University of North Florida and Jacksonville University. Finally, there is Stetson University, located in Deland, Volusia County.

Vocational technical educational opportunities are available in St. Augustine at the St. Augustine Technical Center. It is a public school with an enrollment of 2,247 (Florida Dept. of Commerce, 1976). Courses at the St. Augustine Technical Center are geared to the needs of the community.

Transportation

Roads

U.S. Route 17, the major north-south highway between Palatka and Jacksonville, will most likely be the primary access road to the Putnam Site. State Routes 20 and 100 are the major eastwest highways in Putnam County; they lead to Interstate 75 to the west. State Route 207 connects Palatka to Interstate 95 about 20 miles east of Palatka. Figure 2.10-2 indicates these and other roads in the vicinity of the Putnam Site.

The Florida Highway Patrol has indicated that the U.S. Route 17 - State Route S209 intersection at the Seaboard Coast Line Railroad crossing is very dangerous (Hodges, 1977). The intersection is heavily congested during morning and evening rush hours since State Route S209 is the only access to the homes along the riverfront, and U.S. Route 17 is busy with traffic involving the Hudson Pulp and Paper Company employees and school buses. Additionally, the Rice Creek Bridge on U.S. Route 17, just south of the above mentioned intersection, is a serious bottleneck during rush hours (Hodges, 1977).

Table 2.10-16 presents traffic counts for the above-mentioned points as well as for other key intersections in the vicinity of the Putnam Site. U.S. Route 17 at Moccasin Creek experienced a 24-hour flow of 3,852 vehicles in 1977. U.S. Route 17 at Rice Creek, less than 2 miles south of Moccasin Creek, experienced a 24-hour flow of 5,408 vehicles in 1977. The large increase in traffic flow over this two-mile distance is largely due to traffic from State Route S09.

The State Department of Transportation's Five Year Construction Plan is designed to help alleviate the congestion problems in the Rice Creek area of U.S. Route 17 (Florida Dept. of Natural Resources, 1976e). U.S. Route 17 is scheduled to become a four lane highway from State Route S209 to South Avenue in Palatka. Additionally, the Rice Creek bridge, currently a narrow two-lane structure, is scheduled to be completely replaced by a new four-lane bridge. Although the State Attorney is currently working on property condemnation proceedings for these projects, the date of project completion is still uncertain.

Highway capacity of U.S. Route 17 in the vicinity of the Putnam Site in good weather conditions is approximately 14,000 cars per day at service level C (minimum stable flow rate retaining maneuverability). When the portion of U.S. Route 17 south of Rice Creek bridge has been widened to four lanes the basic (level C) capacity of the highway should be 22,500 cars per day with a possible capacity as high as 28,500 cars per day. For State Route S209, the best possible highway capacity at service level C is 10,500 cars per day, with a more conservative figure being 8,500 cars per day (Bilby, 1978). Existing traffic levels on these highways are well below their rated capacity.

Railroads

Putnam County is serviced by three major railroads. The Seaboard Coast Line Railroad, whose main line passes through Palatka, provides both main line passenger and freight service along the eastern seaboard. The Florida East Coast Railway provides freight service from Palatka eastward to the east coast of Florida. The Southern Railroad provides freight service from Palatka, the southern terminus of the Southern system, northward to Valdosta, Georgia and other southeastern states. Approximately 28 trains pass through Palatka every 24 hours (Hodges, 1977).

Waterways

The Putnam County Port Authority operates the St. Johns River Barge Port. With a dredged channel 12 feet deep and 100 feet wide, the barge port is able to accomodate vessels up to 250 feet in length (Figure 4.4-1). A 3800-foot long access channel from the St. Johns River waterway channel terminates in a 350 foot square turning basin at the barge port. Facilities at the barge port include cluster mooring dolphins for holding waiting barges, and a 20,000 square foot warehouse complete with sprinkler system (Florida Dept. of Commerce, 1976). Professional warehousing, materials handling, stevedoring, and container services are available at the barge port.

Airports

Putnam County has one general aviation facility, the Kay-Larkin airport, located about 3 miles from downtown Palatka. Although there is no scheduled passenger or freight service from Kay-Larkin, there are four 5000 foot runways, one of which is lighted (Florida Dept. of Commerce, 1976). Gasoline, maintenance and repair, and tie-down services are available at Kay-Larkin.

Other airports in the impact area include Gainesville, Daytona Beach, and Jacksonville. The Gainesville and Daytona Beach airports have limited scheduled airline services. Jacksonville International Airport, however, is a full facility airport served by such major airlines as Delta, United, Eastern, National, Northeast, and Southern, as well as numerous minor airlines.

Medical Facilities

The major medical facility in Putnam County is the Putnam Community Hospital in Palatka which began receiving patients on September 1, 1975 (Webb-Westbury Associates, 1975). This hospital is a general acute care medical and surgical facility that was built with private capital and is operated as a wholly-owned subsidiary of the Hospital Corporation of America. The hospital has 117 beds and an 80-percent occupancy rate (Jarnicki, 1977) and offers many services including a coronary care unit, pathology, radiology, physical therapy, electrocardiogram, nuclear medicine, isolation facilities, blood banks, outpatient services, and a 24-hour emergency room.

Other medical facilities in Putnam County include the Lakeshore Nursing Home with 92 beds for in-patient service in Crescent City, and the Putnam Memorial Nursing Home in Palatka with 60 beds for in-patient service (Florida Dept. of Commerce, 1976).

As of 1975, Putnam County had thirteen general practitioners, one gynecologist, one pediatrician, and twelve other assorted specialists including three optometrists and two chiropractors (Florida Dept. of Commerce, 1976; Putnam County Chamber of Commerce, no date). For

dental care, Putnam County had eight general dentists, two orthodontists, and three dental specialists in 1975 (Florida Dept. of Commerce, 1976). Additional medical personnel can be found in Crescent City where there were three physicians and one dentist in 1975 (Putnam County Chamber of Commerce, no date).

Many other hospitals are located within the Seminole impact area. Jacksonville contains twelve hospitals, Gainesville has four hospitals, and St. Augustine has two (Jarnicki, 1977).

Fire Fighting Facilities

Putnam County is served by 21 fire companies, all of which are volunteer organizations except for the Palatka and Crescent City municipal fire departments (Florida Dept. of Commerce, 1976).

As of 1975, the Palatka fire department consisted of 1 fire station, 30 firemen, and 7 vehicles. In the same year, the Crescent City fire department included 1 station, 14 firemen, and 3 fire fighting vehicles. In all, the volunteer units consisted of 19 stations, 283 volunteers, and 41 assorted vehicles (Florida Dept. of Commerce, 1976). With an estimated population of 43,660 in 1976 and 327 firefighters, Putnam County therefore had approximately 7.5 firefighters per 1000 of population. The general minimum standard is 2.4 firefighters per 1,000 of population (Kellum, Patterson, and Bell, 1977c).

Police Protection

Putnam county is served by four different law enforcement agencies - the Putnam County Sheriff's Department, the Palatka Police Department, the Crescent City Police Department, and the Interlachen Police Department. In addition, the Florida Highway Patrol maintains a Division office at Palatka.

The Putnam County Sheriff's Department consisted of 79 employees in 1976. This group included one Sheriff, one Chief Deputy Sheriff, seven detention officers, 10 communications officers, four court officers, nine detectives, 31 patrolmen, and six secretaries (Kellum, Patterson, and Bell, 1977c). The remaining employees work as part-time communications officers, court officers, and youth officers.

The Patrol division in the Sheriff's Department has the use of 20 patrol cars, one van, one truck, and three boats. Putnam County is divided into five patrol zones, each patrolled on a 24-hour basis. Shifts consist of seven officers, six on patrol and one in the station (Kellum, Patterson, and Bell, 1977c).

The Putnam County Jail, constructed in 1963, has capacity for 95 prisoners (83 males and 12 females). The jail is too small to hold the number of prisoners projected for future years (Kellum, Patterson and Bell, 1977a).

As of 1975, the Palatka Police Department consisted of one police station, 25 policemen, and seven patrol vehicles. In the same year, the Crescent City Police Department consisted of one police station, 10 patrolmen, and three patrol vehicles, while the Interlachen Police Department comprised one station, one officer, and one vehicle (Florida Dept. of Commerce, 1976).

The Florida Highway Patrol Division in Putnam County comprises 14 officers. Including these officers with those from the other four police departments, Putnam County had approximately 129 law enforcement officers in 1975. This amounts to approximately 2.95 officers per 1000 population and compares favorably with recognized law enforcement standards which indicate that 1.75 to 2.00 officers are generally required per 1000 persons living within the area to be served (Kellum, Patterson, and Bell, 1977c).

Recreational Activities

Recreation in Putnam County includes those activities that make best use of the ample water resources and warm climate of northern Florida. As a result of the area's reputation for good fishing, Palatka is frequently referred to as the "Bass Capital of the World." In addition to the St. Johns River, the waters of Crescent Lake, Lake George, and Lake Oklawaha are famous for speckled perch, bream, catfish, blue crabs, and shrimp, as well as many species of bass. Other outdoor water sports such as sailing, swimming, boating, and water skiing are also popular in Putnam County.

Hiking and camping are popular activities in the vast forests of the Ocala National Forest which lies in Putnam County, Marion County, and Lake County. Other recreation areas in Putnam County include the Oklawaha Recreation Area, the Rodman Recreation Area, the Kenwood Recreation Area, the Orange Springs Recreation Area, and the Turtle Egg Recreation Area. These areas offer such facilities as boat ramps, canoe launching areas, hiking trails, picnic tables, shelters, and charcoal grills. Ravine Gardens State Park is located within a few blocks of downtown Palatka.

Cultural activities are also prevalent in the Putnam County area. A local concert association sponsors musical events throughout the year, and the Florida School for the Performing Arts presents various dramatic events at the St. Johns River Junior College.

The ocean beaches of Daytona Beach and St. Augustine are all within the Seminole impact area. Other recreational attractions include Walt Disney World in Orlando, the famous tourist center at Silver Springs, and the dog races at Orange Park in Clay County.

2.10.5 Public Utilities

Electricity

Putnam County receives its electric power from the Clay Electric Cooperative, a member of Seminole Electric Cooperative, Inc. (SECI), and from FP&L. The Clay Electric Cooperative, which serves western Putnam County, has no generating capacity of its own, but purchases its power from SECI, and distributes it to the rural areas of Putnam County. As of March 31, 1977, the Clay Electric Cooperative serviced 9,362 customers, 8,651 of which were residential (Putnam County Chamber of Commerce, 1977). During 1976, over 84.6 million kilowatt-hours of electricity were consumed by Clay County Electric Cooperative customers in Putnam County (Putnam County Chamber of Commerce, 1977).

Florida Power and Light Company, which serves the eastern portions of Putnam County, provided service for 11,969 residential customers, 1,834 commercial customers, and 76 industrial customers during 1976. During that same year, FP&L customers in Putnam County consumed over 226 million kilowatt-hours of electric power (Putnam County Chamber of Commerce, 1977).

Florida Power and Light Company has two existing units in operation in Palatka, and two old units were recently retired. The two recently retired units are heavy oil steam units which were constructed in 1951 and 1956 respectively. The combined generating capacity of these two units was 113 megawatts in summer and 117 megawatts in winter. The two new units are combined-cycle, heavy-oil units with a combined generating capacity of 484 megawatts in summer and 552 megawatts in winter.

Natural Gas

Natural gas is supplied to the City of Palatka by the Palatka Gas Authority. Rural areas of Putnam County do not receive natural gas, but are served by about ten companies distributing liquid propane gas and fuel oil (Florida Dept. of Commerce, 1976).

As of 1976, the Palatka Gas Authority provided service to 3,676 customers in Palatka. During that same year, the customers of the Palatka Gas Authority consumed over 270 billion cubic feet of natural gas (Putnam County Chamber of Commerce, 1977).

Water Supply Facilities

Putnam County does not presently provide water supply services within the county. Water is supplied, however, by a few of the incorporated municipalities, and by various other small-scale suppliers. As of 1973, there were approximately 34 existing water systems in Putnam County (Kellum, Patterson and Bell, 1977c). Out of an estimated 12,885 structures in the county, about 5,884, or 45.7 percent, were served by central water systems (Kellum, Patterson, and Bell, 1977c). The majority

of the structures receiving water from central water systems are located in Palatka and Crescent City. Most of the water service is received on an individual basis or as part of small systems which serve single developments or subdivisions. The majority of these systems provide disinfection services, but only the City of Palatka provides fluoridation and filtration in addition to disinfection. Five of the 34 existing systems serve schools only, while 3 of the systems serve the municipalities of Palatka, Crescent City, and Interlachen (Kellum, Patterson and Bell, 1977c). Individual wells supply water in areas of the county not served by central water systems.

The water system for the City of Palatka obtains its water from four wells which enter the Floridan Aquifer (Florida Dept. of Natural Resources, 1976e). The combined capacity of these four wells is 4.6 million gallons per day, although treatment capacity is only 3.5 million gallons per day (Florida Dept. of Natural Resources, 1976e). As of 1975, the maximum daily demand was 3.5 million gallons per day while the average daily demand was 2.5 million gallons per day, for 71 percent utilization rate of the treatment capacity (Florida Dept. of Natural Resources, 1976e).

The pulp and paper industry, which is the major industrial consumer of water in Putnam County, consumes nearly 18.5 billion gallons of water per year, all of which is self-supplied (Florida Department of Natural Resources, 1976e). Approximately 59 percent of their water is drawn from artesian wells, while the other 41 percent is drawn from the surface waters of Etonia and Rice Creeks (Florida Department of Natural Resources, 1976e).

The City of Palatka maintains water storage facilities consisting of two 750,000 gallon elevated tanks and one 400,000 gallon ground storage tank (Florida Department of Natural Resource, 1976e).

Sewage Treatment Facilities

Putnam County does not presently provide sewer services or maintain a system of storm drains. As of 1973, however, there were 19 separate sewage disposal systems operating in the county. Two of these were the municipal systems for Palatka and Crescent City, and five of them served schools only. Out of an estimated 12,885 structures in the county, about 3,961 or 31 percent were served by one of these 19 sewer systems (Kellum, Patterson, and Bell, 1977c). The majority of the structures receiving central sewer service are within the incorporated municipalities of Palatka or Crescent City. Sewer services in these areas are received on an individual basis or as part of small systems serving single developments or subdivisions.

The sewer system for Palatka has a treatment plant with a capacity of 1.75 million gallons per day. The average daily flow through the treatment plant is approximately 1.5 million gallons per day. On occasion, however, the system has reached capacity (Florida Dept. of Natural Resources, 1976e).

The majority of the county residents not receiving sewer service rely on the use of septic tanks for sewage disposal. Because of poor drainage, poor percolation, and a high water table in many areas of Putnam County, however, it appears that much of the soil is poorly suited for the use of septic tanks for sewage disposal.

Solid Waste Disposal

Putnam County provides no door-to-door collection services for solid wastes. Palatka and Crescent City, however, do provide door-to-door collection services, and other areas of the county have private collection service.

The lack of an extensive collection system for the county as a whole has resulted in widespread roadside dumping despite the existence of three county operated sanitary landfill sites (Kellum, Patterson and Bell, 1977c). Due to the high water table and porous soil in much of the county, however, the use of these landfills may adversely impact ground water quality. No current plans exist to institute a county-wide solid waste collection service.

2.10.6 Public Finances (Local)

Property Taxes

As of 1975, the Putnam Site consisted of an estimated 1,942 acres of agriculturally zoned land owned by River Farms, Inc. The total assessed value of these 1,942 acres in 1975 was \$291,225 and the total annual property taxes paid was \$1,832.56. Since the 1975 Putnam County tax rate was 17.98 mills (Florida Dept. of Natural Resources, 1976), and only \$1,832.56 was paid in taxes, it is evident that the non-exempt assessed valuation of these 1,942 acres must have been \$101,922 in 1975. This implies that agriculturally zoned land was subject to an agricultural exemption amounting to 65 percent of the total assessed valuation in 1975.

The total non-exempt assessed valuation for Putnam County in 1975 was \$307,377,895 as is shown in Table 2.10-17. Table 2.10-18 gives a detailed breakdown of the composition of the total and non-exempt assessed valuation. From these data, it becomes apparent that the total non-exempt assessed valuation of the Putnam Site in 1975 as a percentage of the total non-exempt assessed valuation in Putnam County was approximately 0.03 percent.

The breakdown by jurisdiction of the 17.98 mill tax rate in 1975 is illustrated in Table 2.10-19. From this table, it can be seen that the Putnam County School District levied a total of 8.38 mills upon the Putnam County taxpayers in 1975. For the 1976-1977 school year, the school district millage declined to 8.26 mills. The detailed breakdown of the 1976-1977 school district tax levy is illustrated in Table 2.10-20.

The Putnam County School District receives a substantial fraction of its revenue from sources other than local property taxes. From Table 2.10-21, it can be seen that local property tax revenue constituted only 21.88 percent of the total revenues received by the Putnam County School District during the 1975-1976 school year. Table 2.10-21 also indicates, however, that the share of total school district revenue born by local property taxes is expected to increase to 26.12 percent by the 1977-1978 school year.

Various municipalities within Putnam County levy additional millages above the county millages to help finance the added costs of government services in urban areas. As can be seen from Table 2.10-22, these additional levies ranged from 3.43 mills in Pomona Park to 9.92 mills in Palatka for the year 1975.

Sales Tax

The State of Florida has a 4 percent sales tax, which does not include food, drugs, or utility sales. Data for total retail sales for 1972 to 1974 of all the impact area counties is illustrated in Table 2.10-23. The total sales tax collected by Putnam County in 1975 was \$5,612,584. In 1976, Putnam County collected \$5,218,069 (Putnam County Chamber of Commerce, 1977).

Gasoline Tax

In 1975, Putnam County collected \$1,774,726 in state gasoline taxes. In 1976, the figure had increased to \$1,938,428 (Putnam County Chamber of Commerce, 1977).

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Table 2.10-1
Population Characteristics of the Study Area

<u>County</u>	<u>1970 Population</u>	<u>Major City</u>	<u>1970 Population</u>	<u>Miles From Palatka</u>
Alachua	104,764	Gainesville	64,510	44
Bradford	14,625	Starke	4848	39
Clay	32,059	Green Cove Springs	3857	26
Duval	528,865	Jacksonville	528,865	53
Flagler	4454	Bunnell	1687	30
Marion	69,030	Ocala	22,583	54
Putnam	36,424	Palatka	9444	0
St. Johns	30,727	St. Augustine	12,352	28
Volusia	169,487	Daytona Beach	45,327	53

Source: Putnam County Chamber of Commerce, (no date).
Palatka and Putnam County Florida Facts.

Table 2.10-2
Labor Force Characteristics - 1970

<u>State or County</u>	<u>Total Civilian Labor Force</u>	<u>Female Civilian Labor Force</u>	<u>Percent Unemployed of Total Civilian Labor Force</u>	<u>Percent of Labor Force Using Public Transport to Work</u>	<u>Percent of Labor Force Working Outside County of Residence</u>
Florida	2,521,245	1,010,356	3.8%	4.3%	8.0%
Alachua	41,050	17,544	3.4%	1.9%	5.0%
Bradford	4985	1940	4.5%	0.6%	29.4%
Clay	9531	3694	3.1%	0.2%	53.4%
Duval	199,101	81,874	3.3%	6.7%	2.6%
Flagler	1458	530	1.4%	2.9%	23.8%
Marion	25,307	9944	3.5%	1.9%	8.6%
Putnam	13,049	5119	4.3%	2.6%	12.5%
St. Johns	10,990	4246	3.6%	3.9%	15.7%
Volusia	58,394	24,642	4.0%	2.5%	6.7%

Notes: Labor force includes those workers 16 years old and over.

Source: U. S. Department of Commerce, 1972, County and City Data Book.

Table 2.10-3
Employment Characteristics by Occupation
1970

County or State	Total Employment	Manufacturing Percent	Wholesale & Retail Trade Percent	Services Percent	Educational Services Percent	Construction Percent	Government Percent	Professional Managerial Percent	Sales & Clerical Percent	Craftsmen & Foreman Percent
Florida	2,426,268	14.1	23.5	11.5	7.4	8.5	16.0	23.3	26.6	14.5
Alachua	39,639	7.5	19.4	7.9	26.6	6.8	42.9	33.9	25.0	10.3
Bradford	4763	13.9	18.2	6.4	7.8	7.9	28.6	18.2	19.2	15.1
Clay	9232	14.9	18.4	6.5	9.0	7.2	27.4	23.5	25.3	17.8
Duval	192,517	12.3	25.2	10.4	6.5	7.3	17.2	21.9	31.7	14.7
Flagler	1437	12.1	17.7	15.0	7.9	7.2	20.6	25.2	14.2	12.0
Marion	24,428	11.9	24.7	10.5	8.1	8.6	16.4	20.3	22.4	13.3
Putnam	12,492	28.7	17.3	9.2	8.8	4.9	15.8	16.9	19.1	12.3
St. Johns	10,596	13.1	20.0	12.6	8.2	7.6	19.7	23.2	20.9	15.8
Volusia	56,054	10.7	25.0	13.7	8.3	8.9	14.1	24.8	25.1	14.1

Note: Percentages for each county do not sum up to 100% due to overlapping classification.

Source: U. S. Department of Commerce, 1972, County and City Data Book.

Table 2.10-4

Putnam County Manufacturing Sector Employment

<u>MANUFACTURING SECTOR</u>	<u>AVERAGE MONTHLY EMPLOYMENT</u>		
	<u>1969</u>	<u>1974</u>	<u>1975</u>
Total Manufacturing	3,498	3,194	3,137
Food and Kindred Products	193	D	50
Lumber and Wood Products	213	308	300
Furniture and Fixtures	284	D	D
Paper and Allied Products	2,754	2,454	2,397
Machinery Except Electrical	N	D	32
Other Manufacturing	54	432	358

Notes: Only workers covered by unemployment compensation are reported.

D = Non-Disclosure Item. This manufacturing group is summed in "other manufacturing."

N = Employment not reported for this manufacturing sector.

Sources: Employment Security Division, Florida Department of Commerce, Employment and Payrolls, 1969, 1974, and 1975, as cited in Bureau of economic analysis, Division of Economic Development, Florida Department of Commerce, April 1977, Putnam County Economic Data.

Table 2.10-5
Putnam County Employment Characteristics

Year	Putnam County Civilian Labor Force	Annual Growth Rate of Labor Force (%)	Unemployment Rates (%)		
			Putnam	Florida	USA
1970	13,400	18.6	2.5	4.3	4.9
1971	13,580	1.3	3.1	4.9	5.9
1972	13,460	-0.8	2.5	4.5	5.6
1973	14,000	4.0	3.7	4.3	4.9
1974	14,740	5.3	6.2	6.3	5.6
1975	16,280	12.5	8.6	10.7	8.5
1976	16,890	3.7	7.6	9.0	7.7
1977	17,201	1.8	6.3	8.0	7.9

Notes: All county data are March figures while Florida and United States data are annual averages.

Sources: Florida Department of Commerce, Division of Employment Security, (no date), as cited in Bureau of Economic Analysis, Division of Economic Development, Florida Department of Commerce, April 1977, Putnam County Economic Data, and Dames & Moore, 1977.

Table 2.10-6

Putnam County Baseline Employment Projections by Industrial Sector
1980 - 2000

SECTOR 1	1970 ACTUAL	1975 ESTIMATED	1980 PROJECTED	1985 PROJECTED	1990 PROJECTED	1995 PROJECTED	2000 PROJECTED	ANNUAL GROWTH RATE (%) (1970-2000)
Agriculture, forestry and fisheries	1,497	1,540	1,588	1,517	1,464	1,428	1,391	-0.24%
Mining	31	19	5	5	4	4	4	-6.8%
Construction	614	737	872	955	1,017	1,092	1,169	2.1%
Manufacturing	3,585	4,002	4,459	4,797	5,051	5,366	5,686	1.5%
Transportation, Communication, and Public Utilities	558	689	832	937	1,016	1,131	1,248	2.7%
Wholesale and Retail Trade	2,160	2,367	2,593	2,773	2,908	3,092	3,279	1.4%
Finance, Insurance and Real Estate	400	465	537	669	768	883	999	3.1%
Services	2,183	2,380	2,595	2,835	3,015	3,225	3,438	1.5%
Government	1,464	1,781	2,129	2,402	2,606	2,860	3,118	2.5%
Total Employment	12,492	13,980	15,610	16,890	17,849	19,081	20,347	1.6%
Employment-Population Ratio	.34	.36	.38	.386	.39	.395	.41	

Notes: Projections were made by Jacksonville Area Planning Board, which used the OBERS methodology and assumptions. For detailed information on OBERS methodology and assumptions, see U. S. Water Resource Council, April 1974,

1972 OBERS Projections, Volume One, Concepts, Methodology, and Summary Data. For detailed information on Jacksonville Area Planning Board Methodology for adjusting OBERS projections, see Jacksonville Area Planning Board, June 1976, Regional Employment Study.

Source: Jacksonville Area Planning Board, 1976b, Regional Employment Study, and Bureau of the Census, 1970, U. S. Census of Population, and Dames & Moore, 1977.

Table 2.10-7
Seminole Project Area Income Characteristics

<u>County or State</u>	<u>Total Personal Income (million dollars)</u>			<u>Per Capita Personal Income</u>		
	<u>1974</u>	<u>1975</u>	<u>Percent Change</u>	<u>1974</u>	<u>1975</u>	<u>Percent Change</u>
Florida	43,742	47,069	7.6	5406	5640	4.3
Alachua	568	624	9.9	4545	4813	5.9
Bradford	54	62	14.8	3415	3722	9.0
Clay	212	237	11.8	4459	4709	5.6
Duval	2983	3221	8.0	5322	5646	6.1
Flagler	28	30	7.1	4665	4631	-0.7
Marion	388	422	8.8	4112	4376	6.4
Putnam	151	174	15.2	3579	4018	12.3
St. Johns	174	190	9.2	4703	4888	3.9
Volusia	984	1072	8.9	4855	5110	5.3

Notes: All values are in current dollars.

Sources: Bureau of Economic and Business Research, University of Florida, May 1977, Florida Economic Indicators, as cited in Florida Department of Commerce, (no date), Florida Facts, and Dames & Moore, 1977.

Table 2.10-8

Sources of Personal Income

Year	Wage and Salary Disbursements (% of Total)		Proprietor's Income (% of Total)		Dividends, Interest and Rent (% of Total)		Transfer Payments (% of Total)		Other Labor Income (% of Total)	
	Putnam	Florida	Putnam	Florida	Putnam	Florida	Putnam	Florida	Putnam	Florida
1970	63.5	60.3	8.1	7.7	10.1	17.6	15.0	11.5	3.3	2.9
1971	60.6	59.4	8.7	8.0	10.3	17.2	17.1	12.4	3.3	3.0
1972	58.9	58.6	8.6	7.4	11.5	18.3	17.8	12.5	3.3	3.2
1973	56.8	57.6	8.5	7.3	12.3	19.3	19.2	12.7	3.1	3.1
1974	55.8	57.7	7.8	6.3	12.2	18.8	20.9	13.9	3.2	3.3

Sources: Bureau of Economic Analysis, U. S. Department of Commerce, (no date), unpublished data, as cited in Bureau of Economic Analysis, Division of Economic Development, Florida Department of Commerce, April 1977, Putnam County Economic Data.

Table 2.10-9

Average Wage and Salary Income By Industrial Sector - 1974

<u>Industrial Sector</u>	<u>Putnam County</u>	<u>Florida</u>	<u>United States</u>
Total All Industries	7,956	8,420	9,295
Agriculture, Forestry, and Fisheries	5,451	7,115	6,778
Mining	D	11,841	12,671
Contract Construction	8,620	10,349	11,459
Manufacturing	10,547	9,314	10,503
Transportation, Communication, and Public Utilities	9,446	10,815	11,733
Wholesale and Retail Trade	5,509	6,968	7,342
Finance, Insurance, and Real Estate	7,588	8,900	9,277
Services	4,897	7,340	7,525
Government	7,392	9,270	10,869
Unclassified Industries	D	3,210	7,217

Notes: Only wages for workers covered by unemployment compensation are reported.

D = non-disclosure industry. These numbers are included in "Total All Industries." Data are in current 1974 dollars.

Sources: Employment Security Division, Florida Department of Commerce, Employment and Payrolls 1974, as cited in Bureau of Economic Analysis, Division of Economic Development, Florida Department of Commerce, April 1977, Putnam County Economic Data.

Table 2.10-10

Average Wage and Salary Income By Manufacturing Sector

<u>MANUFACTURING SECTOR</u>	<u>1973</u>		<u>1974</u>		<u>1975</u>	
	<u>Putnam County</u>	<u>Florida</u>	<u>Putnam County</u>	<u>Florida</u>	<u>Putnam County</u>	<u>Florida</u>
Food and Kindred Products	D	8,133	D	8,937	8,691	9,537
Lumber and Wood Products	5,129	7,185	5,391	8,214	5,791	8,092
Paper and Allied Products	10,710	10,354	11,862	11,272	13,396	12,677
Printing and Publishing	6,246	8,401	D	8,946	D	9,606
Machinery Except Electrical	D	9,611	D	10,483	6,834	11,827
Other Manufacturing	6,605	0	6,751	0	6,945	0
Total Manufacturing	9,572	8,617	10,547	9,314	11,790	10,089
All Industrial Divisions	7,390	7,841	7,956	8,420	8,772	9,050

Notes: Only wages covered by unemployment compensation are reported.
D = non-disclosure item. This manufacturing sector is summed
in "Other Manufacturing." Data are in current dollars.

Sources: Employment Security Division, Florida Department of Commerce,
Employment and Payrolls 1973, 1974, and 1975, as cited in Bureau
of Economic Analysis, Division of Economic Development, Florida
Department of Commerce, April 1977, Putnam County Economic Data.

Table 2.10-11

Putnam County Basic and Non-Basic Income by Sector - 1974
(Millions of Dollars)

<u>Sector</u>	<u>Total Putnam County Income</u>	<u>Total National Income</u>	<u>Basic Putnam Income</u>	<u>Non-Basic Putnam Income</u>
Total Income	90.2	832,687	0	90.2
I. Agriculture	5.6	39,745	1.3	4.3
II. Non-agriculture	84.6	792,942	-1.3	85.9
A. Private Sector	68.6	647,836	-1.6	70.2
1. Mining	D	8,116	D	0.9
2. Construction	5.2	52,679	-0.5	5.7
3. Manufacturing	33.9	222,041	9.8	24.1
4. Transportation, Communication and Public Utilities	3.6	59,928	-2.8	6.4
5. Retail and Whole- sale Trade	13.0	134,377	-1.6	14.6
6. Finance, Insurance and Real Estate	2.5	42,848	-2.1	4.6
7. Services	8.6	125,301	-5.0	13.6
8. Other	D	2,546	D	0.3
B. Government Sector	16.0	145,106	0.3	15.7
1. Federal Civilian	2.0	35,134	-1.8	3.8
2. Federal Military	1.1	19,147	-1.0	2.1
3. State and Local	12.9	90,825	3.1	9.8

Note: Basic and Non-basic income is calculated via the location quotient methodology as described in Tiebout, Dec. 1962 (see Appendix I-1).

D = Non-Disclosure Industry.

Source: U. S. Department of Commerce, unpublished data, as cited in Florida Department of Commerce, Division of Economic Development, Bureau of Economic Analysis, Putnam County Economic Data, April 1977, and Dames & Moore, 1977.

Table 2.10-12

Putnam County Baseline Income Projections by Industrial Sector
 1980 - 2020
 (In Millions of 1967 Dollars)

<u>Sector</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>Annual Growth Rate (1980-2020)</u>
Agriculture, Forestry, and Fisheries	1.8	2.1	2.5	3.0	3.5	1.7%
Mining	0.1	0.1	0.2	0.2	0.3	2.7%
Contract Construction	4.1	6.1	8.7	12.0	15.4	3.3%
Manufacturing	43.6	62.5	88.2	122.7	157.4	3.2%
Transportation, Communication, and Public Utilities	3.4	5.3	8.1	12.1	16.6	4.0%
Wholesale and Retail Trade	14.1	20.0	28.3	39.1	50.0	3.2%
Finance, Insurance and Real Estate	3.3	5.9	9.7	15.4	21.7	4.7%
Services	11.3	16.6	23.9	33.8	44.1	3.4%
Government	18.9	29.4	43.9	62.0	85.7	3.8%
Total Personal Income	142.6	209.1	300.6	419.9	546.5	3.4%

Source: U. S. Department of Commerce, Bureau of Economic Analysis, as cited in U. S. Army Corps of Engineers, South Atlantic Division, December 1975, Projections of Economic Activity in Florida, Series E Population, and Dames & Moore, 1977.

Table 2.10-13

Housing Characteristics

County or State	Total Number of Year Round Housing Units 1970	Housing Units Percent Change 1960 to 1970 (%)	Homeowner Vacancy Rate - 1970 (%)	Rental Vacancy Rate - 1970 (%)	Median Gross Rents - 1970 (\$)
Florida	2,490,838	45.4	1.8	10.7	114
Alachua	33,519	55.0	2.2	8.6	115
Bradford	4591	17.2	1.0	10.5	69
Clay	10,445	64.2	2.1	9.6	112
Duval	174,149	24.3	2.3	11.5	99
Flagler	1841	23.8	1.1	15.3	69
Marion	25,830	54.1	1.6	10.9	82
Putnam	12,900	24.4	1.4	13.5	67
St. Johns	11,581	16.0	3.2	14.5	79
Volusia	70,289	40.9	2.3	14.4	91

Sources: U. S. Department of Commerce, 1972, County and City Data Book.

Table 2.10-14

Enrollment and Capacity in Putnam County School District
1977 - 1978

<u>Name of School</u>	<u>Grades</u>	<u>Student Capacity</u>	<u>Estimated Enrollment</u>	<u>Number of Teachers</u>	<u>Student-Teacher Ratio</u>	<u>Square Footage</u>	<u>Square Feet Per Pupil</u>
Beasley Middle	6-8	895	965	44	21.9	92,911	96.3
Moseley Elementary	K-5	1,501	1,092	63	17.3	122,203	111.9
Mellon Elementary	K-5	525	473	25	18.9	41,692	88.1
Smith Community	K-5	625	537	28	19.2	34,765	64.7
Interlachen Community	K-5	500	540	28	19.3	33,857	62.7
Interlachen High	9-12	955	608	31	19.6	113,695	187.0
Price Middle	6-8	365	435	19	22.9	21,184	48.7
Melrose Community	K-5	400	352	21	16.7	35,340	100.4
Long Elementary	K-5	335	356	19	18.7	25,611	71.9
Jenkins Middle	6-8	894	705	35	20.1	73,615	104.4
Browning-Pearce Community	K-5	675	637	34	18.7	48,841	76.7
Miller Middle	6-8	609	435	21	20.7	56,396	129.6
Crescent City Community	K-5	700	659	35	18.8	36,730	55.7
Crescent City High	9-12	878	527	29	18.2	95,572	181.4
Palatka High	9-12	2,095	2,127	110	19.3	206,594	97.1
Total	K-12	11,952	10,448	542	19.3	1,039,006	99.4

Note: K = Kindergarten

Source: Putnam County School District, Office of the Superintendent, 1977, and Dames & Moore, 1977.

Table 2.10-15

Putnam County School District Projected Enrollments

<u>Year</u>	<u>PROJECTED ENROLLMENTS</u>			
	<u>Grades K-5</u>	<u>Grades 6-8</u>	<u>Grades 9-12</u>	<u>Grades K-12</u>
1976-1977	4,599	2,700	3,268	10,567
1977-1978	4,594	2,653	3,318	10,565
1978-1979	4,645	2,586	3,302	10,533
1979-1980	4,663	2,486	3,252	10,401
1980-1981	4,638	2,523	3,211	10,372
1981-1982	4,642	2,562	3,129	10,333

Note: Projection methodology is an adaptation of the "Cohort Survival Technique" as used by the United States Census Bureau.

Sources: Putnam County School District, November 1976, Survey of School Plants.

Table 2.10-16

Putnam County 24-Hour Average Annual Traffic Flows

<u>LOCATION</u>	<u>Number of Vehicles Per 24-Hour Period</u>				
	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>
US 17 at Bostwick	2,375	2,905	3,515	3,715	3,756
Route 209 at Bostwick	295	240	490	483	N
US 17 at Moccasin Creek	3,170	3,550	3,330	3,988	3,852
Route 209 at Moccasin Creek	1,135	1,560	1,285	1,651	1,678
US 17 at Rice Creek Bridge	4,655	4,780	5,305	5,528	5,408
US 17 at Pecan	5,600	5,610	6,100	6,382	5,995
Route 100 West of US 17	12,170	12,050	11,790	14,236	14,949
US 17 North of Route 100	6,785	6,850	5,935	6,393	7,542

Note: N = No data.

Source: Photogrammetric Division Traffic Planning Division, Florida State Road Department, and U. S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads.

Table 2.10-17

Putnam County:
Trends in Assessed Valuation

<u>Year</u>	<u>Non-Exempt Valuation (\$)</u>
1972	186,497,732
1973	245,126,908
1974	250,943,149
1975	307,377,895
1976	350,945,025

Note: Data for 1976 is subject to revision.

Source: Putnam County School District, November 1976,
Survey of School Plants.

Table 2.10-18

Putnam County Assessed Valuation
1975

	Total Assessed Valuation (Dollars)	Non-Exempt Valuation (Dollars)
Real Estate	371,013,884	230,830,348
Personal Property	93,877,885	69,256,251
Utilities	7,293,321	7,291,296
Total	472,185,090	307,377,895

Source: Putnam County Chamber of Commerce, February 1977,
Palatka and Putnam County Florida.

Table 2.10-19

Putnam County Millage and
Property Tax Revenue By Jurisdiction
1975

<u>JURISDICTION</u>	<u>MILLS</u>	<u>REVENUE</u>
County General Fund	6.97	\$2,142,407
County Health Unit	.32	98,366
Bond Interest and Sinking Fund	.31	95,297
County School Fund	7.50	2,305,343
County School Bond Debt	.88	270,488
County Road and Bridge	2.00	614,756
Other	-	3,439
Total Taxes Levied	17.98	\$5,530,096

Source: Putnam County Chamber of Commerce, February 1977,
Palatka and Putnam County Florida.

Table 2.10-20

Putnam County School District Tax Levies
on Non-Exempt Property
1976 - 1977

<u>REVENUE FUND</u>	<u>DISTRICT TAX LEVIES IN MILLS</u>		
	<u>School Board Levy</u>	<u>Citizen Voted Levy</u>	<u>Total Levy</u>
Operating Cost Fund	7.5	0.0	7.5
Interest and Sinking Cost Fund	0.0	0.76	0.76
Local Capital Improvement Fund	0.0	0.0	0.0
Total Millage on Non-exempt Property	7.5	.76	8.26

Note: Data applies to the 1976-1977 school year. Given the 8.26 Mill Tax Rate, and \$350,945,025 of non-exempt valuation, and assuming a 95% collection rate, this levy should yield approximately \$2,753,859 for the school district.

Source: Putnam County School District, November 1976, Survey of School Plants.

Table 2.10-21

Putnam County School District Revenues
1975/76 - 1977/78

<u>REVENUE RECEIPTS</u>	<u>1975-1976 SCHOOL YEAR</u>		<u>1976-1977 SCHOOL YEAR</u>		<u>1977-1978 SCHOOL YEAR</u>	
	Amount	Percent	Amount	Percent	Amount	Percent
State Revenue	\$8,072,185.82	63.82	\$7,942,139.02	68.88	\$8,395,228.74	65.91
Federal Revenues received through the State	601,136.00	4.76	5,000.00	.04	20,000.00	.16
Local District Revenues	2,765,891.00	21.88	2,636,357.00	22.86	3,326,548.00	26.12
Other Revenues (balances)	1,200,269.32	9.50	946,985.03	8.22	995,690.52	7.81
Total Revenue	\$12,639,482.14	100.00	\$11,530,481.05	100.00	\$12,737,467.26	100.00

Source: Putnam County School District, Office of the Superintendent, 1977.

Table 2.10-22

Millage Rates in Selected Putnam
County Municipalities
1975

<u>Municipality</u>	<u>Putnam County Levy</u>	<u>City Levy</u>	<u>Total Levy</u>
Crescent City	17.98	9.42	27.40
Interlachen	17.98	6.95	24.93
Palatka	17.98	9.92	27.90
Pomona Park	17.98	3.43	21.41
Welaka	17.98	5.93	23.91

Source: Putnam County Chamber of Commerce, February 1977,
Palatka and Putnam County, Florida.

Table 2.10-23

Total Retail Sales in the Study Area
1972 - 1974
(In Millions of Current Dollars)

<u>County or State</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
Florida	\$17,898.6	\$23,895.	\$26,708.6
Alachua	252.4	340.3	415.6
Bradford	21.9	31.4	31.8
Clay	54.3	80.5	66.2
Duval	1,364.7	1,772.6	1,837.8
Flagler	6.9	8.9	15.7
Marion	219.2	306.8	346.2
Putnam	73.9	99.7	98.0
St. Johns	60.8	83.7	101.8
Volusia	451.6	560.6	719.8

Source: Sales Management Magazine, July 23, 1973, July 8, 1974, and July 21, 1975, Survey of Buying Power.

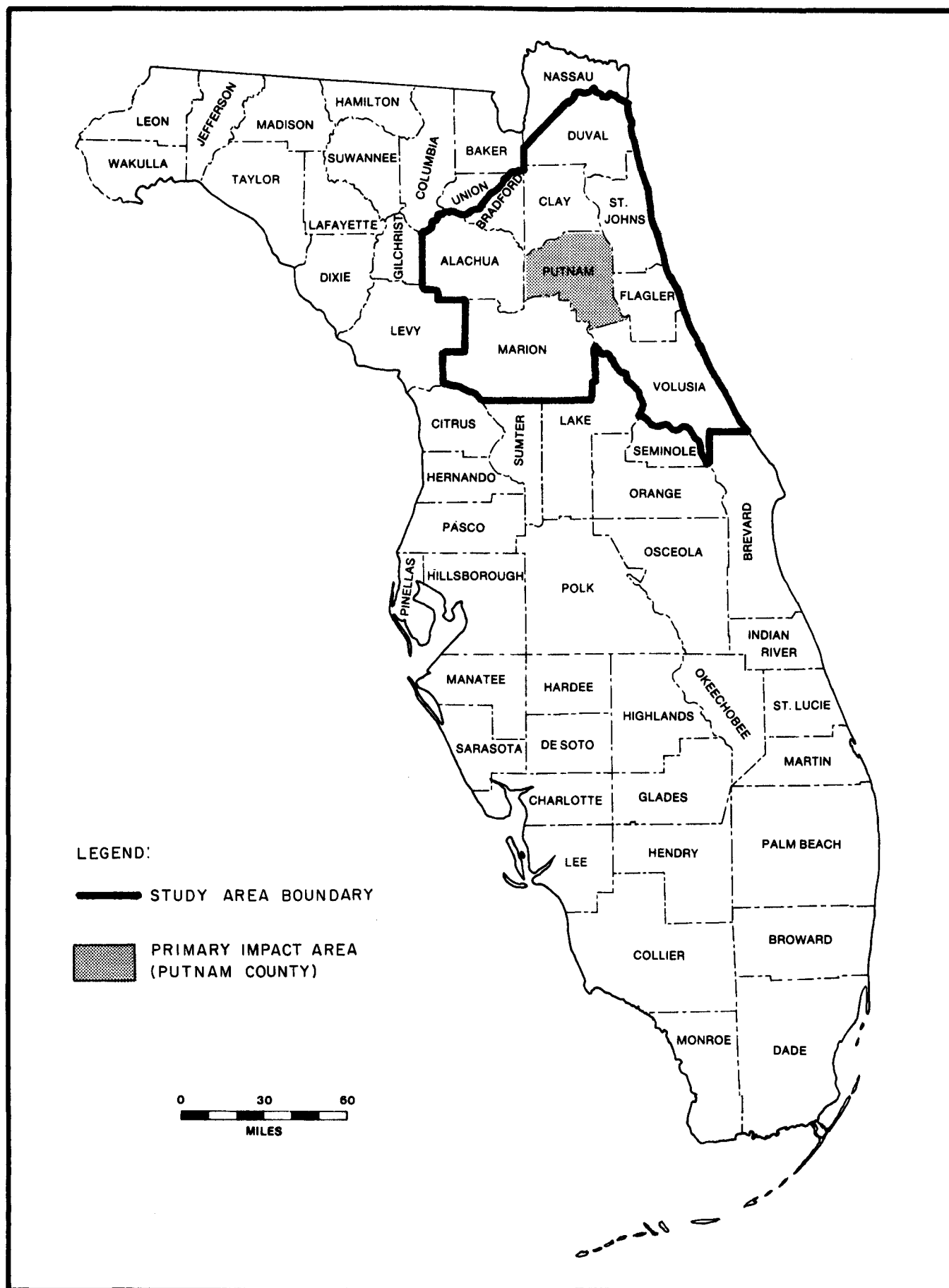


Figure 2.10-1. Putnam Site Socioeconomic Impact Study Area.

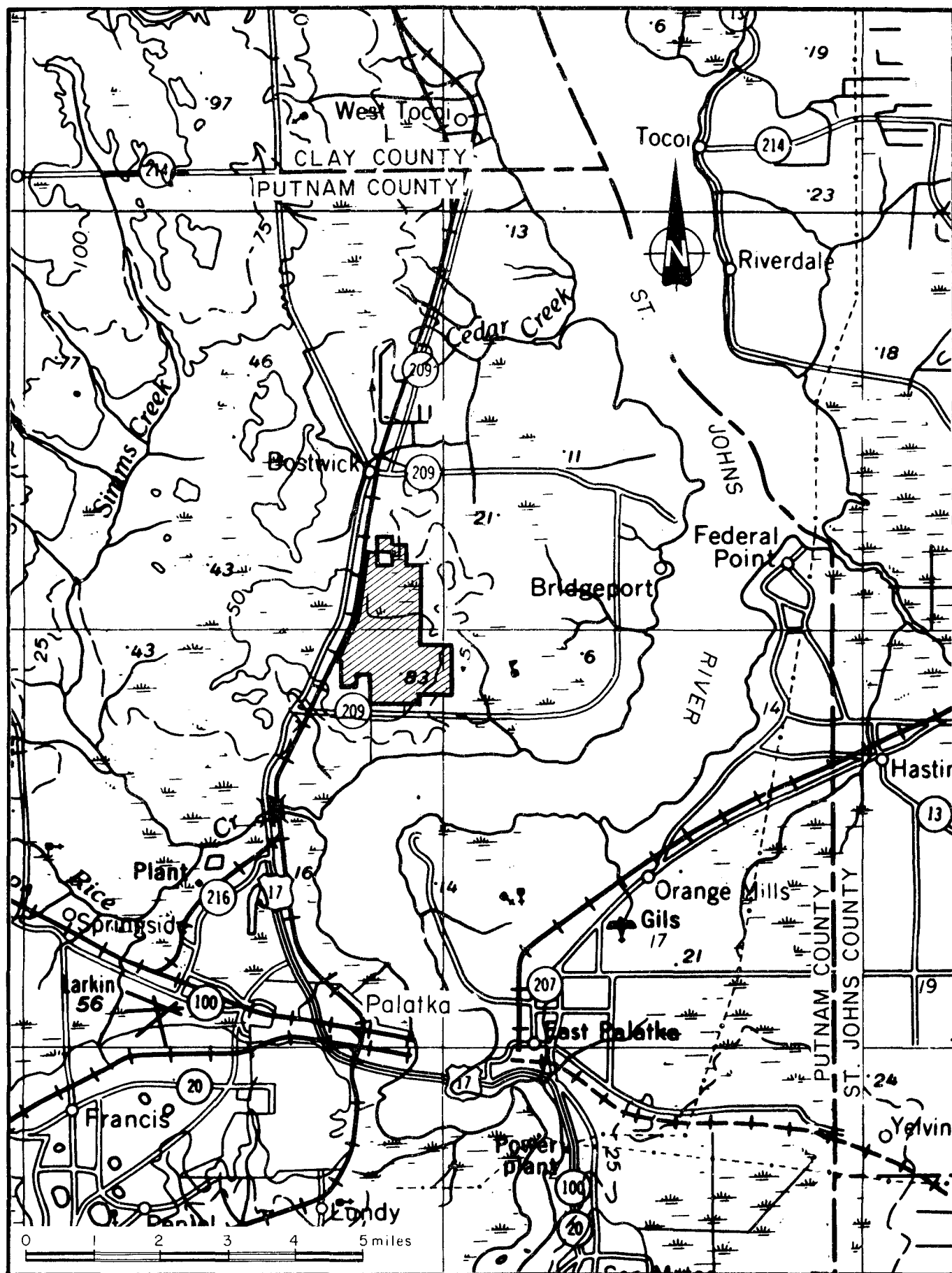


Figure 2.10-2. Putnam Site Area Roads.

2.11 WATER USE

2.11.1 Surface Water Use

Withdrawal

There is relatively little withdrawal from the St. Johns River throughout its length. The principal purposes for the withdrawal are domestic, industrial, and irrigation uses. Such uses of the river are, to a degree, limited by poor water quality throughout the entire course of the river. In the upper portion of basin, total dissolved solids (TDS) concentrations are higher than normally experienced in a surface watercourse due primarily to the inflow of highly mineralized water from springs. Downstream of Palatka, the concentration of TDS is increased due to the effect of winds and tides bringing sea water upstream.

The only significant domestic withdrawal of the St. Johns River occurs from Lake Washington in its upper reaches. Increased TDS downstream precludes use of the river water for domestic water supply. Industrial uses, such as cooling water, are only a small part of the total river flow. The only significant surface water withdrawal from the St. Johns in the vicinity of the site is the Florida Power & Light (FP&L) Palatka Plant, 7.5 miles upstream. This plant withdraws a maximum of about 15.0 cubic feet per second (cfs). Approximately 11.5 cfs of this is lost due to evaporation and drift (Florida Power & Light, 1977). The old FP&L Putnam Plant located adjacent to the Palatka Plant, now inactive except for occasional peak-demand use, withdraws 124 cfs for once-through cooling purposes.

Although the potential exists for a greater use of the river for irrigation, only minimal use occurs presently because of readily available ground water of better quality.

Water Dischargers

Based on the St. Johns River Water Management Plan (DER, 1975), the plant site is located on the St. Johns River segment 20.3 FA. This segment extends from the confluence of Rice Creek and the St. Johns River, two miles upstream of the site, to Hibernia, Florida, 31 miles

downstream of the site. Segment 20.3 HA extending from Rice Creek upstream through Lake George, and segment 20.3 GA, which encompasses the Rice Creek drainage basin, are the two adjacent upstream segments (Appendix C, Figure C-7).

Downstream of the site, twelve wastewater treatment facilities discharge into segment 20.3 FA (DER, 1975). Ten are domestic facilities with a total design flow of 0.845 million gallons per day (mgd) and two are industrial with a total design flow of 4.7 mgd. The nearest facility downstream of the site is a manufacturing plant eight miles away with a design capacity of 0.305 mgd. A summary of these surface water discharges is given in Appendix C, Table C-17.

Upstream of the site, seven wastewater treatment facilities discharge into segments 20.3 GA and 20.3 HA (DER, 1975). Of the seven, five discharge into the St. Johns and two into Rice Creek. The five facilities discharging into the St. Johns are all in the Palatka urban area and include three industrial facilities and two domestic facilities. The largest discharger is the FP&L Palatka Plant, the major effluent of which is cooling tower blowdown estimated at approximately 2.0 mgd. The remaining four facilities have a total design flow of 1.77 mgd.

The two facilities on Rice Creek are in the Palatka urban area and have a total design discharge of 50.01 mgd. Of this total, 50 mgd is discharged into Rice Creek four miles upstream of its mouth, and is from an industrial facility, Hudson Pulp and Paper Company. The remaining facility discharges 0.01 mgd of domestic waste into a swamp contiguous to Rice Creek approximately 3.5 miles from the mouth.

A summary of the surface water discharges upstream of the site in segments 20.3 GA and 20.3 HA are given in Appendix C, Table C-18.

TABLE C-1)

WASTEWATER DISCHARGES DOWNSTREAM OF SITE
(SEG. 20.3 FA)

No.	Plant Name and Location	Discharge Point	Plant Flow (mgd)		Waste Water Effluent Charact. (lbs/day)				Estimated UOD
			Design	Aver.	BOD 5	TSS	Nitro.	Tot P04	
DOMESTIC									
1	Town of Green Cove Spgs.	St. Johns River	0.500	.400	55	96	108	64	528.0
2	Town of Hasings	Swamp to Cracker Cr. to St. Johns River	0.100	.075	10.4	18	20.4	12	99.0
3	Magnolia Sprgs. Apts.	Swamp to St. Johns R.	0.070	.070	12	9.0	21	12	92.4
4	Reynolds Indust. Pk.	St. Johns River	0.068	.068	2.8	6.8	18.5	10.9	89.8
5	Holiday Inn	Ditch to Six Mile Swamp to St. Johns R.	0.050	.0006	0.8	1.4	1.6	1.0	7.9
6	Econo Travel Motor Hotel	Ditch to swamp to St. Johns River	0.020	.015	2.1	3.6	4.1	2.4	19.8
7	Candyland, Inc.	Ditch to swamp to St. Johns River	0.015	.015	2.1	3.6	4.1	2.4	19.8
8	Wesley Retirement Village	St. Johns River	0.010	.010	1.4	2.4	27	1.6	13.3
9	Vines Union 76	Red House Br. to Six Mile Cr. to St. Johns R.	0.008	.008	1.1	1.9	2.2	1.3	10.6
10	Johns Manville	St. Johns River	0.005	.005	.7	1.2	1.4	8	6.6
COMMERCIAL OR INDUSTRIAL									
11	Titanium Enterprises	Ditch to Clark Cr. to St. Johns River	4.4	2.3	-	-	-	-	-
12	Johns Manville	St. Johns River	.300	.300	-	-	130	77	-
Total			5.546	3.2666					

TABLE C-18

WASTEWATER DISCHARGES UPSTREAM OF SITE
(SEG. 20.3 GA and 20.3 HA)

No.	Plant Name and Location	Discharge Point	Plant Flow (mgd)		Waste Water Effluent Charact. (lbs/day)				Estimated UOD
			Design	Aver.	BOD 5	TSS	Nitro.	Tot P04	
DOMESTIC									
13	City of Palatka, Putnam County	Canal to St. Johns River	1.750	1.700	128	142	462	272	2,244
14	Captain Joe's Restaurant	St. Johns River	.0075	UK	0.8	0.7	-	-	-
15	Paradise Park MHP Rt. #1, Palatka	Rice Creek,	.010	.006	0.8	1.4	1.6	1.0	7.9
COMMERCIAL OR INDUSTRIAL									
16	Florida Power & Light	St. Johns River	2.0	2.0	NA	UK	-	-	-
17	East Side Launderomat	Ditch to St. Johns River	.010	.003	1.4	2.4	2.7	1.6	13.2
18	Florida Packing & Provisions, Inc.	Pipeline to St. Johns River	.009	.005	0.6	1.2	1.4	0.8	6.6
19	Hudson Pulp & Paper Co.	Rice Creek	<u>50.0</u>	<u>48.0</u>	26x10 ⁶	-	-	-	-
Total			53.7865	51.714					

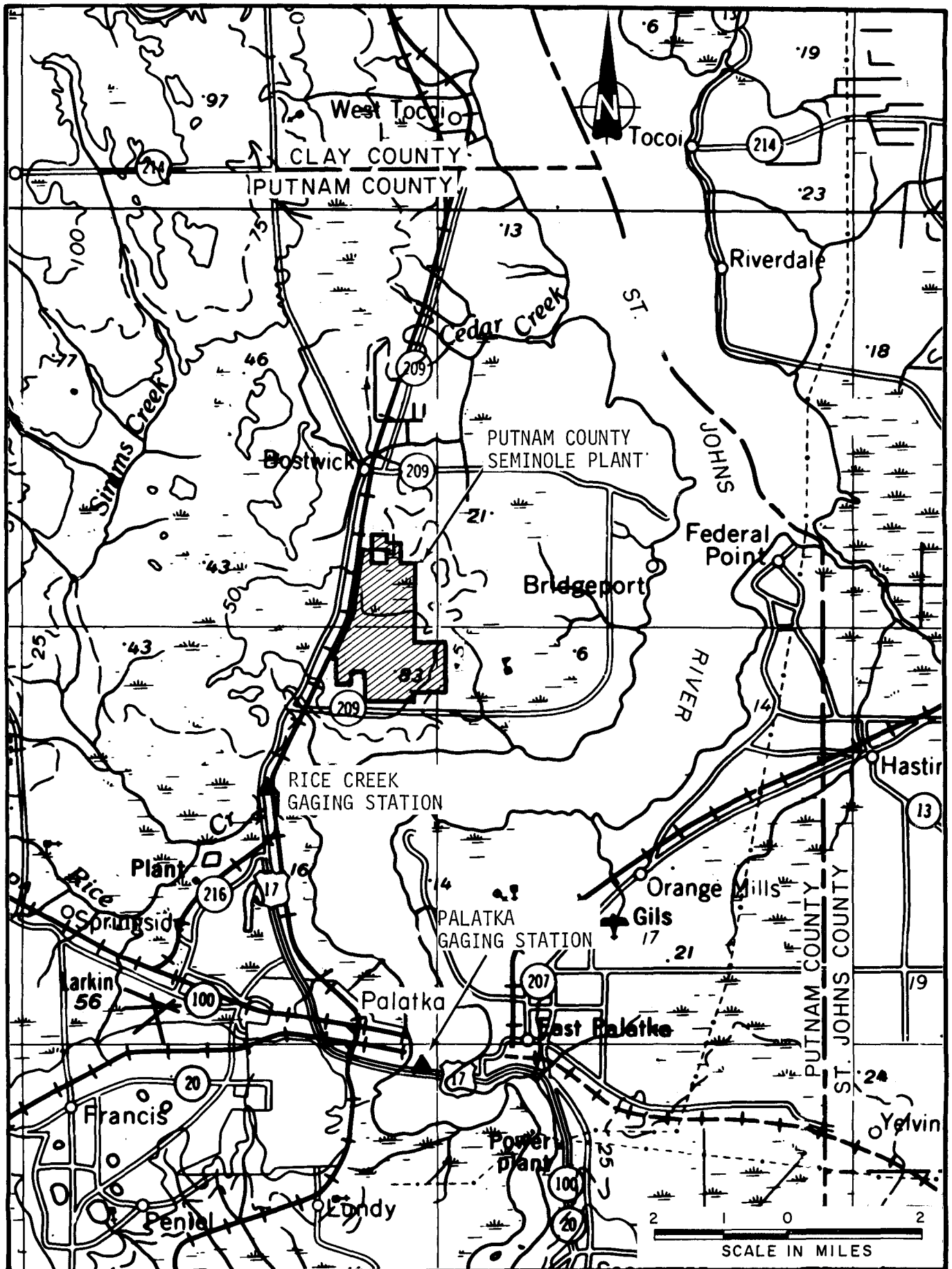


Figure C -1. Location Map.

2.11.2 Ground Water Use

Selected wells within a five-mile radius of the center of the site were inventoried for physical characteristics and water use. Appendix D.6 gives the results.

A total of 145 domestic, agricultural, and industrial wells was inventoried from the literature and/or in the field. Table 2.11-1 shows that approximately 74 percent of the wells inventoried withdrew from the Floridan Aquifer, 16 percent withdrew from the water table aquifer, and 10 percent were undetermined.

Ground water use in the Bostwick area is notable. Northward, down gradient from the site, three water table wells were identified. These wells (S-1, S-2, S-3) were located about one-half mile southeast of Bostwick (Appendix D, Figure D-8). They were near the ditch that drains from the lowlands north of the site. Other water table wells in the Bostwick area appear to be topographically independent of any movement of water-table ground water from the site. Only one other identified well (S-17) is along the ditch draining from the swamp, but it withdraws from the deeper Floridan Aquifer.

Well yields are usually a function of well construction as well as the characteristics of the aquifer. Some Floridan Aquifer wells are reported to produce at a rate greater than 2000 gpm (Well C-8, Table D-7). Yields from the water table aquifer are at significantly lesser rates but sufficient for residences and for the multiple dwellings of a trailer park in Bostwick.

Ground water withdrawn in Putnam County during 1970 by use included 2.7 mgd for public water supply (most from the Floridan Aquifer), 9.7 mgd for agriculture, and 15.5 mgd for industry (Jacksonville Area Planning Board, 1977).

Table 2.11-1

Source of Water in Wells

<u>Quadrant*</u>	<u>Total</u>	<u>Floridan Aquifer</u>	<u>Water Table Aquifer</u>	<u>No Depths Available</u>
A	41	22	17	2
B	4	3	1	-
C	31	27	2	-
D	<u>69</u>	<u>55</u>	<u>4</u>	<u>10</u>
Total	145	107	24	14

*Note: See Appendix D, Figures D-7 and D-9.

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SITE CERTIFICATION APPLICATION AND ENVIRONMENTAL ANALYSIS

SEMINOLE PLANT UNITS NO. 1 & NO. 2

**SEMINOLE ELECTRIC COOPERATIVE,
INC.**

VOLUME II

3.0 STATION FACILITIES

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3.0 STATION FACILITIES

Descriptions of facilities contained herein reflect the best available information at the time this document is written. It is expected that changes and refinements will be made as the engineering and design process proceeds. The information was furnished by Seminole Electric Cooperative, Inc. (SECI) and Burns and Roe, Inc., the project architect/engineer consultant.

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3.1 STATION LAYOUT AND APPEARANCE

The plan-view layout of major station facilities is shown in Figure 3.1-1. The environmental basis for the layout is described in Section 9.3.1. Table 3.1-1 gives a summary of pertinent data for Seminole Plant Units No. 1 and No. 2.

3.1.1 Structures

A profile of the station structures is shown in Figure 3.1-2 and an artist rendering is given as the frontispiece to Volume I. Table 3.1-2 gives pertinent data for the power block.

3.1.2 Site Drainage Plan

Landscaping Plan

The proposed site landscaping plan is shown in Figure 3.1-3. Site clearing will be minimized; only those areas will be cleared which are needed to accommodate plant facilities and allow reasonable access to those facilities. Landscaping, as required, will utilize indigenous grasses, shrubs, and trees to minimize maintenance requirements for energy and water; minimize disruption of vegetative communities; and fully use vegetative buffer around the site for aesthetic enhancement and noise control.

Areas to be cleared will be marked. Clearing will be accomplished under supervision. Care will be taken to assure that adequate control is maintained over all phases of the clearing operation. Debris from clearing will be disposed of in an approved manner.

Untreated Storm Drainage

The proposed site will be designed to handle storm runoff in excess of the infiltration capacity of site soils. While excessive runoff is not expected because of the very porous soils, a proposed drainage system design, Figure 3.1-4, will consist of properly sloped ground toward open ditches or swales to collect and channel runoff from the

area. The excess runoff shall be directed towards existing swamps or lowlands onsite as shown on Figure 3.1-4. The lowlands will serve dual purpose of sedimentation ponds as well as holding ponds for water to accumulate prior to infiltration into the ground. The cross-sectional area of the ditches and culverts will be adequate for critical quantities of flow based on the 10-year rain occurrence as defined by the U.S. Dept. of Commerce (1961) allowing for inlet time considerations.

Culverts will be concrete or corrugated galvanized steel and will be designed for full capacity, covering the computed flow times a safety factor of not less than 1.25. The design will follow the "Rational Method" (American Society of Civil Engineers, 1970).

Treated Storm Drainage

Drainage and rainwater runoff from coal and limestone areas will be conveyed by unlined ditches to the ash pond for sedimentation and equalization before further treatment. Continuous low-volume coal pile seepage collected between rainfall events will be pumped to the bottom ash disposal area.

3.1.3 Transportation System

3.1.3.1 Fuel

Coal is expected to be delivered via the Louisville and Nashville Railroad and transferred to the Seaboard Coast Line Railroad on 70- to 90-car unit trains. Each car will hold 100 tons of coal. It is expected that one to two trains will arrive at the site per day. Train arrivals can be expected at any time of the day or night, seven days per week, depending on railroad scheduling at the time.

3.1.3.2 People

There will be vehicle entrances at the west side of the property to U.S. Route 17 and at the south end of the property to State Route S209. The service entrance will be on the west side of the site at U.S. Route 17, and the personnel entrance will be at the south end of the property at State Route S209.

Table 3.1-1
Seminole Plant Units No. 1 and No. 2
Summary of Pertinent Data

I. Electrical Generating System

Number of Boilers	2
Type	Pulverized Coal
Rated Capacity of Generators with valves wide open (MW-net)	1200
Rated (Guaranteed) Capacity (MW-gross nominal)	1240
Max. Generation at valves wide open - 5% over pressure all heaters in service (MW-gross nominal)	1360
Max. Steam Flow (Lbs/Hr)	4,904,000

II. Flue Gas System

Number of Stacks (dual-flue)	1
Height of Stack (ft)	675
Number of Liners	2
Diameter at Top (inside-ft, each flue)	36
SO ₂ Removal System	Limestone Scrubbers
Avg. SO ₂ Removal including coal washing at mine (%)	85 ^a
Particulate Removal	Electrostatic Precipitators
Avg. Particulate Removal (%)	99.6 ^a
Nitrogen Oxides Control	0.6 lbs/10 ⁶ Btu by boiler design

III. Cooling System

Type	Closed Cycle
Cooling Tower Type (1 per unit)	Natural Draft
Cycles of Concentration	4

Table 3.1-1 (Continued)

Max. Heat Rejection Rate (Btu/Hr)	6.05×10^9
Avg. Heat Rejection Rate (Btu/Hr)	4.12×10^9
Approach (°F)	13
Temperature Range (°F)	21
Design Ambient Wetbulb (°F)	79
Design Relative Humidity	60%
Flow through Condensers (gpm)	520,000
Design Evaporation (gpm)	11,100
Avg. Evaporation (gpm)	8,250
Design Drift (gpm)	27
Avg. Drift (gpm)	27
Design Makeup (gpm)	14,800
Avg. Makeup (gpm)	11,000
Design Blowdown (gpm)	3,650
Avg. Blowdown (gpm)	2,700
Travel Time across Condensers (sec)	17.5
Type of Condenser Anti-fouling	Shock Chlorination

IV. Fuel

Type	Bituminous Coal (Illinois Basin)
Annual Coal Consumption at 0.7 ^b Load Factor (Million tons per year)	3.262
Coal Consumption @ Rated cap. (TPH @ 11,700 Btu/lb)	460
Coal Consumption @ max. cap. (TPH) ^c	566
Fuel Heat Value (Btu/Lb)	11,000 to 12,500
Boiler Design Fuel Heat Value (Btu/lb)	11,700
Sulfur Content (%) (Range as fired)	1.5 to 3.0
Design Sulphur Content (%) (as fired)	3.0
Avg. Sulphur Content % - as fired estimated	2.5
Ash Content (%) (Range as fired)	6 to 10
Design Ash Content % - as fired	.10

Table 3.1-1 (Continued)

Avg. Ash Content % - as fired estimated	8%
Coal Preparation	Crushed & Washed
Method of Delivery	Rail
Ratio: Bottom Ash/Fly Ash	0.2/0.8
V. Stack Emissions	
Total Suspended Particulates, Avg. (Lbs/Hr) ^b	238
Total Suspended Particulates, Max. (Lbs/Hr) ^c	374
SO ₂ , Avg. (Lbs/Hr) ^d	9074
SO ₂ , Max. (Lbs/Hr) ^c	14260
NO _x , Avg. (Lbs/Hr) ^b	4754
NO _x , Max. (Lbs/Hr) ^c	7472
Avg. Exit Gas Velocity (fps)	19.2
Avg. Exit Gas Temperature (°F)	128
Avg. Exit Gas Volume (acfm)	2.35 x 10 ⁶
Max. Exit Gas Volume (acfm)	3.69 x 10 ⁶
VI. Water Use	
Source: St. Johns River	
Max. Withdrawal (gpm)	19,750
Avg. Withdrawal (gpm)	10,980
Source: Floridan Aquifer	
Max. Withdrawal (gpm)	2,700
Avg. withdrawal (gpm)	410
VII. Liquid Discharges	
(Individual system discharges are listed in Table VII of the NPDES Permit Application contained in Appendix C.)	
Discharges to St. Johns River	
Cooling Tower Blowdown	
Maximum (gpm)	3470
Average (gpm)	1200
Sanitary Wastewater	
Maximum (gpm)	10
Average (gpm)	6

144
 1.2
 288
 124
 1728
 3470

Table 3.1-1 (Continued)

Central Wastewater Treatment		
Maximum (gpm)		1200
Average (gpm)		500
VIII. Solid Waste Disposal		
Sanitary Sludge (land spreading)		minor
Fly Ash (acre-feet, total)		6,100
Bottom Ash (acre-feet, total)		1,500
Scrubber Sludge (acre-feet, total)		11,500
Combined/Dewatered Ash/Sludge (acre-feet, total)		16,000
Office and Miscellaneous hauled to suitable landfill		minor
IX. Other		
Construction Force at Station Site (peak)		1013
Permanent Staff at Station		140
Start Construction		Dec 1979
Commercial Operation		
Unit No. 1		Jun 1983
Unit No. 2		Jun 1985
Estimated Capital Costs (\$ Million)		
Unit No. 1 (1983)		460
Unit No. 2 (1985)		465

^aPreferred alternative based on proposed New Source Performance Standards. Overall sulfur removal efficiency will be 85 percent including 6 percent credit for coal washing at mine.

^bAverage consumption and emissions are based on 1) 2.5% sulfur as fired; 2) 8% ash content; c) 11,700 Btu/lb fuel; 4) 70% L.F. and 5) 30% removal of sulfur at the mine by washing and 79% removal at the plant site by scrubbing.

^cMaximum consumption and emissions are based on 1) 3.0% sulfur as fired; 2) 10% ash content; 3) 11,000 Btu/lb fuel; 4) 100% L.F. and; 5) 30% removal of sulfur at the mine by washing and 79% removal at the plant site by scrubbing.

Table 3.1-2
Power Block Description

<u>Electrical Output (per unit)</u>	<u>Gross</u>	<u>Net</u>
Maximum Turbine-Generator Output (5% overpressure, Valves Wide Open (VWO))	680,000 KW	635,000 KW
Normal Peak Turbine-Generator Output (Rated pressure, VWO)	652,000 KW	600,000 KW
Turbine-Generator Guaranteed Output	620,000 KW	579,000 KW
Average Output (based on 70% capacity factor)	457,000 KW	427,000 KW
Generator Output	Approx. 794,000 KVA @ 90% PF	
Voltage Rating of Generators	Approx. 23,000 Volts	
Maximum Steam Flow	4,904,000 lbs/hr	
Type of Firing	Main: Pulverized bituminous coal Ignition and Warmup: No. 2 Fuel Oil	

3.1.4 Other Associated Facilities

3.1.4.1 Spill Prevention Control and Countermeasure Plan

The following plan will be submitted to fulfill CFR requirements as presented in Chapter 40, Part 112.

1.0 INTRODUCTION

Chapter 40, Part 112 of the Code of Federal Regulations requires that nontransportation-related onshore and offshore facilities engaged in certain oil related activities and which could reasonably be expected to discharge oil into or upon the navigable waters of the United States or adjoining shorelines prepare a Spill Prevention Control and Countermeasure Plan (SPCC Plan).

The Seminole Plant Units 1 & 2 described on the following pages have been prepared in accordance with good engineering practices and have full approval of the management of Seminole Electric Cooperative, Inc.

As required by 40 CFR 112.7, this SPCC Plan follows the sequence outlined in Section 112.7 and discusses the conformance of the plant with the applicable guidelines. Since the plant is a proposed new source, not to be in operation until 1983, the prevention measures discussed will be included as a fundamental part of the site layout and plant design.

As required by Section 112.4 and 112.5, this SPCC Plan will be amended, as warranted.

2.0 DESCRIPTION OF OIL RELATED FACILITIES AND ACTIVITIES

- A. Fuel oil supply for startup of the main boilers and diesel generator
- B. Oil filled transformers
- C. Main turbine and boiler feed pump turbine oil supply
- D. Miscellaneous lube oil systems

3.0 EXPECTED EQUIPMENT FAILURE

- A. Fuel oil supply for startup of the main boilers and diesel generators
 - 1. Type of Failure: Tank rupture
 - 2. Quantity: 150,000 gallons

3. Control: The tank will be surrounded by retaining walls capable of containing the entire contents of the tank should a leak develop, and will be of sufficient diameter and height to assure that a leak will not project outside the containment wall. A sump area will be provided from which the oil will be pumped into trucks and removed.

B. Oil filled transformers

1. Type of Failure: Tank rupture
2. Quantity: Largest transformer - approximately 10,000 gallons
3. Control: The transformers will be designed with an oil containment dike/pit under each transformer with a sump area from which the oil will be pumped into trucks and removed.

C. Main turbine and boiler feed pump turbine oil supply

1. Type of Failure: Tank rupture
2. Quantity: 30,000 gallons
3. Control: A containment room will be constructed around these storage tanks and will be designed to contain the entire capacity of the tanks. A pump and sump will be located within the room to remove all oil and/or water.

4.0 PROPOSED SPILL PREVENTION MEASURES

4.1 General Description of System

Discussed in Section 3.0.

4.2 Facility Drainage

In-plant effluent treatment systems are designed to treat drainage from contained areas that contain oil spills or excessive leaks. These contained areas will be drained by manually activated pumps and will pass through an oil interceptor prior to entering waste treatment. All plant drainage (except storm drains) flows through the waste treatment system.

4.3 Bulk Storage Tanks

Fuel oil tank is an above-ground steel tank. The retaining wall around the tank has sufficient freeboard to handle the contents of the tank. Rainwater drainage is through an oil interceptor to the waste treatment system. The tank is above-ground construction. Visual inspection will be made on a routine basis. Visible oil leaks which result in a loss of

oil from tank seams, gaskets, rivets, and bolts to cause the accumulation of oil in contained areas will be corrected promptly. Turbine oil storage tanks are located above ground in the Turbine Generator Building and will be inside a containment room. Large spillage of oil will be transferred to the waste oil storage tank by pump. Water washdown which contains oil will pass through an oil interceptor and then to the waste treatment system.

D. Miscellaneous lube oil systems

1. Type of Failure: Minor system leaks
2. Quantity: Less than 50 gallons
3. Control: Water washdown which contains oil will pass through an oil interceptor and then to the waste treatment system.

4.4 Facility Transfer Operations, Pumping, And Implant Process.

All underground piping will be either coated or have cathodic protection to reduce corrosion.

If corrosion damage to piping is found, additional examination and corrective action will be taken as indicated by the severity and magnitude of the damage.

When a pipeline is not in service or is on standby for an extended time, the terminal connection at the transfer point will be capped or blank flanged and marked as to origin.

Pipe supports will be properly designed to minimize abrasion and corrosion and to allow for expansion and contraction.

All above-ground valves and pipelines will be subjected to regular examinations by operating personnel in accordance with procedures to be established.

If vehicular traffic could endanger above-ground piping, signs will be posted to warn traffic of the potential danger.

4.5 Facility Tank Truck Loading/Unloading

Tank truck unloading procedures will comply with the requirements of the U.S. Department of Transportation.

Rack area drainage flows into the catchment basin. Warning signs will be used in unloading areas to prevent vehicular traffic departure before complete disconnect.

5.0 INSPECTION AND RECORDS

Procedures for inspection and recording will be formulated and will become an integral part of the SPCC plan. These procedures will be submitted to the appropriate agencies for their review prior to implementation.

6.0 SECURITY

The Seminole plant will be fully fenced, and entrance gates will be guarded at all times.

The master flow and drain valves and other valves that will permit outward flow of the tank capacity will be securely locked in the closed position when in non-operating or non-standby status.

The starter controls on all oil pumps will be located at a site accessible only to authorized personnel.

The loading connection of oil pipelines will be capped securely or blank flanged when not in service or standby service for an extended time.

The Seminole plant will be operated 24 hours a day and, therefore, will be well lighted at night.

7.0 PERSONNEL, TRAINING

The Plant Manager will be designated as being accountable for oil spill prevention. He will report to the Director of Power Production who in turn will report to the Vice President and General Manager.

The Plant Manager will schedule and conduct spill prevention briefings for the plant operations and maintenance personnel in order to assure adequate understanding of the SPCC plan as described.

3.1.4.2 Fuel Oil Storage

Diesel and fuel oil supply for startup of the boilers and diesel generation will be stored in tanks as described in Section 3.2. This area will be diked and closed off from the environment consistent with controls in the Spill Prevention Control and Countermeasure Plan. Any accumulated rainwater or oil will be pumped through an oil-water separator prior to further treatment in the Chemical Waste System.

3.1.4.3 Bulk Chemical Storage Facilities

Chemical bulk storage will include:

1. 66 % Sulfuric Acid
2. 50% Liquid Sodium Hydroxide
3. 50% Liquid Alum
4. 30% Aqueous Ammonia
5. 35% Aqueous Hydrazine
6. Hydrated Lime, 93% dry
7. Chlorine
8. Carbon Dioxide
9. Hydrogen
10. Nitrogen
11. Acetylene (Bottles)
12. Oxygen (Bottles)
13. Argon/Helium (Bottles)

Liquid chemical bulk tanks and associated pumps will be installed directly over the neutralization sumps. Each sump will be equipped with a normally closed drain valve and connected to a neutralization sump. Any leakage will be neutralized before pumping to the Chemical Waste System.

3.1.4.4 Machine Shop and Vehicle Maintenance Facilities

Floor drainage in these areas will be collected, passed through an oil interceptor, and further treated in the Chemical Waste System.

3.1.4.5 Scrubber Drains

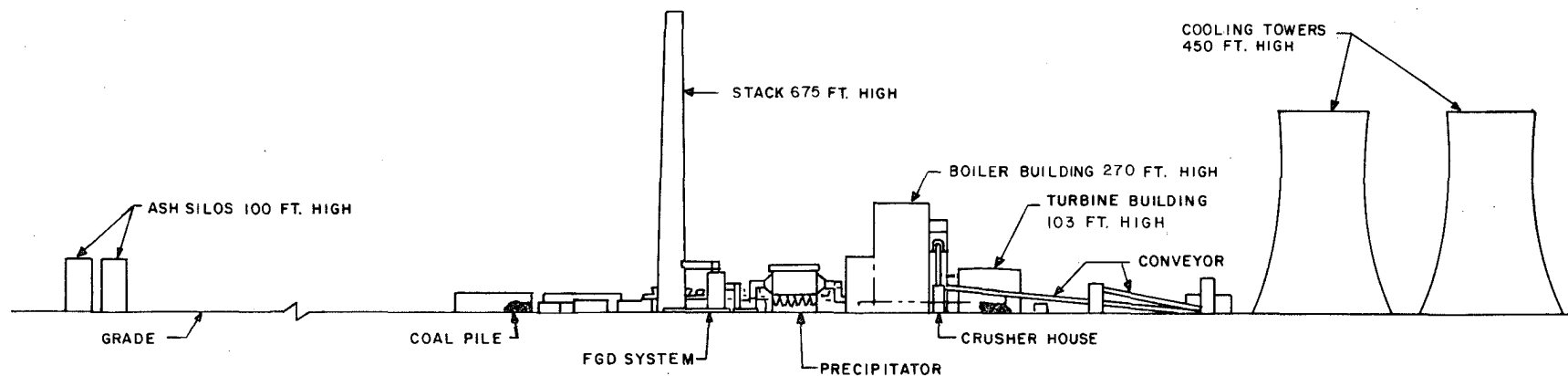
Scrubber drains can be classified by two (2) types: 1) oily; 2) reagent. Oily drains (for spread reducers, etc.) will be directed through an oil interceptor. Reagent drains will be recycled back into the reaction tank.

3.1.4.6 Oil Pumps and Tanks

The areas in the main plant island which have pumps or vessels which pump or house oils will be diked, and drains from these areas will be directed to an oil interceptor before further treatment.

3.1.4.7 Transformers

The transformers will be designed with an oil containment dike/pit under each transformer. These drains will pass through an oil interceptor.



1. ALL HEIGHTS ARE APPROXIMATE
2. GRADE ELEV. APPROX. 80 FT. ABOVE MSL

Fig. 3.1-2. Station Profile.

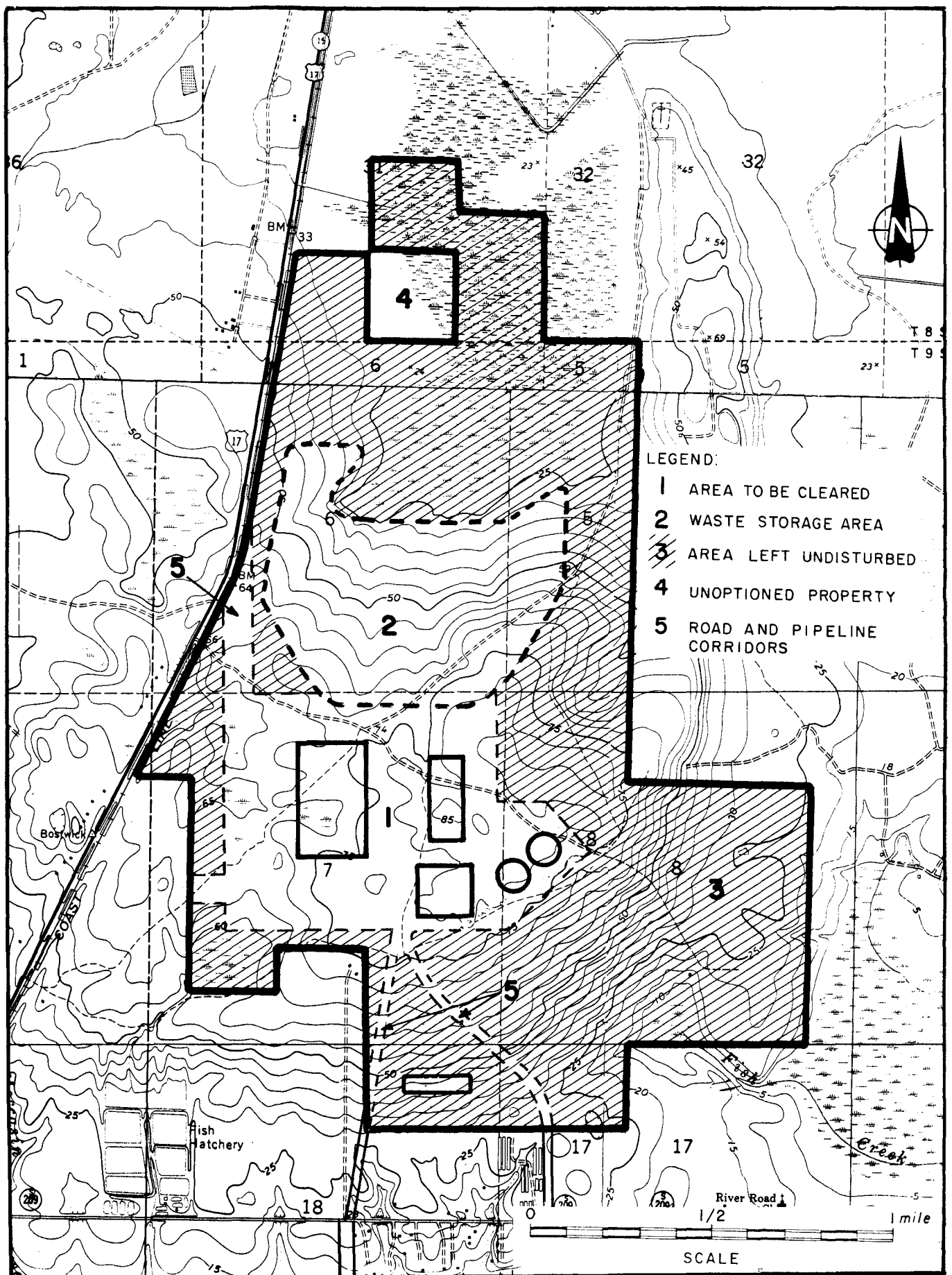
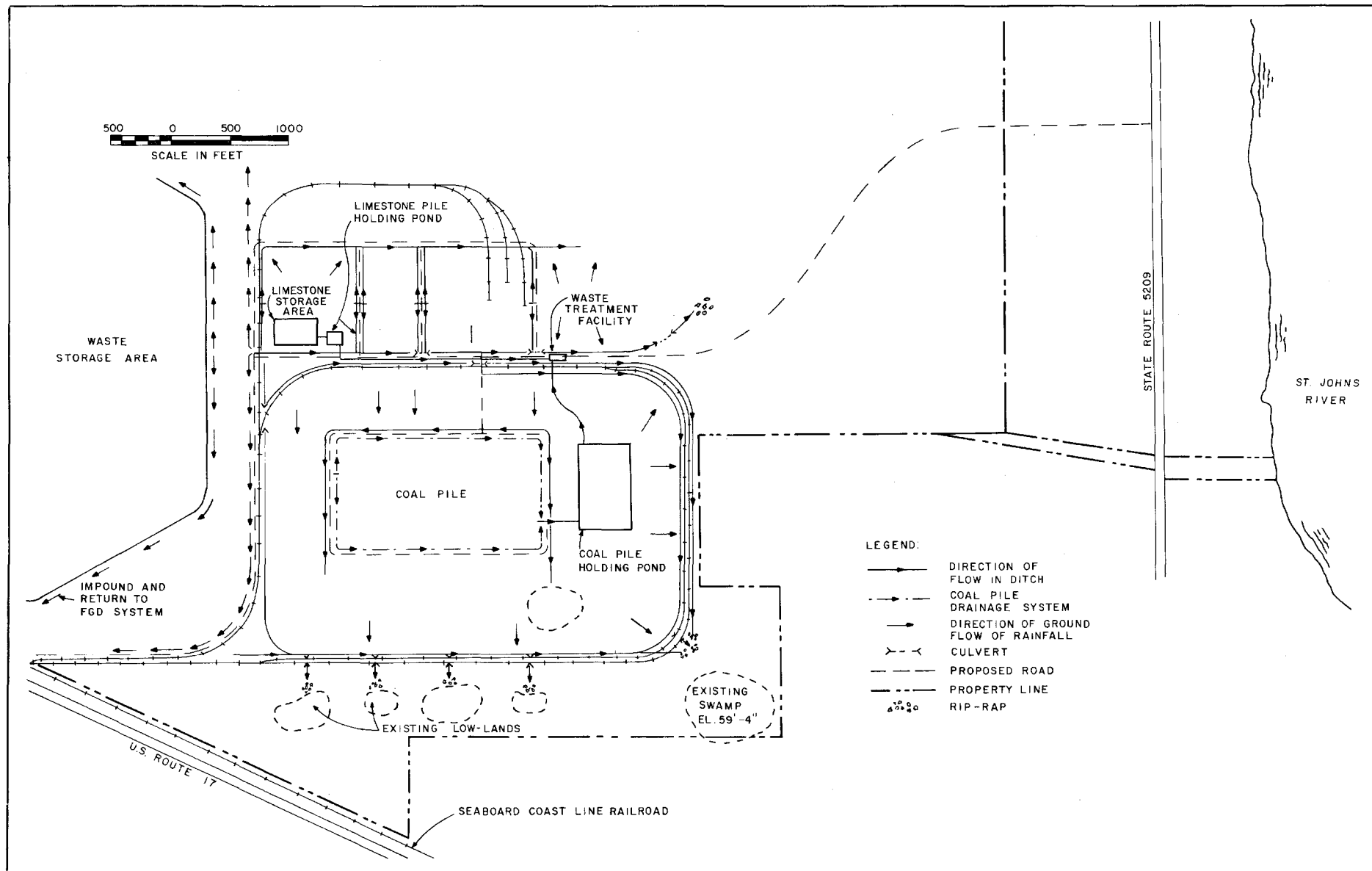


Figure 3.1-3. Generalized Site Landscape Plan.



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Figure 3.1-4. Storm Drainage System.

3.2 FUEL DESCRIPTION

Seminole Plant Units No. 1 and No. 2 are being designed to burn a wide range of Eastern and Midwestern (Illinois Basin) bituminous coal conforming to the following range of characteristics, presented on an as-received basis:

Moisture (percent)	≤ 15
Volatiles (percent)	≥ 30
Fixed Carbon (percent)	≥ 40
Ash (percent)	≤ 10
Sulfur (percent)	1.5 to 3.0
Heat Content (Btu/lb)	$\geq 11,000$
Softening Temperature (°F)	2,200 minimum
Grindability (Hardgrove)	50 to 60

Contractual negotiations have been completed with a supplier in West Kentucky and Illinois for bituminous coal.

Coal will be stored in an active pile equivalent to 72 hours of steam generator maximum continuous rating. Inactive storage will be in the form of an open pile about 34 acres in area by 40 feet high, equivalent to 90 days of 100-percent load factor operation. The silos within the station will hold 12 hours of coal at steam generator maximum continuous rating.

Coal will be removed from unit train cars into hoppers, from which feeders will move the coal onto conveyors. A redundant conveyor belt system will move the coal to a transfer tower for forwarding either to dead or active storage or to the plant. Reclaim will be either by a bucket reclaimer or hoppers under the active pile, with feeders moving the coal onto reclaim system conveyors. A conveyor belt system will move the coal to the silos. Coal will be removed by automatic feeders from the silos into ball tube mills for pulverizing before feeding the fuel into the steam generator furnace.

In addition to coal, No. 2 fuel oil will be used for initial lightoff, low load flame stabilization, and supply to the diesel equipment (emergency diesel generator, etc.) This oil will have approximately the following analysis:

Carbon (percent)	87.0
Hydrogen (percent)	12.4
Sulfur (percent)	0.5
Nitrogen (percent)	0.1
Heat Content (Btu/lb)	18,000

It is estimated that there will be approximately twenty startups during the first year of operation of each unit and six startups per year per unit thereafter. Based on 12,000 gallon consumption per startup, the first year consumption will be 240,000 gallons per unit and 72,000 gallons annually per unit after that.

Oil will be delivered to the station by tank truck and stored in one closed fuel oil tank. The tank will have a capacity of 150,000 gallons. The tank will be surrounded by retaining walls capable of containing the entire contents of the tank should a leak develop and will be of sufficient diameter and height to assure that a leak will not project outside the containment wall. Tank water and rainwater will be treated before discharge.

3.3 AIR EMISSIONS CONTROL SYSTEM

(Considerably more detailed information on emission controls is provided in Appendix F.)

3.3.1 Control of Boiler Emissions

3.3.1.1 Sulfur Dioxide

Many methods currently exist for the control of sulfur dioxide (SO_2) emissions in flue gases. Seminole's base design includes the installation of a Flue Gas Desulfurization (FGD) system to limit sulfur dioxide emissions to those required by Federal and State emission standards. Among the major criteria for the selection of the type of FGD processes to be considered were the ability to achieve desired removal efficiency, availability and reliability, operating costs, availability and cost of reagent, proper engineering design of system, and environmental impact potential.

The FGD system proposed to be installed and operated at the Seminole Station will be the limestone flue gas scrubbing process. Limestone scrubbing systems have demonstrated the ability to achieve desired removal efficiencies. The Seminole Station scrubbing system is being designed to achieve a 79 percent SO_2 removal efficiency. (This, in combination with coal washing at the mine, will result in an overall sulfur removal of 85 percent.) Burning fuel with a 1.5 to 3.0 percent sulfur content and 11,000 to 12,500 Btu/lb heating value, the FGD system should limit maximum SO_2 emissions to no more than $1.15 \text{ lb}/10^6 \text{ Btu}$. This is in compliance with the proposed Federal Electric Utility Steam Generating Unit New Source Performance Standard (NSPS) and Florida new source emission standard of $1.2 \text{ lb}/10^6 \text{ Btu}$.

3.3.1.2 Nitrogen Dioxide

The only proven method of limiting nitrogen oxides (NO_x) emission is in the combustion process. Methods used are flue gas recirculation, overfire air, and two (2) stage combustion. This furnace design will utilize the most proven methods which are two (2) stage combustion and overfire air to accomplish reduced NO_x emissions. The boilers planned for the Seminole Station are guaranteed by the manufacturer to limit NO_x emissions to meet required emission limitations.

NO_x emissions vary depending upon plant load conditions, being greatest at the unit highest load and least at its lowest load. Assuming all NO_x to be in the form of nitrogen dioxide (NO_2), the furnace design planned for the Seminole Station will limit NO_2 emissions to a maximum emission rate of $0.6 \text{ lb}/10^6 \text{ Btu}$ at peak capacity. This is in compliance with the current Florida emission standard of $0.7 \text{ lb}/10^6 \text{ Btu}$ and proposed Federal NSPS of $0.6 \text{ lb}/10^6 \text{ Btu}$.

3.3.1.3 Total Suspended Particulates

There are several methods commonly used for the removal of particulates from flue gases. The Seminole Station is proposed to be equipped with electrostatic precipitators, which represent currently the most proven and reliable method of particulate control in the power industry for large central stations. Electrostatic precipitators will provide the necessary efficiency and availability needed to meet and maintain air quality standards. Precipitators will be installed between the air pre-heater outlet of the furnace and the inlet to the induced draft fans.

The precipitators to be installed at the Seminole Station will be designed to achieve a control efficiency of 99.6 percent. At this efficiency and assuming a combination of high ash/low Btu coal, the maximum particulate emission rate will be $0.03 \text{ lbs}/10^6 \text{ Btu}$ at peak operating capacity. This rate is in compliance with the current Florida emission standard of $0.1 \text{ lb}/10^6 \text{ Btu}$ and the proposed Federal NSPS of $0.03 \text{ lb}/10^6 \text{ Btu}$.

3.3.2 Good Engineering Practice Stack Height

Good Engineering Practice (GEP) stack height is defined as the height necessary to insure that emissions do not result in excessive concentrations in the immediate vicinity of the stack as a result of atmospheric downwash and wake effects that may be created by the stack itself, nearby structures, or nearby terrain obstacles. In calculating ambient ground-level concentrations due to stack emissions, regulatory policy is to avoid giving credit for stack heights which exceed the GEP height.

According to a draft EPA document (EPA, 1977a) on GEP stack height design, GEP stack height is defined as the height of nearby structures which are close enough to exert a wake effect, plus 1.5 times the lesser dimension (height or width) of these nearby structures. This same document suggests that the area in which stack emissions would be influenced by the wake effect of a hyperbolic natural draft cooling tower extends approximately three tower heights from the upper edge of the tower. As will be noticed in Figure 3.1-1, both of Seminole's cooling towers have been located far enough away from the boiler stacks, using the three-times-height rule of thumb, that GEP stack height need not be defined in terms of cooling tower height. Instead, the dimensions of the power block structures determine GEP stack height for this project.

The highest point of the power block is the boiler building which is approximately 270 feet high. The lateral dimension of the power block, which consists of several contiguous structures (boiler building, electrostatic precipitator housing, turbine building, etc.), exceeds the vertical dimension. Therefore, defining GEP stack height as the height of nearby structures (which are close enough to exert a wake effect) plus 1.5 times the lesser dimension (height or width) of nearby structures, the resulting GEP height for Unit No. 1 and Unit No. 2 stacks is $(270) + (270 \times 1.5)$, or approximately 675 feet. This is the height on which modeling is based.

3.3.3 Fugitive Dust Control

Potential sources of fugitive dust emissions are coal storage and handling, limestone handling, fly ash disposal, and excavation and traffic during construction.

A complete wetting system and/or dust collection equipment for dust suppression will be utilized at the coal unloading site. The coal will be stacked in an open pile. The inactive coal pile will be compacted by bulldozers to minimize surface dust blowoff.

As the coal is reclaimed for use in the plant, it will be transferred from belt to belt; at these transfer points dusting can occur, therefore pneumatic collecting devices have been supplied. The enclosed coal crusher house and the coal tripper gallery at the boilers will be ventilated and equipped with dust collection devices.

The control of nuisance dust caused by excavation and traffic will be by application of water and/or chemicals to reduce dust concentrations.

3.4 STATION SERVICE WATER SYSTEM

The service water will originate from two deep wells located near the western border of the property and drawing from the Floridan Aquifer. Each well pump will have 1500 gpm capacity. Average daily withdrawal rate is expected to be about 590,000 gallons.

A generalized flow diagram of the station water use system is shown in Figure 3.4-1. Well water will require treatment prior to station uses except for fire water storage. The basic flow diagram for the well water pretreatment system is shown in Figure 3.4-2. Treatment will include aeration to oxidize iron and sulfides, and to remove dissolved carbon dioxide prior to lime softening and filtration. Treatment chemicals will include alum, lime $[\text{Ca}(\text{OH})_2]$, chlorine, and a potable water-grade polyelectrolyte. Treated water leaving the lime softening unit will contain 5 to 10 mg/liter of suspended matter. This water will be further treated in dual-media gravity type filters.

Filtered water from the pretreatment system will be further treated for potable water use and boiler makeup water. The basic flow diagram for this system is shown in Figure 3.4-3. The system will include activated carbon purifiers for the removal of resident traces of organics, chlorine, and suspended matter. Activated carbon treated water will be used in the potable water system and as the inlet to ion exchange demineralizing units. Demineralized water from these units will be used for the boiler makeup water and in the condensate polishing system described in Section 3.6.4.

Figure 3.4-1

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Generalized Flow Diagram of the Station Water
Use System is Contained in Figure 3, NPDES
Permit Application (Appendix C).

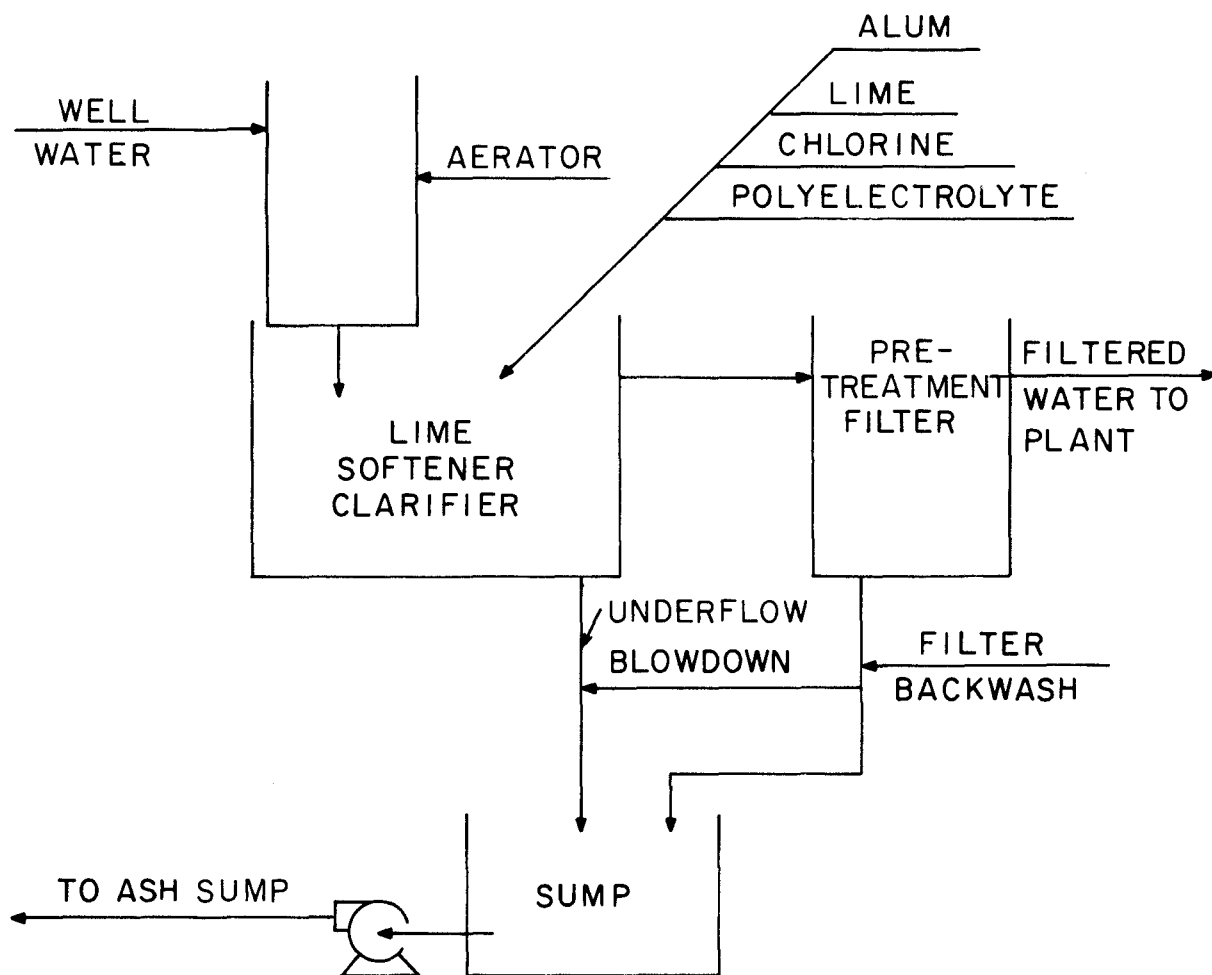


Figure 3.4-2. Well Water Pretreatment System Flow Diagram.

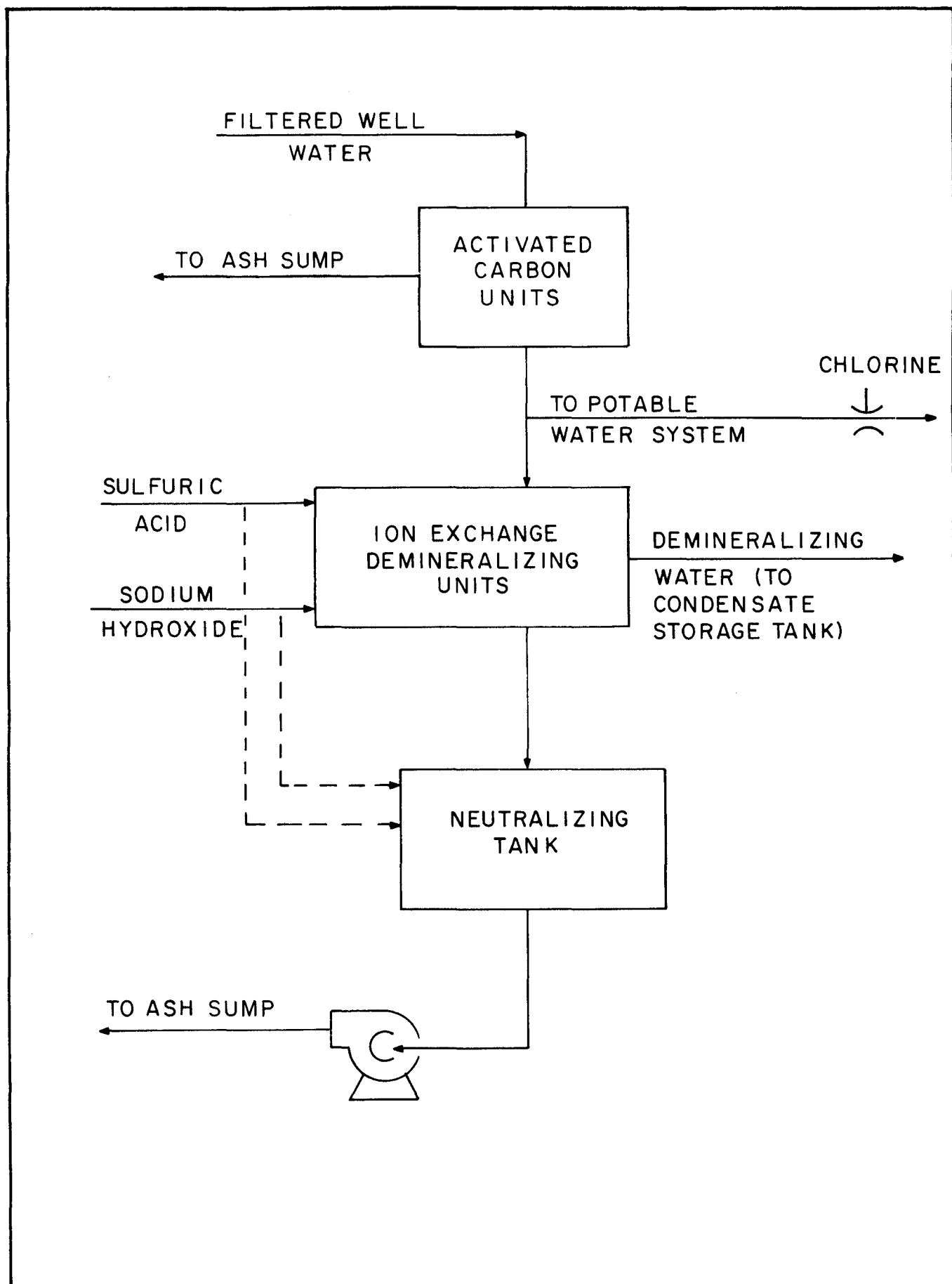


Figure 3.4-3. Makeup Demineralizing System Flow Diagram.

3.5 HEAT DISSIPATION SYSTEM

3.5.1 Cooling Towers

The station's rejected heat load will be expelled into the atmosphere through two natural-draft cooling towers. Most of the heat load will originate in the steam turbine cycle, with the balance coming from residual heat removal systems in the plant. Circulating water will be continuously circulated through the condensers where it will pick up rejected heat from the turbine and auxiliaries. This water, together with the water from other heat removal systems, will be pumped to the cooling towers where heat will be dissipated to the atmosphere by evaporation cooling.

The heat load for maximum power generation or design conditions is 6.05×10^9 Btu/hr. Under design conditions, the recirculating cooling water flow in Units 1 and 2 will be 270,000 gpm each. Recirculating water will be cooled in a closed loop. Evaporation rate at design is approximately 2.1 percent of flow or 11,100 gpm, and drift will be 0.005 percent of the flow or 27 gpm for two units. To control the formation of deposits and corrosion in the system, the towers will be operated at four cycles of concentration and pH adjustment by chemical addition, as required. This means the solids present in the raw river water will be re-concentrated by a factor of four due to the evaporation process. The design blowdown rate from both cooling towers will be about 3650 gpm. A portion of this blowdown, 1,200 gpm, may be recovered for the flue gas desulfurization (FGD) system. The maximum makeup water requirements will be 16,127 gpm for both units. The cooling tower characteristics are summarized in Table 3.5-1.

23.2 MGD

To control biological growth in the condenser, chlorine will be added intermittently. Only enough chlorine to provide a residual of 0.2 ppm chlorine at the discharge point when two (2) units are in operation. This will be accomplished by staggering chlorine injections to the two (2) units so that while one unit will have approximately 0.00 ppm the other unit will have a maximum free chlorine limit of 0.4 ppm (MAX CASE) thereby obtaining a composite efficient of 0.2 ppm or less.

It is expected that there will be four to six applications each day for a period of 15 to 30 minutes. Chlorine injection is expected to take place in the circulation water pump suction line.

Periodic applications of chlorine to the tower fill and distribution system may be required to control growths. During such periods, the blowdown valves will be manually closed to prevent any unauthorized release of chlorine bearing water. In normal operation, small quantities of sulfuric acid will be added to the recirculating water under pH control. This is necessary to prevent the formation of calcium carbonate scale on heat transfer surfaces. The pH of the circulating water will be maintained in the range of 7.0 to 7.5.

3.5.2 Intake Structure

The intake structure will be that described in Section 9.2.7.7 Scheme 6 - Wedgewise Screen Intake.

3.5.3 Discharge Structure

The type of discharge structure is shown in Figure 3.5-1. It will be a submerged outlet consisting of a single 16-inch diameter pipe. A nozzle will be situated at the end of the pipe.

The location of the nozzle will be such that (1) water of sufficient depth (estimated at 6 feet) will exist at normal low tide to achieve sufficient mixing, and (2) sufficient distance (estimated at 150 feet) will be maintained from an intake structure, or channel to a discharge structure, to prevent excessive recirculation of discharged water to the intake.

The nozzle will be designed to maintain an exit velocity of 10 to 15 feet per second (fps) under design conditions of hydraulic head and discharge. The design range of exit velocities is based on two considerations. First, the lower end of the range is based on maintaining at least a 10 to 1 discharge ratio with the upper limit of expected

ambient current velocities. Second, the upper end of the range, 15 fps, is based on preventing the occurrence of a surface boil at the depth of 5 feet during periods of minimum tide elevation (total river depth will be 6 feet, but the nozzle will be submerged 5 feet). The discharge range of 10 to 15 fps should insure good mixing through the turbulent jet action in order to prevent stratification and concentration of effluent in the river.

The discharge nozzle will be designed to pass the maximum expected plant discharge at the before-mentioned velocity. A surge tank will be provided in the discharge system to maintain the design exit velocities. During periods of lower-than-maximum plant discharges, a valve arrangement will interrupt flows to the river while the surge tank fills up. When the tank is full, the valve will be opened. Then, the wastewater will discharge to the river at the prescribed velocity until the level in the tank falls to a predetermined level, at which time the valve will close, thus completing the cycle. In other words, discharges to the river will be intermittent during periods of low plant wastewater flow.

As shown in Figure 3.5-1, the nozzle will be directed away from the river bottom at an angle of approximately 20 degrees in order to prevent erosion of the bottom and resuspension of sediments. Near the discharge nozzle, riprap will be placed on the bottom to prevent scour caused by jet turbulence. The point of discharge will be elevated slightly from the bottom, about 1 foot above the riprap. The discharge jet will be directed toward the downriver flow direction at approximately 45 degrees to the ambient current direction.

A series of piles will be placed at the nozzle in order to prevent displacement of the pipes due to thrusts caused by change in flow direction and the discharge jet.

Table 3.5-1

Summary of Pertinent Data
for Heat Dissipation System

HEAT DISSIPATION RATES (Btu/Hr)

Max. Power Generation	6.04×10^9
Average Power Operation	4.12×10^9

COOLING TOWERS

Type	Natural Draft
Number	2
Height	450 ft.
Recirculating Flow Rate (each tower)	270,000 gpm
Diameter at Base	450 ft.

PRINCIPAL WATER USE (Maximum for two units, gpm)

Surface Water Withdrawal	16,127
Evaporation	12,130
Drift	27
Blowdown	3,970

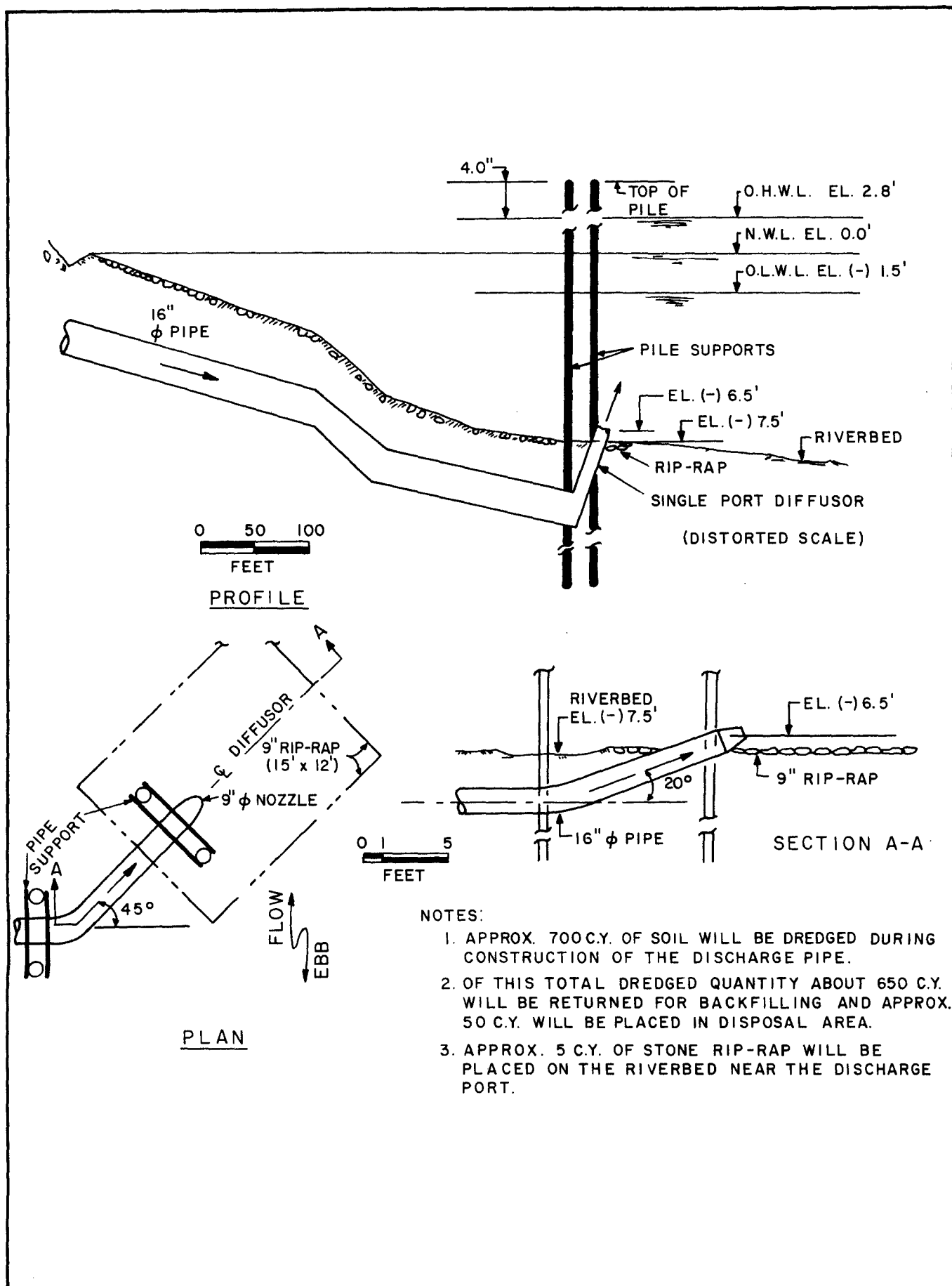


Figure 3.5-1. Proposed Discharge Structure.

3.6 CHEMICAL WASTE SYSTEM

3.6.1 General

The Chemical Waste System is provided to collect and treat wastewater streams to meet the water discharge quality limitations given in 40 CFR 423 and Chapter 17-3 of the Florida Administrative Code. The basic philosophy of the system design is to neutralize strong wastes at the source, separate oil before pumping, collect and equalize the wastes in one of two ash pond areas, then adjust pH and reduce remaining oil, heavy metals, and suspended matter by coagulation and sedimentation before monitoring and release.

Flow, frequency, daily and annualized average production of the wastewater sources described below are summarized in Table VII of the NPDES Permit Application (Appendix C). The quantities shown are based on station operation at full rated capacity. A flow diagram of plant water systems is given in Figure 3.4-1.

3.6.2 Well Water Pretreatment System

Clarifier Blowdown

Waste produced by the well water lime softening unit discussed in Section 3.4 will be primarily a calcium carbonate slurry with small amounts of ferric, aluminum, and magnesium hydroxides. Sludge from the lime softening unit will be blown off intermittently every 30 minutes. Sludge will be collected in a sump and pumped to the equalization pond or ash sump for sedimentation and equalization before further treatment.

Pretreatment Filter Backwash

Under full load conditions, each of the three, two-compartment filters described in Section 3.4 will be backwashed at an average rate of approximately 850 gpm for a period of about 5 minutes per day. The composition of the suspended matter in the filter backwash water will be similar to that in the clarifier blowdown sludge. The filter backwash water will be discharged to the same sump receiving clarifier blow-down and pumped to the equalization pond or ash sump for sedimentation and equalization before further treatment.

3.6.3 Makeup Demineralizing System

Periodically, the activated carbon units described in Section 3.4 will require backwashing to remove traces of suspended matter that pass through the pretreatment system filters. At maximum plant demand, each of the three activated carbon purifiers will require backwash at a rate of approximately 400 gpm for 15 minutes, followed by a short rinse, once per week. This wastewater will be routed to the equalization pond or ash sump for sedimentation and equalization before further treatment.

The operating capacity of the ion exchange demineralizing resins is limited. When exhausted, cation-exchange resins are regenerated with a dilute solution of sulfuric acid, while anion resins are regenerated with a dilute solution of sodium hydroxide. Excess regenerant solutions and rinse water not recoverable by recycle are collected in a batch neutralization tank that is an integral part of the system. The collected wastes are mixed, and additional sulfuric acid or sodium hydroxide are automatically added to adjust the pH to a range of 6.5 to 8.5. The flow rates from regenerating ion exchange units is variable during the cycle. After verification of proper pH adjustment by the operator, neutralized demineralizer wastes will be pumped at a rate of about 250 gpm to one of the two ash ponds for equalization prior to further treatment. At maximum plant load, up to two makeup demineralizer regenerations could take place in one day.

3.6.4 Condensate Polishing System

A deep bed-mixed type condensate polishing system will be provided to treat hotwell condensate on Units 1 and 2. These ion exchange units will remove traces of corrosion and erosion products as well as any contaminants entering the feedwater cycle as a result of air or condenser in-leakage. When the ion exchange resins are exhausted, or when excessive pressure drop conditions occur, the resins will be hydraulically transferred to a regeneration facility near the makeup demineralizing system. Here the resins will be backwashed, separated, regenerated, rinsed, mixed, and prepared for hydraulic transport to a service unit when needed.

The basic flow diagram for the condensate polishing system is shown in Figure 3.6-1. Demineralized water is used for all transfer and regenerating operations. As in the makeup demineralizing system, the ion exchange resins of the condensate polishing system are regenerated with dilute solutions of sulfuric acid for cation exchange resins and sodium hydroxide for anion exchange resins. Excess transfer water, backwash water, spent acid and caustic regenerant solutions, and rinse waters are collected in a neutralizing tank. As part of the automatic cycle, the pH of the collected waste is adjusted to a range of 6.5 to 8.5 by the addition of sulfuric acid or sodium hydroxide as needed. After verification of proper pH adjustment by the operator, the neutralized waste will be pumped at a rate of about 250 gpm to the equalization pond or ash sump for equalization prior to further treatment. Under full load conditions, up to one condensate polishing system regeneration on each generating unit could be expected each day.

3.6.5 Boiler Blowdown

The high pressure boiler water chemistry at this station will be based on zero solids, or all volatile treatment. Up to 2 mg/liter of ammonia and 0.020 mg/liter of hydrazine will be present in the feedwater at the economizer inlet. Essentially, all the hydrazine will be decomposed into nitrogen and ammonia in the high temperature environment of the boiler. Chemistry management to provide high purity steam will limit total solids in the boiler water to about 2 mg/liter. This low level of total solids in the boiler water will be maintained by the condensate polishing system.

Blowdown will come directly from the boiler drums and from the water and steam sampling system analyzers that continuously monitor the system. All blowdown water will be continuously cooled before passing to the percolation fields for disposal. Each of the main boilers will continuously produce up to 20 gpm of blowdown.

3.6.6 Floor Drains

Under normal operating conditions, there is little flow in the floor drain system. However, periodic clean-up operation will result in some occasionally oily waste. Mechanical emulsification with subsequent difficulty in separation will be avoided by the use of local oil interceptors. After separation of oil, wastewater will be pumped to either the equalization basin or ash sump for equalization before further treatment. Oil trapped by the interceptors will be removed periodically, drummed, and incinerated or reused. Each of the floor drain systems in Units 1 and 2, the machine shop, and vehicle maintenance area, will have a capacity of about 50 gpm.

3.6.7 Turbine Oil Sumps

Turbine oil sumps associated with Units 1 and 2 do not normally contain any water. Oil is collected here and recovered or drummed for disposal. However, during periodic clean-up operations, washwater will enter the turbine oil sumps. After manual removal of oil, any water remaining will be pumped at a rate of up to 50 gpm to a floor drain sump for further oil separation prior to pumping to either the equalization basin or ash sump for equalization before further treatment.

3.6.8 Laboratory Drains

Power station laboratory wastewaters contain very small quantities of contaminants resulting from fuel and water testing. Up to about 5 gpm of laboratory wastewater will be pumped to either the equalization basin or ash sump for equalization before further treatment.

3.6.9 Bottom Ash Sluice Water

Bottom ash from Units 1 and 2 will be hydraulically sluiced intermittently at a rate of about 2000 gpm to a dewatering facility. Water decanted will be recycled and reused. About 5 percent of the sluice water flow (or 100 gpm) plus the process flow input (440 gpm) giving a gross flowrate of 540 gpm will be continuously withdrawn to avoid supersaturation of the system with sparingly soluble constituents such as calcium sulfate or calcium carbonate. Water withdrawn from the bottom ash system will be further treated in the Central Wastewater Treatment System.

3.6.10 Air Preheater Wash

Periodically, the air preheaters are washed at a high rate for a short period of time. Preheater washwater flows of up to 2500 gpm will be collected in a local sump for batch treatment if required, then pumped to the equalization basin or ash sump for equalization before further treatment.

3.6.11 Boiler Fireside Wash

As part of a scheduled maintenance outage, the internal or fireside of the boiler may require water washing. The wastewater from hose type washing at rates up to 200 gpm will be collected in a local sump for batch treatment, if required, then pumped to one of two ash ponds for equalization before further treatment.

3.6.12 Stack Wash

As in the case of boiler fireside wash, an occasional hose type washing of a portion of the stack liner may be required. This operation, during a unit outage, may produce up to 200 gpm of wastewater. The wastewater will be collected in a local sump for batch treatment, if required, then pumped to the percolation field for disposal.

3.6.13 Cooling Tower Basin Cleaning

During infrequent maintenance outages, it may be necessary to remove silt and debris from the cooling tower basins. This will be accomplished by draining the system under supervision to avoid disturbing accumulated sediments. When drained as much as possible without disturbing the sediments, the drain valves will be closed and the system cleaned by hosing. Accumulated sediments, debris, and washwater will be trucked to the sludge disposal area for addition to the combined effluent.

3.6.14 Boiler Chemical Cleaning

Prior to initial commercial operation, and about every 4 to 5 years afterwards, the boiler and preboiler system will require cleaning. The cleaning operation typically includes an alkaline flush or "boilout" with a solution of trisodium phosphate and detergent followed by a water wash. The boiler itself is then usually cleaned with a dilute solution of hydrochloric acid (5 percent) with a small amount of inhibitor added.

After the acid cleaning, the system is water flushed, then filled with a solution containing small amounts of ammonia and hydrazine to protect it against corrosion until startup.

Spent alkaline and acid cleaning solutions, and washwater will be pumped at a rate of about 500 gpm to the equalization basin. The wastewater will be batch treated using lime or caustic soda, or other chemicals found necessary in laboratory jar tests. After treatment, the wastewater will be pumped to the percolation field for disposal.

3.6.15 Central Wastewater Treatment System

The Central Wastewater Treatment System is provided to collect, equalize, store, treat, and monitor excess water before release. The basic flow diagram is shown in Figure 3.6-2. Strong wastes are batch treated at the source and oil is trapped locally before pumping wastes to the equalization basin. The large-volume detention and contact with various wastes provides equalization of chemical composition and temperature required for good operation of coagulation-sedimentation treatment systems. Any free oil not absorbed by ash or other sediments will be trapped by retaining baffles and removed by surface skimmers.

Wastewater will be pumped from one of two equalization basins to a pH adjustment tank at a rate controlled on the basis of pond level. Here, the pH will be adjusted to a narrow optimum range to assure minimum heavy metal concentration and good coagulation conditions. Any floating oil will be skimmed periodically and returned to the inlet end of one of the two ash ponds.

After pH adjustment, the water will flow to a conservatively rated solids-contact type clarifier. Alum and a potable-water-grade coagulant aid will be added to assure good clarity of the treated water. Coagulated constituents in the clarifier sludge will be intermittently blown down to the inlet side of the operating equalization basin for sedimentation and retention.

The clarified treated water will flow by gravity to a monitoring detention tank. Control parameters will be continuously monitored, and if acceptable, the treated water will be released. If control

limits are exceeded, the system will provide automatic recycle back to the inlet end of the operating equalization basin, and the operators will be notified by automatic alarm.

Table 3.6-1 Deleted

Wastewater volumes may be found in
Table VII of the NPDES Permit Application
(Appendix C)

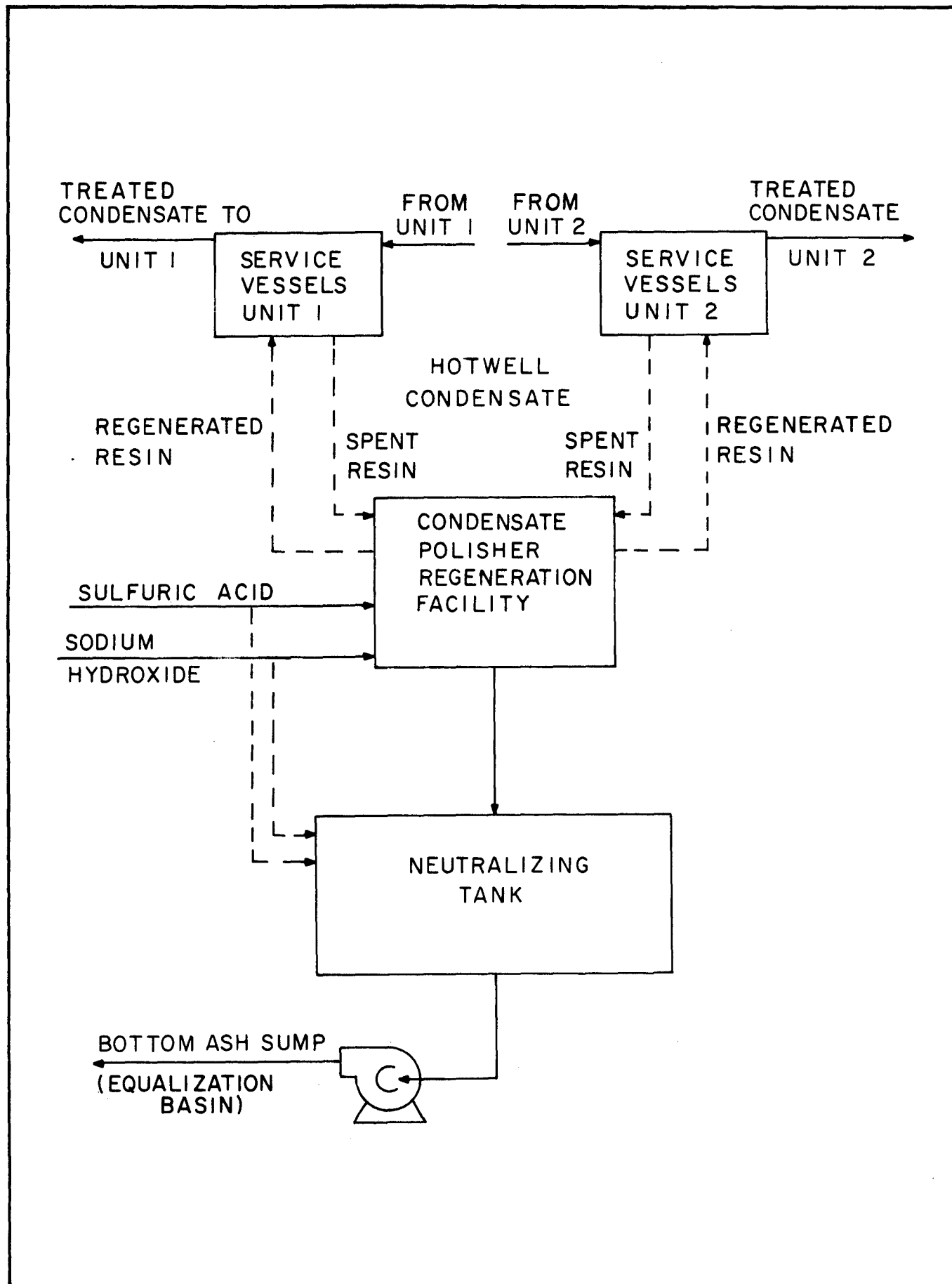


Figure 3.6-1. Condensate Polishing System Flow Diagram.

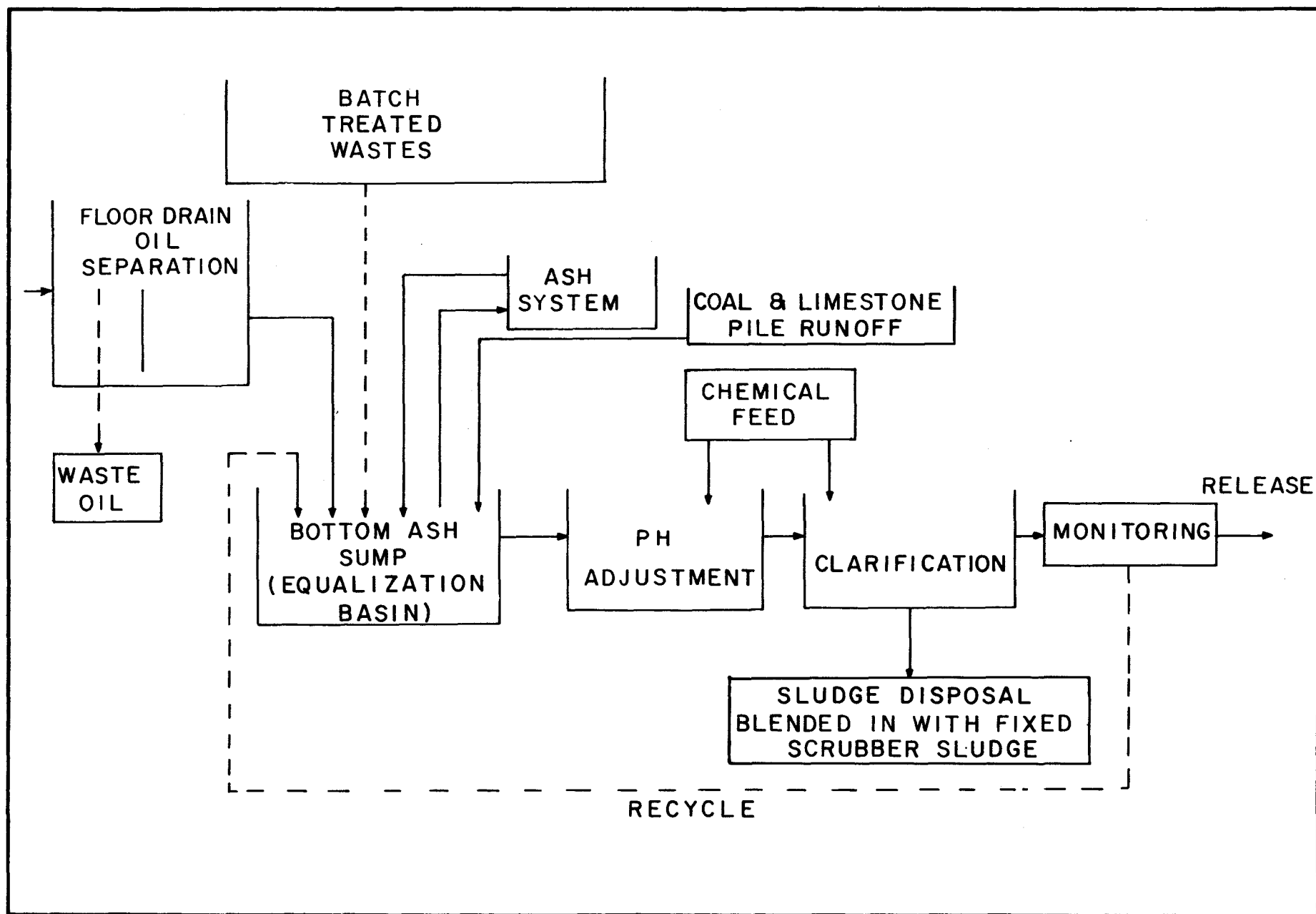


Figure 3.6-2. Central Wastewater Treatment System Flow Diagram

3.7 SANITARY WASTEWATER TREATMENT SYSTEM

A sanitary wastewater treatment system will be provided consisting of a prefabricated, digestion-type sewage treatment plant capable of treating approximately 10,000 gallons per day of domestic-type sewage.

A flow diagram of the plant is shown in Figure 3.7-1. The plant will include a comminutor and clarifier in addition to an aeration chamber. Effluent water from the system will be chlorinated if needed and will meet all aspects of EPA, local and State of Florida requirements prior to disposal. Effluent will be discharged with excess cooling tower blowdown and with effluent from the Central Wastewater Treatment System. Resulting sludge will be land spreaded.

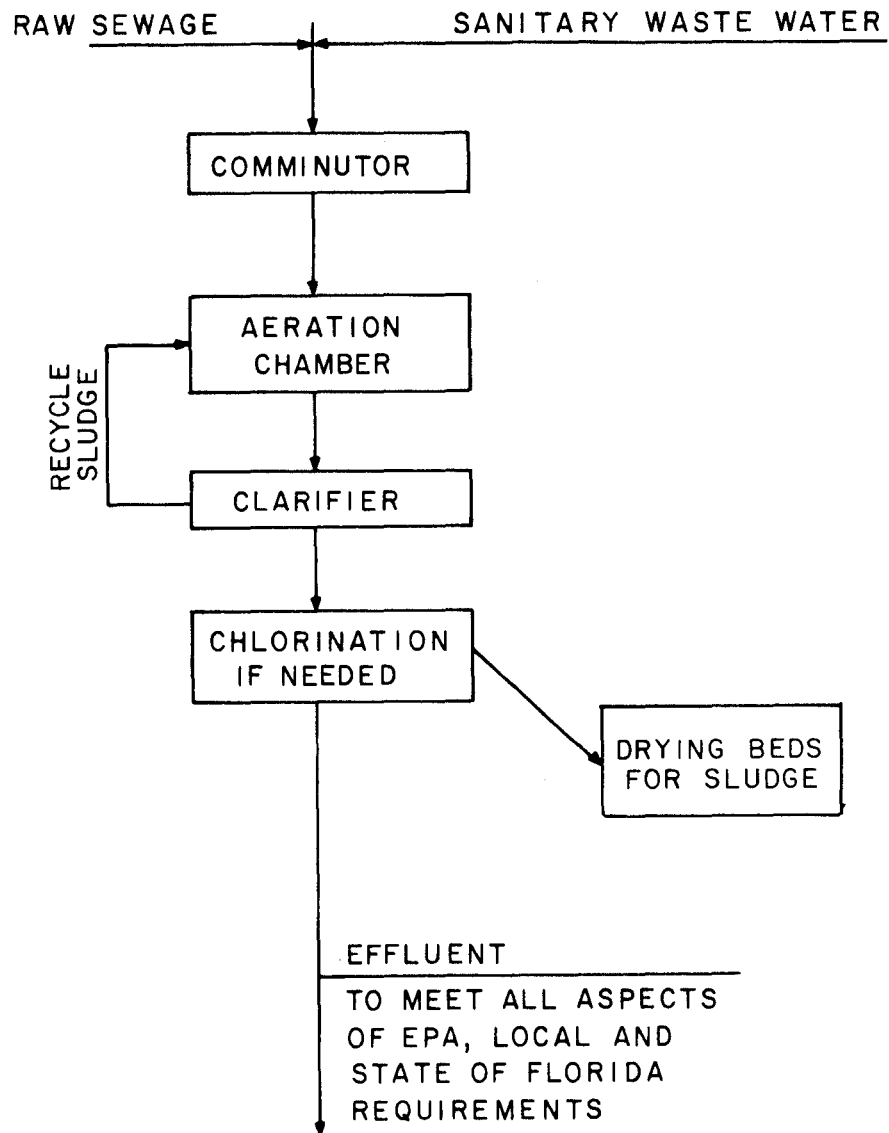


Figure 3.7-1. Sanitary Wastewater Treatment System Flow Diagram.

3.8 SOLID WASTE DISPOSAL SYSTEM

3.8.1 General

Listed below are the types and volumes of major solid waste expected to be generated by the proposed station over the life of the station:

<u>Type of Solid Waste</u>	<u>Estimated Volume (acre-feet)</u>
SO ₂ Scrubber Sludge	11,500
Fly Ash	6,100
Bottom Ash	1,500
Combined fly ash, bottom ash & SO ₂ Absorber Sludge	16,000 per

The combined fly ash, bottom ash and SO₂ absorber sludge volume of 16,000 acre-feet which is the combination of blending each of the above components with a cementitious product (lime, cement, etc.) to form a "fixed" effluent which will be used to build an impervious liner which will allow future storage of a product which has not been "fixed". The following subsections discuss the handling systems for these wastes as presently conceived.

3.8.2 Ash Handling System

3.8.2.1 Bottom Ash

Bottom ash will be collected in a wet hopper located beneath the boiler and removed directly to the dewatering tanks (bins) by sluicing. Ash sluice water will pass through jet eductors, removing the ash from the clinker grinder located under the hopper to the dewatering tanks located at the effluent process area. Overflow from the dewatering tanks will be recycled for ash sluicing.

3.8.2.2 Economizer Ash

Economizer ash will flow directly from hoppers under the economizer section of the boiler into economizer ash storage tanks. It will be removed by sluicing directly to the bottom ash hopper and will be sluiced with the bottom ash to the dewatering bin.

3.8.2.3 Fly Ash

Fly ash is proposed to be collected by electrostatic precipitators and deposited in hoppers under the precipitators. A dry pneumatic system will remove the ash to silos for ultimate disposal. From the silos, ash can either be removed dry to closed bulk storage trucks or freight cars for offsite sale, or blended with the SO₂ absorber sludge and transported to the combined storage area.

3.8.3 Ash Production

Each steam generator will produce approximately 22 tons per hour of ash at maximum output using performance coal. Seventeen tons per hour will be fly ash; 4 tons per hour will be bottom ash. For both units, average ash production will be 209,000 tons per year of fly ash and 52,000 tons per year of bottom ash. Economizer ash is negligible in volume and is included in the bottom ash quantities.

Ash sluice water will be used at a rate of approximately 2000 gpm to transport the bottom ash and economizer ash from each steam generator. This water, as previously noted, will be recycled from the bottom ash pond. Makeup to the sluice water will come from the cooling tower blowdown system.

3.8.4 Flue Gas Desulfurization Waste

Each steam generator will produce approximately 45 tons of sludge per hour at maximum output burning performance coal. Average sludge production for both units will be 546,000 tons per year. The sludge will contain 15 percent solids when pumped to the thickener and will consolidate to approximately 35 percent solids after allowing it to settle. The thickener underflow will then be transferred to vacuum filters or hydroclone for further reduction in water content ($\approx$ 75 to 85%). All the water which has been decanted will be recycled for scrubber reuse. The 75 percent effluent if oxidized can either be sold or processed with the fly ash, bottom ash and fixing agent in the mixing mill. The mixed product is then transported to the disposal site where it will be contoured and compacted.

533.33 Acre Feet/yr.
86044444 cys/yr
= 163 Tons/cu yd

3.8.5 Composition of Ash and Scrubber Sludge

Typical compositions of ash and scrubber sludge are expected to be as follows:

<u>Ash Constituents</u>	<u>Percent</u>	
Phosphorous pentoxide	0.15	
Silica	50.00	
Ferric oxide	19.20	
Alumina	20.35	
Titania	1.00	
Lime	3.00	
Sulfur trioxide	1.70	
Potassium oxide	2.35	
Sodium oxide	0.85	
Undetermined	0.50	
<u>Scrubber Sludge Constituents</u>	<u>Unoxidized</u>	<u>Oxidized</u>
$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	48	83 to 88
$\text{CaSO}_3 \cdot 1/2 \text{H}_2\text{O}$	44	4 to 9
CaCO_3 (assuming stoichiometry of 1.08)	5	5
$\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$	3	3
Fly Ash	Trace	Trace

3.8.6 Sludge and Ash Fixation Process

The selected method of waste ash and sludge disposal is considered to be the best technology available for protection of ground water quality within the context of the hydro-geological setting of the Putnam Site.

The specific process that has tentatively been selected is a modification of the Poz-O-Tec^R System developed by IU Conversion Systems, Inc. The process receives both FGD sludge and dry fly ash from the flue gas cleaning system of the power plant. The sludge is partially dewatered by thickeners (if necessary) followed by vacuum filtration. The resulting filter cake is then blended with fly ash, bottom ash, and lime in a muller or pug mill type mixer to insure thorough mixing. The resulting material can be compacted. As the material cures, cementitious

reactions occur which improves its physical properties. The following physical properties are expected after 14 to 28 days of curing (Duval and others, 1978):

Moisture Content:	30 to 40%
Bulk Density:	110 to 115 lbs/cu ft
Permeability:	10^{-7} cm/sec
Internal friction angle:	40°
Cohesion:	1500 to 50,000 lbs/sq ft

The material can reportedly be placed on normal slopes of 2 horizontal to 1 vertical, and behaves much the same as a silty clay when initially produced and placed. The appearance and behavior is very similar to clayey soil. Upon curing, the material gains strength and develops the properties of a concrete-like material (Duval and others, 1978).

With respect to protection of ground water quality, the low permeability of the cured material (10^{-7} cm/sec) is comparable to practically impervious soils such as homogeneous, unweathered clays that have permeabilities of 10^{-7} to 10^{-9} cm/sec (Terzaghi and Peck, 1948). The fixated material will be used to construct dikes and lining in the disposal areas.

After an adequate lining is in place, the sludge preparation process will be modified by eliminating the lime and other additives from the mixture. The material, without lime, can be described as a "stabilized cake." The stabilized cake will then be placed in the lined disposal areas. The reason for eliminating lime for part of the material is to minimize the resource and energy expenditure associated with manufacture and transportation of lime.

INCOMPLETE DOCUMENT

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MISSING FROM THIS DOCUMENT AT THE TIME OF
SCANNING.

3.9 FIRE AND SECURITY MEASURES

3.9.1 Fire Prevention and Protection

Fire Fighting Facilities

The station well water supply system will be the main water source for fire protection. The system will be initially installed and used to supply clean water to the storage tank for both construction and permanent plant fire protection services. This tank will be used for potable water until the permanent plant pretreatment system is installed for potable and plant makeup services which will be supplied by a branch connection from the well pump discharge.

The water storage tanks for fire protection will be 300,000 gallon internally lined steel fabricated tanks. They will be located north of the stack and will supply about three hours of water for fire protection. The first tank will be installed during the initial construction period.

One diesel engine fire pump will be provided in a fire pump house located near the water storage tank. This pump will have its own fuel oil storage tank and battery powered electrical system for startup. This pump and pump house will be installed during the initial construction period. This pump house will also house a motor driven jockey pump and a motor driven fire pump. The jockey pump will be made operable along with the diesel pump.

A permanent underground yard fire loop will be installed from the fire pump house. This system will have several post indicator shutoff valves for isolation and system extensions as needed. This loop will be installed during the initial construction period in such a configuration that parts may be removed to accommodate construction needs later.

The fire-fighting facilities discussed above will be augmented with hand fire extinguishers located throughout the project to assure prompt extinguishment of incipient fires.

Management

Early contact will be made with the Palatka Fire Department. Communications will be established to provide a prompt response to assure equipment and personnel are available to fight major fires.

A fire brigade will be formed and trained in the use of equipment to promptly extinguish incipient fires. The guards on duty during non-working hours will be trained to extinguish fires, summon the Palatka Fire Department and management personnel.

Fire Prevention

Housekeeping to prevent significant accumulations of combustible debris will be maintained throughout the life of the project. Flammable liquids will be stored and dispensed in accordance with codes and regulations including control of smoking and other known ignition sources. Welding operations will be effectively controlled to assure sparks and slag do not fall on combustible material resulting in fires.

Other operations will be reviewed by the onsite Safety and Security Manager. Appropriate requirements will be incorporated into the safety program as these are made known.

3.9.2 Security

Security during construction and operation have many similarities. The construction security program will be developed in coordination with the Seminole Electric Cooperative, Inc., and will be turned over to SECI at completion of construction.

A guard force will be provided to assure security requirements are being met. The guard force shall be under the direction of a Safety and Security Manager.

Security fencing will be provided at appropriate locations early in the construction period. The main plant area will be well lighted. Gates will be guard controlled for access to the site by authorized personnel only.

Periodic search of vehicles and containers entering and leaving the project will be maintained. All suppliers' trucks and delivery vehicles will be inspected on leaving the project.

Guards will patrol the project site by inspecting gates, fences, and designated areas during nights and non-working days. Any unusual observation will be promptly recorded and necessary controls promptly implemented. Guards will be provided with radio communications to each other and the Safety and Security Manager to assure matters are effectively and promptly resolved. Telephone and/or radio communications will be provided to the Palatka Fire Department and Local Law Enforcement Officials.

If possible, a radio-telephone patch will be provided to assure communications. As the plant becomes operational, additional security measures may be installed as determined by SECI. Television monitoring and other electronic intervention/detection devices may be required as the project develops.

A Security Manual will be developed expanding on the above. As the Security Program develops, appropriate requirements will be incorporated into the Security Manual.

3.10 CONSTRUCTION SCHEDULE

Figure 3.10-1 is a general project schedule showing important milestones. Notable items include: (1) onsite construction activity is scheduled to begin in December 1979, (2) Units No. 1 and No. 2 commercial operation is scheduled for June 1983 and June 1985, respectively; and (3) construction of associated transmission lines is scheduled to coincide with station milestones.

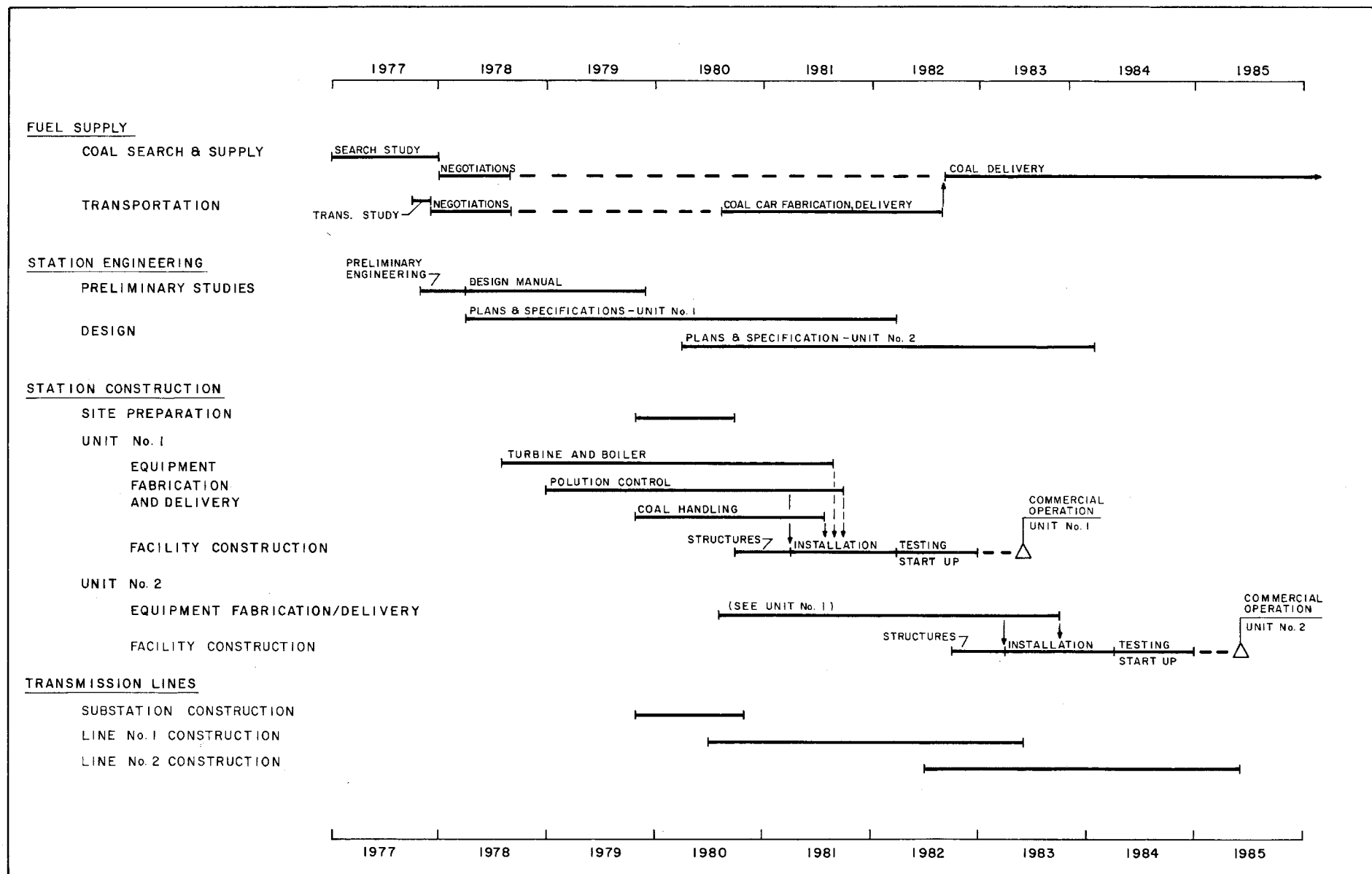


Figure 3.10-1. Project Schedule.

3.11 REFERENCES

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4.0 ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND STATION CONSTRUCTION

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4.0 ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND STATION CONSTRUCTION

4.1 AIR QUALITY

The impact of site preparation and station construction on ambient air quality will be minor and will result primarily from the generation of non-toxic fugitive dust due to land clearing, excavation, and movement of vehicles over unpaved surfaces. Any increase in particulate concentrations resulting from such activities will be intermittent and primarily confined to the immediate vicinity of the Putnam Site because dust particles created by fugitive mechanisms of this type tend to be relatively large and subject to rapid deposition. Control of nuisance dusts will be accomplished by the application of water and/or dust suppression chemicals when needed. No toxic or explosive dusts are expected to be created by construction activities.

Vehicle exhaust emissions will also occur during site preparation and station construction. In relation to existing traffic-related emissions in the area, however, these additional emissions will be insignificant and will result in a negligible impact.

4.2 CONSTRUCTION WATER SYSTEM

4.2.1 Source and Quantity of Construction Water

The station water supply well will provide water for construction as well as for later operation, including drinking water, construction water, and sanitary facilities. Two wells will draw water from the Floridan Aquifer and will be capable of yielding water at the rate of 50 gallons per minute (gpm) as required to provide the 20,000 gallons per day needed during the construction phase. The water will be chlorinated and stored in a pressure tank capable of holding at least 3,000 gallons.

4.2.2 Effects of Withdrawal

Withdrawal at the rate of 50 gpm will cause no significant effect on the potentiometric surface of the Floridan Aquifer outside the site area. Less than a half-foot of drawdown can be expected at the closest well drawing from the Floridan Aquifer (Well A-21, Figure D-7).

4.2.3 De-watering Effects

Temporary dewatering of the water table aquifer for construction will have no lasting environmental impact. Ground water that is removed will be allowed to recharge the aquifer at some distance from the de-watered area. Calculations show that the cone of depression caused by the withdrawal will not extend beyond the site property boundaries. The estimated pumping rates are listed in Table 4.2-1. It is unlikely that dewatering will take place in all foundation areas simultaneously.

4.2.4 Construction Wastewater

Wastewater during the period of construction will be essentially sanitary waste. The incidence of petroleum products or chemicals in this water is negligible. In the final stages of construction, there will be additional wastewater from the flushing of piping systems, testing of the boiler, and cleaning both the boiler and piping systems. This water will either be removed via tank truck to approved disposal facilities, or will be treated by the permanent wastewater treatment system (Section 3.6).

Further, during-construction housekeeping regulations will not permit dumping of any petroleum products on the ground which would form a potential for pollution but will require disposal of these products in an approved manner.

Sanitary wastes will be collected by a sewerage network and treated in a modularized extended aeration treatment plant. The effluent from this plant will comply with requirements of the Florida Departments of Environmental Regulation and Health and Rehabilitive Services before discharge into an onsite percolation field. There will also be some portable toilet facilities located in outlying areas of the construction site which will be of the holding tank type and pumped periodically by the supplier of the facility.

Table 4.2-1

Estimated Construction Dewatering Pumping Rates

<u>Facility</u>	<u>Estimated Pumping Rate (gpm)</u>
Power Block	800 to 1,000
Scrubbers/Precipitators	500 to 700
Limestone/Waste Area/Stack Area	800 to 1,100
Cooling Tower Area	700 to 900
Silo	500 to 800
Pretreatment Area	600 to 800
Coal Dumper/Tunnels/Tower	700 to 1,100

Source: Burns and Roe, Inc.

4.3 LAND DISTURBING ACTIVITIES

4.3.1 Erosion and Runoff Effects

Sediments represent the major nonpoint source of water pollution on most construction sites, especially on those which require extensive grading. Sediment consists primarily of solids and organic materials detached from the ground surface by runoff erosion and carried into the drainage system. The introduction of sediment into various natural bodies of water, and the associated turbidity and solids deposition, results in potential adverse physical, chemical, and biological effects.

Standards of performance to control the quantity or quality of pollutants discharged as the result of construction runoff are contained in "Effluent Guidelines and Standards for Steam Electric Power Generating" (40 CFR 423.45). These criteria do not apply, however, to any runoff greater than the 10-year, 24-hour rainfall event.

The site preparation and construction activity for the main structures will require approximately 420 acres of land (Area 1, Figure 3.1-3). As discussed in Appendix C, Section C.1.2, the soil in the site area is predominantly a fine sand that resists erosion due to its particle size and permeability. Based on the Universal Soil Loss Equation (SCS, 1975), the soil loss in the portion of the site undergoing construction activity will increase approximately from 0.2 to 3.0 tons per acre per year during land disturbing activities. The 3.0 tons per acre per year is still a relatively low rate of soil loss. From Chapter 2.0, Section 2.3.1.3, yields as high as 350 tons per acre per year have occurred on construction sites.

Construction runoff resulting from precipitation falling directly onto the construction area will be trenched away and dissipated through infiltration (see Figure 3.1-4). Therefore, the effect of erosion will be to displace soil from cleared areas toward these points of onsite discharge, and no offsite impacts are expected.

Upon completion of construction, cleared areas will be dressed and vegetated to be compatible with the existing natural landscape

elements. Therefore, no impacts due to construction area runoff will occur after this time.

4.3.2 Impacts on Terrestrial Ecology

Vegetation

Much of the vegetation within the plant site boundaries will be removed or altered. About 65 percent will be left undisturbed. The habitat most adversely affected will be the Sandhill Community. Of the approximate 520 acres of Sandhill that exist on the Putnam Site (Figure 2.7-1), about 55 percent or 290 acres will be cleared. Previous lumbering activities in the Sandhill Community have significantly altered the plant life, so that the quality of this particular Sandhill area as a wildlife habitat has already been greatly lowered. Much of the Pine Flatwoods north of the Sandhill Community will be disturbed as this area is to be utilized for waste disposal. Other areas that will be either cleared or altered will be two small Cypress Heads on the west side of the site (Figure 2.7-1).

Dust from construction activities may cause some temporary effects on natural vegetation on adjacent land. However, much of the nearby area is agricultural, and the natural vegetation has been subject to dust from plowing and other farming operations. It is doubtful that the impact of dust caused by construction will be significant on these nearby areas.

Wildlife

The primary impact of site development on wildlife species presently utilizing the Putnam site will be the removal of habitat. The current plant layout places the plant structures and the waste storage area in the Sandhill and Pine Flatwoods habitats. These habitats will be cut and cleared which will remove them as useful areas to wildlife. The more motile species (i.e., birds and larger mammals) will probably be able to escape into surrounding habitat. Presently, Pine Flatwoods is the primary habitat surrounding the Putnam Site. Surveys on the site found wildlife populations to be relatively low due to frequent disruption by man and competition from feral hogs (Section 2.7).

Therefore, it is unlikely that the animals on site will overcrowd any populations in surrounding habitats. Animals unable to escape, such as amphibians, reptiles, and small mammals may be destroyed during site development. These populations were not very abundant, so their removal will represent a minor impact of site development.

The inhabitants of the disturbed portion of the Sandhill Community may be able to move to the undisturbed Sandhill habitat, but this may cause overcrowding since only about 45 percent of the Sandhill Community will remain undisturbed. The only inhabitant endemic to this habitat found on site was the gopher tortoise. Site development will destroy the tortoise burrows and probably any tortoises as well. A few tortoises may move into the surrounding undisturbed Sandhill and Flatwoods and be able to construct usable burrows, but much of their onsite habitat will be destroyed by site development. The actual size of the tortoise colony on this site is unknown, but three individuals of different sizes were found, and the majority of the burrows were in use. Investigations of the possibility of censusing this colony are continuing.

Tall pines in the northern portion of the Putnam Site may have been used as a nesting site by eagles in the past. These pines have been cut by the landowners, so the site is presently devoid of attractive nest trees (Section 2.7.1). Other areas in the Putnam Site region offer more attractive nesting for eagles.

The manatee is known to occur in the St. Johns River near the Putnam Site. These aquatic mammals are more numerous during the summer season but are probably not found in the immediate vicinity of the site due to a general lack of the aquatic macrophytes on which they feed. Nothing associated with the construction of the facility will impact the manatee.

4.4 DREDGING IMPACTS

General

An intake structure located at the shoreline of the St. Johns River will require an intake channel to deep water. The channel will be dredged from the bottom of the river, and impacts will result. Figure 4.4-1 shows a conceptual intake channel dredge plan. The construction of the channel will be by bucket dredge. A "bucket dredge" is a chain conveyor with buckets attached that dumps onto a belt conveyor. The contractor will be given the option of using the bucket dredge or the clamshell dredge. This will apply to both the intake channel work and the discharge pipe embedment work. Upon selection of a specific dredging method the Department of Environmental Regulation will be notified for review and comment. About 3000 cubic yards of spoil will be removed from the intake channel and 700 cubic yards from the discharge pipeline trench (about 650 cubic yards will be returned to the pipeline trench for backfilling). Of this amount of spoil, about 1000 cubic yards will be removed from behind a sheet pile cofferdam placed around the actual intake structure foundation. Since excavation of this portion of the material will be separated from the river, it will not contribute to dredging impacts to the river. The spoil will be pumped as a slurry to a disposal area excavated on the main plant site (Figure 4.4-1, Part Plan, Spoil Area). Moisture will be allowed to drain from the spoil area by percolation. The contractor will be given the option of trucking the spoil to the disposal area. During dredging operations, turbidity curtains will be used.

Impacts to the Aquatic Ecosystem

Dredging operations may have several potential impacts on the aquatic ecosystem. The primary impact of dredging will be the removal of substrate and the commensurate alteration of habitat in the dredged area. Other impacts which may potentially occur during the actual dredging operation include a temporary increase in turbidity and the potential for some associated chemical releases from the dredged materials.

An area of approximately 30,000 sq. ft. of substrate will be dredged for the intake channel and pipeline trench. This operation will result in a temporary reduction in benthic organisms in the dredged area since they will be removed from the aquatic environment. Many of the benthic organisms are food sources for fish; therefore, dredging will also result in a reduction of available food in the immediate area being dredged. It should be noted that many of the fish in this area are not benthic feeders (bay anchovy, thredfin shad, gizzard shad), and that fish in general are extremely agile. It is probable that the dredging of the intake area will result in a temporary displacement of fish to other areas. Spoil disposal has usually been one of the more significant impacts of dredging on the aquatic environment. In this case however, it will not be a source of impact at the site since all disposal will be placed behind dikes inland from shore.

Aquatic macrophytes were observed within 250 feet of the shoreline. It is estimated that about 16,000 square feet of these macrophytes will be removed for the intake channel and about 3,000 square feet for the pipeline trench. Since the pipeline trench will be back-filled to original contours, macrophytes are expected to reestablish themselves in that area. However, no appreciable macrophyte populations are expected in the intake channel because of the increased water depths. The significance of the macrophyte bed as a potential nursery area is currently under study. Because of the large extent of macrophytes along many miles of shoreline in the general vicinity it is not expected that the loss of substrate in this limited area will be of particular concern.

Some short-term impacts such as increased turbidity and suspended sediments may potentially cause temporary and minor local reductions in light penetration, but this impact will be temporary in nature and limited in area, and the effect of the impact is expected to be negligible.

The suspended sediments associated with turbidity may potentially cause some mechanical damage to the gills of fish and invertebrates which remain in the area during dredging. Since the affected area is relatively small, the impact will be minor. Many fish will avoid the area and the invertebrate community, if damaged, will recover quickly after dredging is completed. Some benthic organisms may recolonize a dredged area within two weeks (Slotta, 1974), and in many cases complete recolonization is relatively complete in 6 months to a year (May, 1973).

Chemical releases associated with the resuspension of bottom sediments are not expected to be a source of significant impact. Compounds such as pesticides, PCBs and phenols were found in low concentrations in the sediments at Transect B and in most cases were at undetectable levels (Section 2.3.1.4). Arsenic and the various heavy metals which were evaluated as part of the sediment analysis (Section 2.3.1.4) should not cause any potentially significant adverse impacts to the aquatic biota. Concentrations of these materials were relatively low at Transect B in most cases, with the exception of arsenic and iron. The relatively nontoxic iron (most of which will probably be in the form of iron hydroxide) has the capability of scavenging other metals out of solution and precipitating them with the iron. It is also probable that the solubility rates of many of the materials are too low to become disassociated in the short time period required for the suspended sediments to resettle (May, 1973).

It should be noted that the amount of dredging proposed for this project is negligible when compared to the amount of dredging activities that have taken place in past years near the site as evidenced by Figure 4.4-2. Those activities have included placing spoil in the river (note the reference to "spoil areas" in Figure 4.4-2).

Impacts to Ground Water

The dredge disposal area is shown on Figure 4.4-1. Approximately 2,000 cubic yards of spoil at approximately 15 percent solids will be

placed in the disposal area. Additionally, approximately 1,000 cubic yards of essentially dry spoil will be placed in the disposal area. The potential impact upon ground water is associated with the slurry water used to transport the spoil to the disposal area. This water will be the interstitial water naturally contained in the sediments prior to dredging.

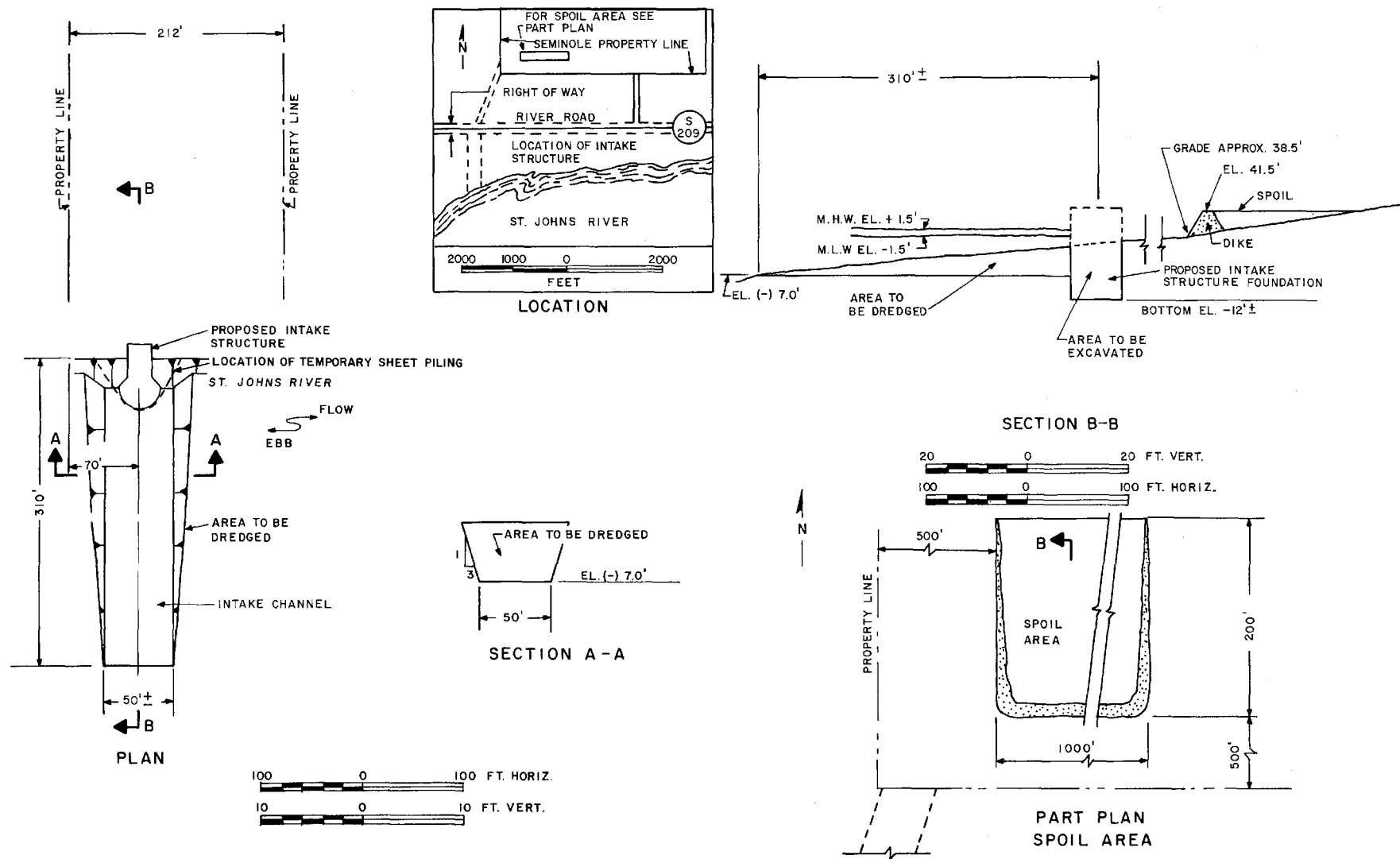
To evaluate the potential impacts of this blowdown to the water table aquifer, the water quality data for the St. Johns River (Table C-8 and the sediment analyses Table C-12) were used. The chemical constituents considered were chloride, sulfate, cadmium, mercury, lead, and zinc. All of these constituents, except sulfate, occasionally exceed Florida water quality criteria, but in general the concentrations are below the water quality criteria.

Compounds such as pesticides, PCBs, and phenols were found in low concentrations in the bottom sediments of the St. Johns, but in most cases were at undetectable levels. For the impact analysis, the concentrations of these constituents were estimated by conservatively assuming that 100 percent of the maximum concentrations found in the sediments would leach into the sluice water.

The results of the impact analysis are summarized on Table D-25 (Appendix D). As shown, the concentrations at the property boundary were calculated to be within the State of Florida ground water quality criteria, and impacts to off-site ground water are expected to be insignificant.

Summary

In summary, the overall impact of the dredging operation is expected to be minimal. This is because the area to be dredged is relatively small, and dredging activities will occur for only a short time. Construction activities such as inland spoil disposal and runoff control will also further minimize any potential for impacts to occur.



SOURCE: BURNS AND ROE, INC.

REVISED 3/15/79

Figure 4.4-1. Intake Channel Dredge Plan.

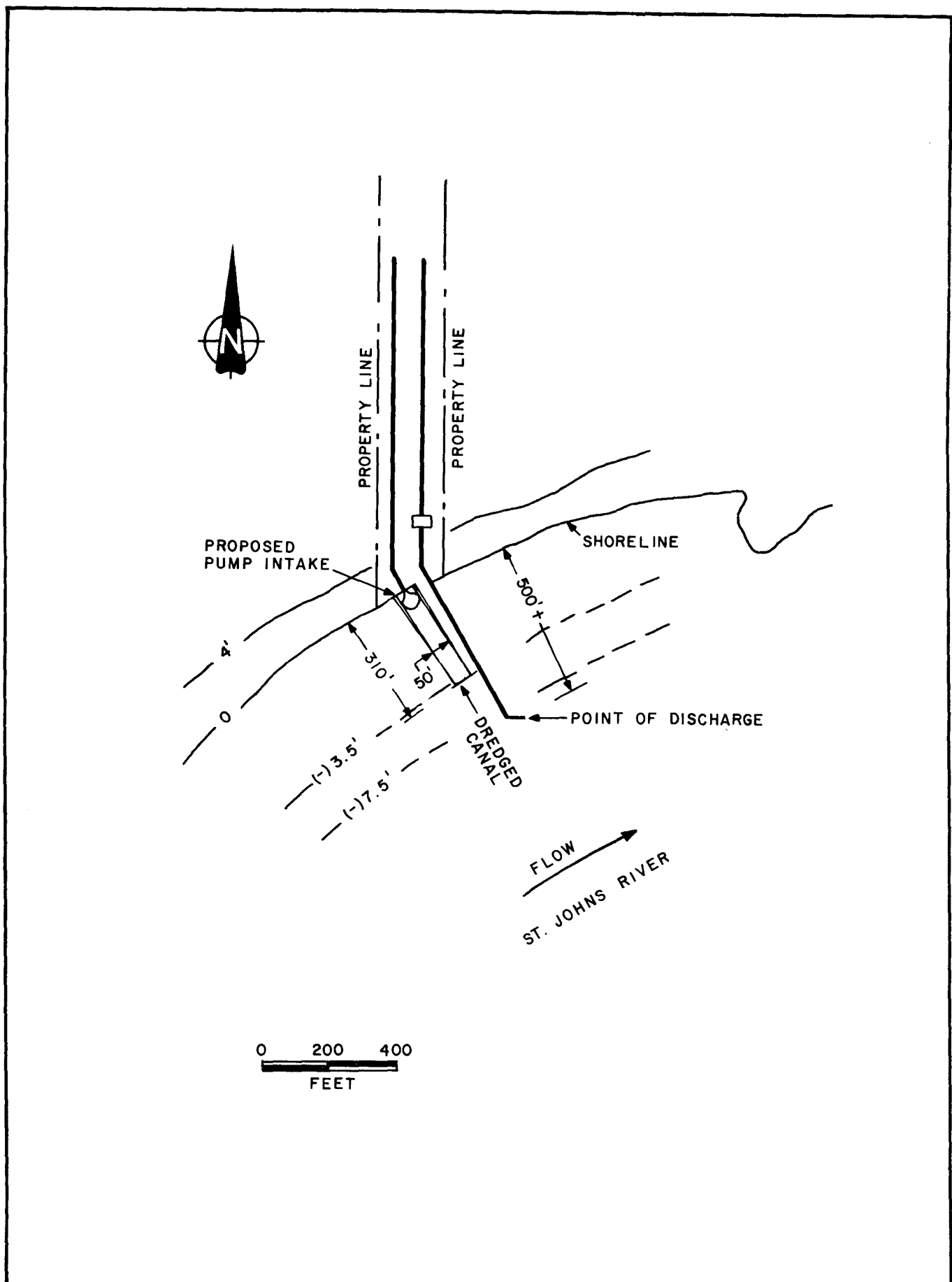


Figure 4.4-1a. Intake and Discharge Structures Dredge Plan.

JOINT APPLICATION
DEPARTMENT OF THE ARMY/FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
FOR
ACTIVITIES IN WATERS OF THE STATE OF FLORIDA

Refer to Instruction Pamphlet for explanation of numbered items and attachments required.

1. Application number (To be assigned)	2. Date Day Mo. Yr.	3. For official use only																					
4. Name, address and zip code of applicant Seminole Electric Cooperative, Inc. 2410 East Busch Boulevard Tampa, Florida 33612																							
Telephone Number <u>813-933-7406</u>																							
5. Name, address, zip code and title of applicant's authorized agent for permit application coordination Tom Crumlish, Project Manager Seminole Electric Cooperative, Inc. 2410 East Busch Boulevard Tampa, Florida 33612																							
SEP 11 1978 PERMIT																							
6. Describe the proposed activity, its purpose and intended use, including a description of the type of structures, if any, to be erected on fills, or pipe or float-supported platforms, and the type, composition and quantity of materials to be discharged or dumped and means of conveyance. a. Dredging and excavation of intake channel. Dredging of discharge trench for discharge pipe. b. Construction of intake and discharge structures. FOR ADDITIONAL INFORMATION, SEE ATTACHMENT (ITEM 6). <table style="width: 100%; margin-top: 10px;"> <tr> <td style="width: 33%;"></td> <td style="width: 33%; text-align: center;">Dredged/Excavated</td> <td style="width: 33%; text-align: center;">Backfill</td> </tr> <tr> <td>Volume of Material:</td> <td style="text-align: center;">3700 CY</td> <td style="text-align: center;">650 CY</td> </tr> <tr> <td></td> <td style="text-align: center;">CY</td> <td style="text-align: center;">CY</td> </tr> <tr> <td></td> <td style="text-align: center;">3050 CY</td> <td style="text-align: center;">CY</td> </tr> <tr> <td></td> <td style="text-align: center;">CY</td> <td style="text-align: center;">CY</td> </tr> <tr> <td></td> <td style="text-align: center;">Waterward of O.H.W. or M.H.W.</td> <td style="text-align: center;">Waterward of O.H.W. or M.H.W.</td> </tr> <tr> <td></td> <td style="text-align: center;">Landward of O.H.W. or M.H.W.</td> <td style="text-align: center;">Uplands</td> </tr> </table>				Dredged/Excavated	Backfill	Volume of Material:	3700 CY	650 CY		CY	CY		3050 CY	CY		CY	CY		Waterward of O.H.W. or M.H.W.	Waterward of O.H.W. or M.H.W.		Landward of O.H.W. or M.H.W.	Uplands
	Dredged/Excavated	Backfill																					
Volume of Material:	3700 CY	650 CY																					
	CY	CY																					
	3050 CY	CY																					
	CY	CY																					
	Waterward of O.H.W. or M.H.W.	Waterward of O.H.W. or M.H.W.																					
	Landward of O.H.W. or M.H.W.	Uplands																					
7. Proposed use Private [] Public [] Commercial [X] Other [] (Explain in remarks)																							
8. Name and address including zip code of adjoining property owners whose property also adjoins the waterway. <table style="width: 100%;"> <tr> <td style="width: 50%;"> WEST - Daniel and Ruey Hodapp 3400 S. Dixie Highway Room 104 Dayton, Ohio 45439 </td> <td style="width: 50%;"> EAST - Robert A. Warner 6100 Lake Ellenor Drive Orlando, Florida 32809 </td> </tr> </table>			WEST - Daniel and Ruey Hodapp 3400 S. Dixie Highway Room 104 Dayton, Ohio 45439	EAST - Robert A. Warner 6100 Lake Ellenor Drive Orlando, Florida 32809																			
WEST - Daniel and Ruey Hodapp 3400 S. Dixie Highway Room 104 Dayton, Ohio 45439	EAST - Robert A. Warner 6100 Lake Ellenor Drive Orlando, Florida 32809																						
9. Location where proposed activity exists or will occur 1.2 miles due East of U.S. Route 17 on Street address Florida State Highway 209 Longitude <u>91° 24' 25"W</u> Latitude <u>29° 42' 46"N</u> (If known) Sec. <u>18</u> Twp. <u>9 S</u> Rge. <u>27 E.</u> <u>Florida</u> <u>Putnam</u> <u>Palatka</u> State County In City or Town Near City or Town																							
10. Name of waterway at location of the activity St. Johns River																							

11. Date activity is proposed to commence Feb. 1981
Date activity is expected to be completed April 1981

12. Is any portion of the activity for which authorization is sought now complete? Yes [] No [X]
If answer is "Yes" give reasons in the remarks section. Month and year the activity was completed _____
_____. Indicate the existing work on the drawings.

13. List all approvals or certifications required by other Federal interstate, state or local agencies for any structures, construction, discharges, deposits or other activities described in this application, including whether the project is a Development of Regional impact.

Issuing Agency Type of Approval Identification No. Date of Application Date of Approval

a. See Attachment (Item 13), STATUS OF PERMITS & APPROVALS

b. Proposed project is not regulated by Chapter 380 F.S. as a Development of Regional Impact.

14. Has any agency denied approval for the activity described herein or for any activity directly related to the activity described herein?
Yes [] No [X] (If "Yes" explain in remarks)

15. Remarks (see Instruction Pamphlet for additional information required for certain activities)

See Attachment (Item 15)

16. Application is hereby made for a permit or permits to authorize the activities described herein. I agree to provide any additional information/data that may be necessary to provide reasonable assurance or evidence to show that the proposed project will comply with the applicable State Water Quality Standards or other environmental protection standards both during construction and after the project is completed. I also agree to provide entry to the project site for inspectors from the environmental protection agencies for the purpose of making preliminary analyses of the site and monitoring permitted works, if permit is granted. I certify that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities.

Signature of Applicant

Date

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than \$10,000 or imprisoned not more than five years, or both.

The application must be signed by the person who desires to undertake the proposed activity; however, the application may be signed by a duly authorized agent if accompanied by a statement by that person designating the agent and agreeing to furnish upon request, supplemental information in support of the application.

FEE: Attach Checks/Money Orders on front
Payable to Department of Environmental Regulation
\$200 Standard form projects
\$20 Short forms and Chapter 403 projects only

ATTACHMENT (ITEM 6)

Application is made to construct and operate river water Intake and Discharge Structures located on the St. Johns River in Putnam County approximately 5 miles downstream of the U.S. Route 17 bridge at Palatka, Florida (Figure A). The proposed structures will be on the northwest bank of the river (left bank facing downstream) at latitude 29°42'46"N, longitude 91°24'25"W. The river at this point is approximately 1.1 miles wide.

The structures (Figures B and C) are part of the proposed Seminole Plant Units 1 and 2, a coal-fired steam electric generating station designed to produce 1200 megawatts (net) of electric power. The station will consist of two coal-fired boilers and steam generating units; two 450-foot high natural draft hyperbolic cooling towers; two 600-foot high stacks; a flue gas desulfurization waste storage area; two bottom ash storage ponds; a switchyard; electric transmission lines; and other associated facilities.

The cooling water circulating system for the station requires 16,800 gallons per minute (gpm) as makeup water for the cooling tower evaporation and blowdown losses from the two units. The makeup water is proposed to be drawn from the St. Johns by means of a cylindrical wedge wire screen intake structure as shown in Figure B.

The screen structure will consist of 8 cylindrical wedge wire screen units located near the shoreline to allow access by maintenance personnel. A crane will be provided so that screen units can be lifted out for cleaning by water pressure hoses and brush scrubbing. This would be accomplished by cutting off flow through a screen unit by closing its sluice gate before lifting it out.

The screen surface area will be designed to achieve an approach velocity of 0.2 feet per second (fps) with clean screens. Screens will be cleaned when fouling reduces the screen opening area such that approach velocities reach about 0.4 fps. The final selection of screen

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opening size is expected to be within the range of 1.0 to 2.0 mm, and will be the smallest feasible opening size that will not cause excessive fouling.

At the centerline of each screen unit will be an embedded air back-wash pipe. An air compressor equipped with a flexible air line will be provided to allow each screen unit to be cleaned in place. This procedure will reduce the required frequency for mechanical removal and brush cleaning.

The Intake Structure will require an intake channel to deep water (Figure B). About 3,000 cubic yards (c.y.) of fine to medium grain sand will be removed by bucket dredge from the bottom of the river. Of this total quantity, approximately 1,000 c.y. will be excavated or dredged behind sheet piling. In addition, periodic dredging of the canal is expected during operation. The spoil will be pumped as a slurry to a disposal area on the main plant site. Moisture will be allowed to drain from the spoil area by percolation. Approximately 100 c.y. of stone rip-rap will be placed on the river banks near the pump intake.

The effluent water at 2,083 gpm will be conveyed through a 16 inch diameter buried pipe to a submerged nozzle approximately 125 feet downstream of the intake structure and 500 feet waterward from the northwest bank of the St. Johns (Figure A). The discharge nozzle will be designed to pass the normal expected plant discharge at an exit velocity of 10 to 15 feet per second (fps).

As shown in Figure C, the nozzle will be directed away from the river bottom at an angle of approximately 20 degrees in order to prevent erosion of the bottom and resuspension of sediments. Near the discharge nozzle, riprap will be placed on the bottom to prevent scour caused by jet turbulence. The point of discharge will be elevated slightly from the bottom, about 1 foot above the riprap. The discharge jet will be directed toward the downriver flow direction at approximately 45 degrees to the ambient current direction.

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The trench for the submerged outfall will require the dredging of approximately 700 cubic yards of material from the bottom of the river. Of this total, approximately 650 c.y. will be returned for backfilling and the remaining will be pumped as a slurry to a disposal area in the same manner as the spoil from the intake channel.

For further reference, see Site Certification Application and Environmental Analysis for Seminole Plant Units No. 1 and No. 2, Seminole Electric Cooperative, Inc., prepared by Dames & Moore and submitted to the Army Corps of Engineers by the Florida Department of Environmental Regulation on August 7, 1978. Pertinent report sections are:

<u>Subject</u>	<u>Section</u>
Station Layout and Appearance	3.1
Intake Structure	9.2.7
Discharge Structure	3.5.2
Dredging Requirements	4.4.1

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ATTACHMENT (ITEM 13)

STATUS OF PERMITS AND APPROVALS

Subject of Permit Application or Approval	Statutory Mandate	Administering Agency	Date of Application (Proposed)	Approval Date (Expected)	Comments
<u>FEDERAL</u>					
Application for loan approval	Rural Electrification Act	REA	(3/79)	(12/79)	
Environmental Analysis	National Environmental Policy Act; Exec. Order 11514: Pro- tection and Enhancement of Environmental Quality; Exec. Order 11991: Relating to Protection and Enhancement of Environmental Quality	REA	(8/78)	(11/79)	
NPDES	Federal Water Pollution Control Act (§402)	EPA	(8/78)	(11/79)	
Preconstruction New Source Air Quality Review	Clean Air Act (§110)	EPA	(8/78)	(11/79)	This review will be conducted by the State through its Site Certification process.
PSD	Clean Air Act (§160-169)	EPA	5/78	(Prior to 5/79)	
Activities in Navigable Waters	Rivers and Harbors Act (§10)				
1. Intake/discharge structures		COE	(8/78)	(11/79)	
2. Transmission Lines		COE	NA	NA	Applications to be filed prior to line construction.

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ATTACHMENT (ITEM 13) Cont'd

Subject of Permit Application or Approval	Statutory Mandate	Administering Agency	Date of Application (Proposed)	Approval Date (Expected)	Comments
Activities in Wetlands	Federal Water Pollution Control Act (§404)	COE	(8/78)	(11/79)	
Construction of Tall Stack	Federal Aviation Act	FAA	2/78	5/78	Approval contingent on State DOT stack construction approval
<u>STATE</u>					
Site Certification Application	Florida Electrical Power Plant Siting Act	DER	(8/78)	(10/79)	
Transmission Line Road Crossings	Ch. 338 F.S. (Ch. 14-46 FAC Utilities Installation or Adjustment)	DOT	NA	NA	Application to be filed prior to construction.
Modifications of State Road 17		DOT	(8/79)	(11/79)	
Construction of Tall Stack	Ch. 75-16 F.S.	DOT	6/78	6/78	
Water Well Drilling	Ch. 381.03(1)(9)3 F.S.	DHRS	4/78	4/78	
Well Regulation	Florida Water Resources Act	SJRWMD	4/78	4/78	
Easement through State Owned Lands	Ch. 253 F.S. and Ch. 76-24F F.S.	DNR	(8/78)	(Prior to 10/79)	

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JUL 11 1978

ATTACHMENT (ITEM 13) Cont'd

Subject of Permit Application or Approval	Statutory Mandate	Administering Agency	Date of Application (Proposed)	Approval Date (Expected)	Comments
<u>LOCAL</u>					
Land Use or Zoning Approval	Putnam County Zoning Ordinance 75-6 Chapter 163 F.S. Chapter 125 F.S.	Putnam County Commission	4/78	5/78	
Pipeline Road (209) Crossings	Putnam County Ordinance Ch. 338 F.S.	Putnam County Commission DOT	NA	NA	Application processed within two weeks of submission.

Abbreviations:

REA	U. S. Rural Electrification Administration
EPA	U. S. Environmental Protection Agency
COE	U. S. Corps of Engineers
FAA	Federal Aviation Administration
DER	Florida Department of Environmental Regulation
DOT	Florida Department of Transportation
DHRS	Florida Department of Health and Rehabilitative Services
SJRWMD	St. Johns River Water Management District
DNR	Florida Department of Natural Resources
NA	Not available

ATTACHMENT (ITEM 15)

Six intake structures were evaluated for the proposed structure.

Scheme 1 - Modified conventional intake with standard traveling screens. The modifications for fish protection include "flush mounting" of the screens and the provision of fish escape passages through the outside walls of the structure.

Scheme 2 - The same general configuration as Scheme 1, but with the traveling screen itself modified with the Surry-type, dual-spray fish recovery system.

Scheme 3 - Perforated (or wedge-wire) pipe offshore intake, with pump structure on shore.

Scheme 4 - Perforated (or wedge-wire) pipe shoreline intake, utilizing multiple removable screen units.

Scheme 5 - Radial well system (Ranney collectors).

Scheme 6 - Cylindrical, wedge-wire shoreline intake, utilizing multiple removable screen units.

Schemes 1 and 2 were rejected due to unacceptable biological impacts. Scheme 3 was rejected because of access problems in maintaining and cleaning the screen units at a remote offshore location.

Scheme 5 is presently being studied to determine the suitability of geologic conditions (i.e., the presence of an aquifer adjacent to the river and permeable soils).

Based on preliminary soils data, the radial well concept appears to be unfeasible. If this preliminary conclusion is substantiated, an in situ screen test will be conducted to determine the final design of the shoreline screen structure (Schemes 4 and 6). The screen test will lead to the final selection of intake configuration and screen opening sizes. Although Scheme 6 is expected to be the preferred configuration and therefore is described in detail in Item 6, if the in situ test indicates otherwise, Scheme 4 will be substituted (Figure D). Dredging requirements as described under Item 6 will be the same for both Schemes 4 and 6.

For the discharge structure, the alternative of locating it near the shore was considered. This was rejected as hydrodynamic model studies of the discharge plume indicated a separation of 500 feet should be maintained between the intake and discharge to prevent excessive recirculation of discharged water to the intake. As a single narrow corridor for both the intake and discharge pipeline is desired to limit consumption of land area, the separation between structures must be obtained by placing the discharge nozzle offshore.

Dredging operations may have several potential impacts on the aquatic ecosystem. The primary impact of dredging will be the removal of substrate and the commensurate alteration of habitat in the dredged area. Other impacts which may potentially occur during the actual dredging operation include a temporary increase in turbidity and the potential for some associated chemical releases from the dredged materials localized around the dredged site.

It should be noted that the amount of dredging proposed for this project is negligible when compared to the amount of dredging activities that have taken place in past years near the site. Those activities have included placing spoil in the river.

The overall impact of the dredging operation to the aquatic ecosystem will be minimal. This is because the area to be dredged is rela-

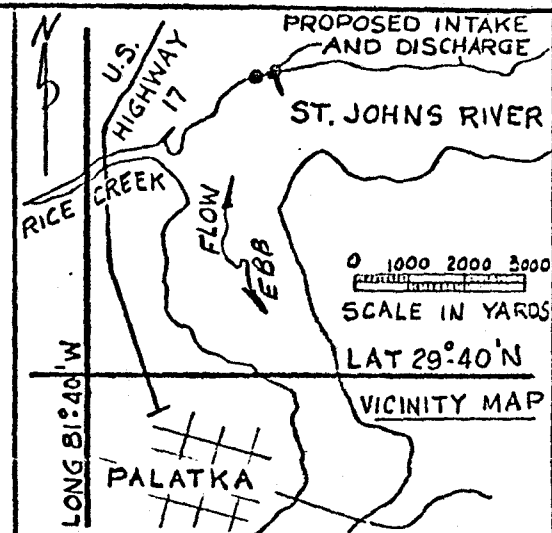
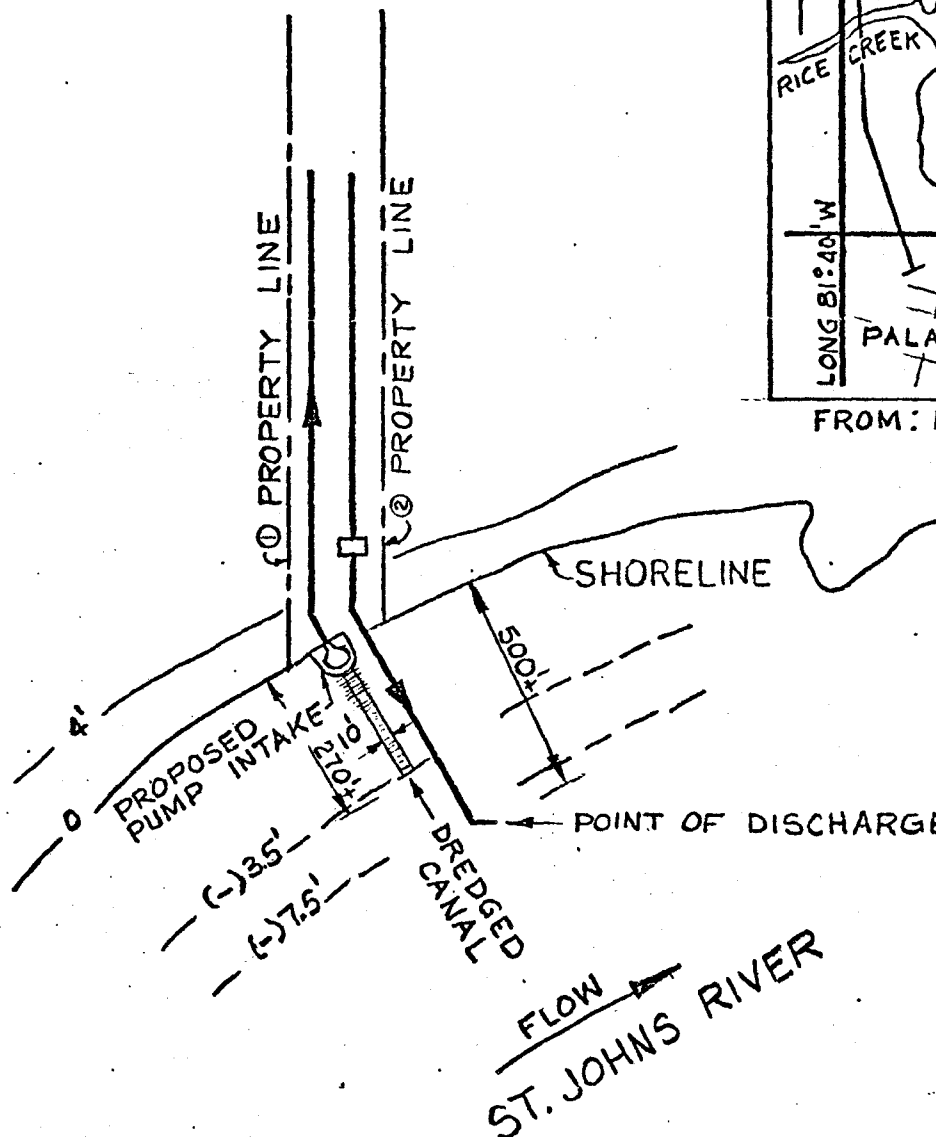
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tively small, and dredging activities will occur for only a short time. Construction activities such as inland spoil disposal, runoff control, and dredging during the winter season will also further minimize any potential for impacts to occur.

The overall plan for the project is contained in Site Certification Application and Environmental Analysis for Seminole Plant Units No. 1 and No. 2, Seminole Electric Cooperative, Inc., prepared by Dames & Moore. Pertinent report sections are:

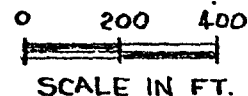
<u>Subject</u>	<u>Section</u>
Intake Structure Alternatives	9.2.7
Discharge Structure Alternatives	9.2.8
Dredging Impacts	4.4.1

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FEB 11 1975
FERN



FROM: NOAA CHART 11492

PLAN



PURPOSE: Power plant make-up and discharge

DATUM: Mean sea level

ADJACENT PROPERTY OWNERS:

① Daniel and Ruey Hodapp

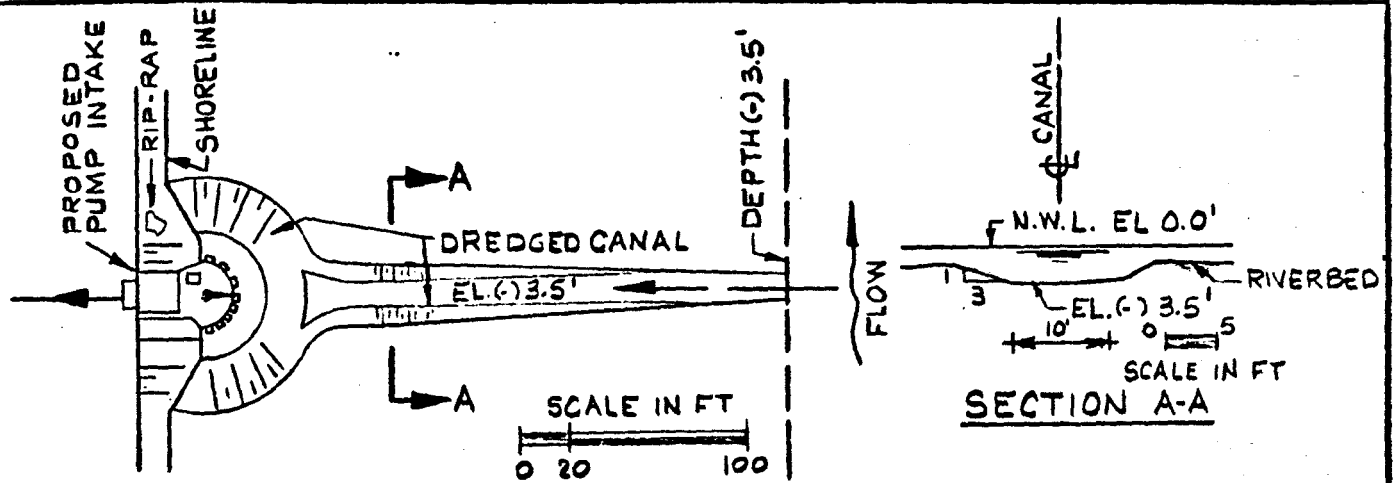
② Robert A. Warner

PROPOSED PUMP INTAKE &
DISCHARGE PIPE
IN St. John River
AT Palatka (4 miles north)

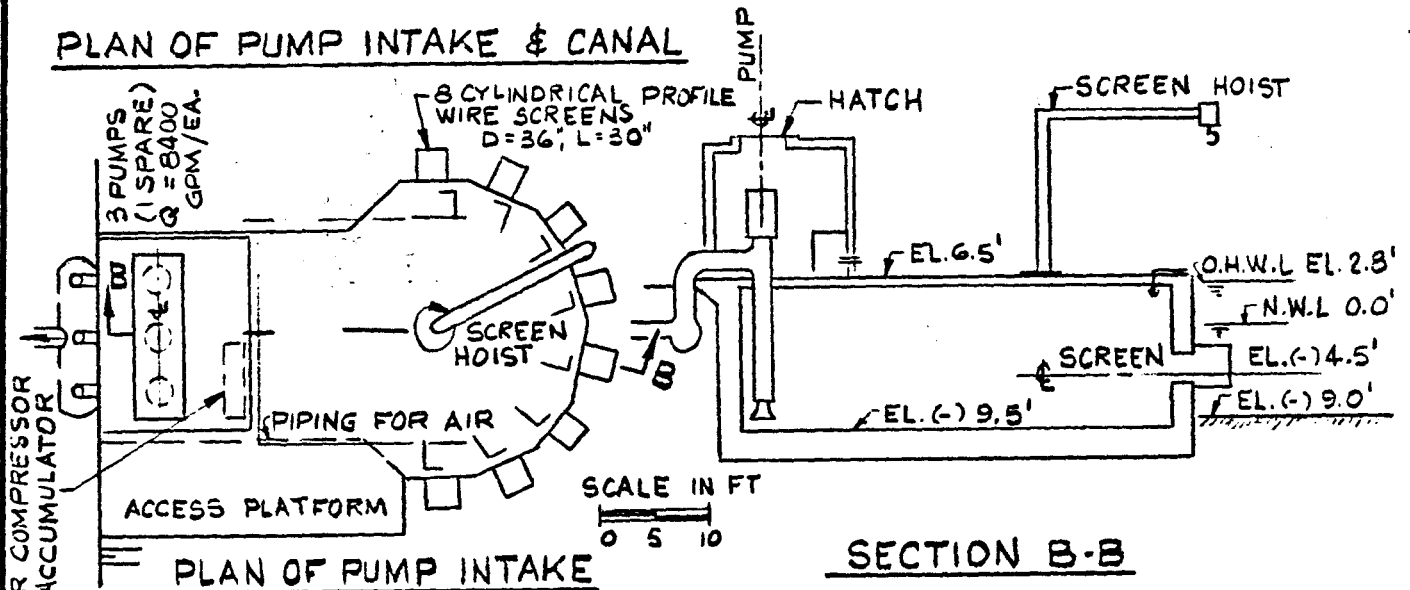
COUNTY OF Putnam STATE Florida
APPLICATION BY Seminole Electric
Cooperative, Inc.

SHEET 1 OF 4 DATE 8/25/78

FIGURE A



PLAN OF PUMP INTAKE & CANAL

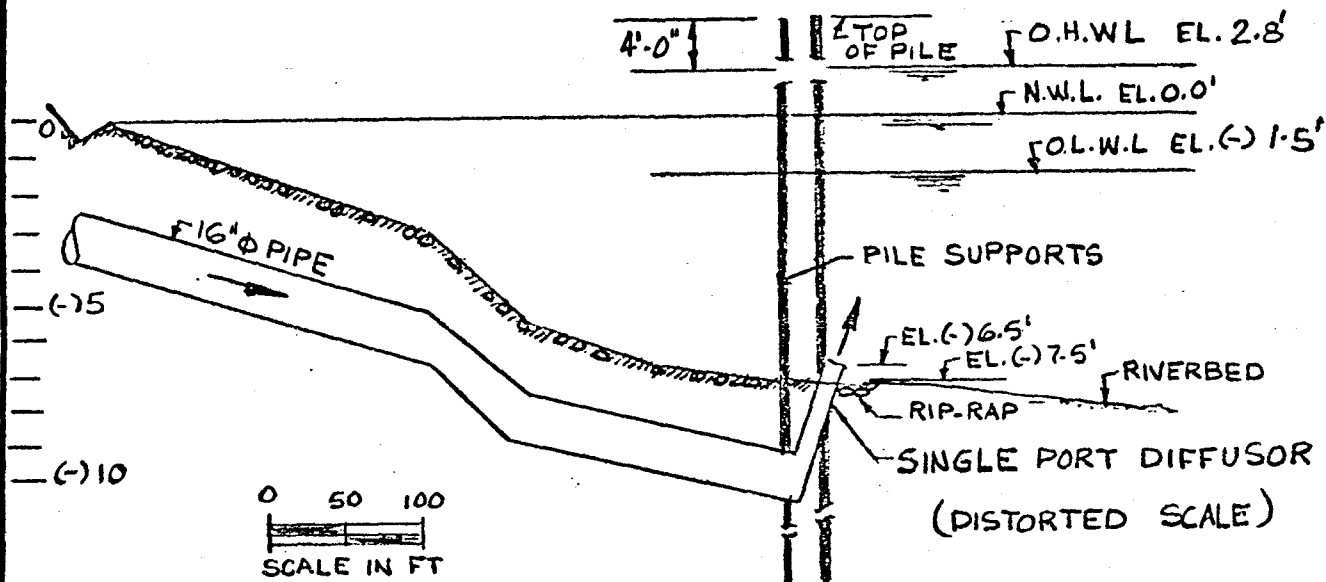


1. APPROX. 3000 C.Y. OF SOIL WILL BE DREDGED OR EXCAVATED DURING CONSTRUCTION OF THE PUMP INTAKE AND CANAL. OF THIS TOTAL QUANTITY 1000 C.Y. WILL BE EXCAVATED OR DREDGED BEHIND SHEET PILING, IN ADDITION, PERIODIC DREDGING OF THE CANAL IS EXPECTED DURING OPERATION.
2. DREDGED OR EXCAVATED SOIL WILL BE PLACED IN DISPOSAL AREA.
3. APPROX. 100 C.Y. OF STONE RIP-RAP WILL BE PLACED ON THE RIVER BANKS NEAR THE PUMP INTAKE.

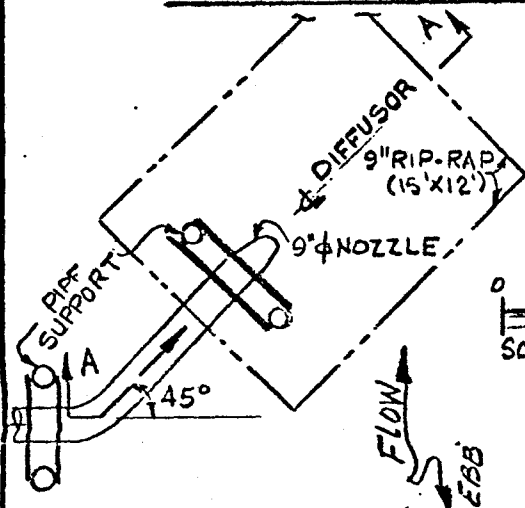
PURPOSE: Power plant make-up and discharge
 DATUM Mean sea level

PROPOSED PUMP INTAKE &
 DISCHARGE PIPE
 IN St. John River
 AT Palatka (4 miles north)
 COUNTY OF Putnam STATE Florida
 APPLICATION BY Seminole Electric
 Cooperative, Inc.
 SHEET 2 OF 4 DATE 8/25/78

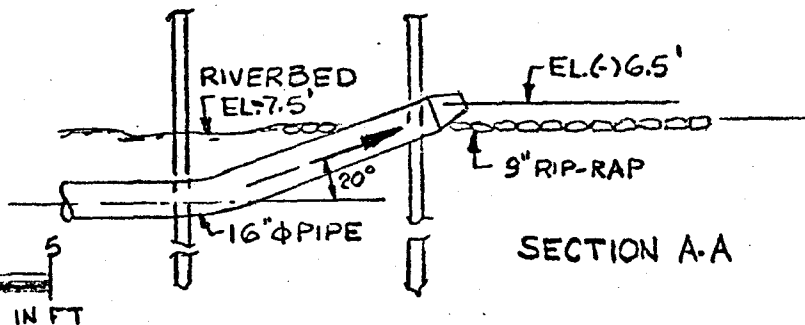
FIGURE B



PROFILE OF DISCHARGE PIPE



PLAN OF DIFFUSOR



1. APPROX. 700 C.Y. OF SOIL WILL BE DREDGED DURING CONSTRUCTION OF THE DISCHARGE PIPE.
2. OF THIS TOTAL DREDGED QUANTITY ABOUT 650 C.Y. WILL BE RETURNED FOR BACKFILLING AND APPROX. 50 C.Y. WILL BE PLACED IN DISPOSAL AREA.
3. APPROX. 5 C.Y. OF STONE RIP-RAP WILL BE PLACED ON THE RIVERBED NEAR THE DISCHARGE PORT.

PURPOSE: Power plant make-up and discharge
 DATUM Mean sea level

PROPOSED PUMP INTAKE &
 DISCHARGE PIPE
 IN St. John River
 AT Palatka (4 miles north)

COUNTY OF Putnam STATE Florida
 APPLICATION BY Seminola Electric
 Cooperative, Inc.

SHEET 3 OF 4 DATE 8/25/78

FIGURE C

CLEANING DECK
THIS END

SCHEMATIC ONLY

7-SCREEN UNITS
36" Ø x 4' LG.

3 PUMPS @
9000 GPM
(INCL. 1 SPARE)

PLAN

HOIST & MONORAIL
TO CLEANING AREA

WATER BACKWASH

AIR BACKWASH
EXT. L.W. - 2.5

SCREEN UNIT

DREDGED
AREA

+6.5↓

-10.5↓

ISOLATION GATE

POSSIBLE INTERNAL SLEEVE
FOR VELOCITY DISTRIBUTION

SECTION

PURPOSE: Power Plant
Make-up and discharge
Datum Mean Sea Level

NOT TO SCALE

PROPOSED PUMP INTAKE &
DISCHARGE PIPE
IN St. John River
AT Palatka (4 miles north)

COUNTY OF Putnam STATE Florida
APPLICATION BY Seminole Electric
Cooperative, Inc.

SHEET 4 OF 4 DATE 8/25/78

FIGURE D

INFORMATION NEEDED ON AFFIDAVIT OF OWNERSHIP OR CONTROL

1. The affidavit of ownership or control should be signed by at least one owner of the property, lessee, or easement holder.
2. If subdivided, the property should be described by lot number, block number (if any), name of subdivision, and plat book number and page where recorded.
3. If unplatted, the property should be described by section, township, and range, and subdivision of section.
4. If the description is based on courses and distances not following the plane coordinates, the point of beginning should be identified.

Please contact this office should clarification or further instructions be necessary.

AFFIDAVIT OF OWNERSHIP OR CONTROL

TO THE DEPARTMENT OF ENVIRONMENTAL REGULATION:

I hereby certify that I am the (check one):

record owner _____

lessee _____

record ease-
ment holder _____

applicant to record owner for
easement _____

of the below described property situated in _____ County,
Florida; and that said property is all the property that is contiguous to and landward of the area
in which the work proposed in the permit application is to be conducted. Furthermore, I certify
that as record owner, lessee, or record easement holder I have or will have prior to undertaking
the work all necessary approvals or permission from all other persons with a legal interest in
said property to conduct the work proposed in the permit application.

LEGAL DESCRIPTION

Sworn to and subscribed before me at _____

_____ County, _____, this _____ day
of _____, 19_____.

NOTARY PUBLIC

My commission expires:

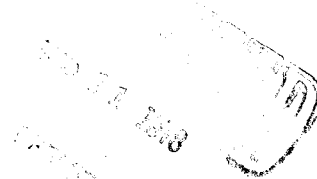


EXHIBIT A**Parcel One:**

The South one-half (S1/2) of the North East quarter (NE1/4) of the South East quarter (SE1/4) and the South East quarter (SE1/4) of the South East quarter (SE1/4) and the North West quarter (NW1/4) of the South East quarter (SE1/4) and the South East quarter (SE1/4) of the South West quarter (SW1/4) of Section 31, Township 8 South, Range 27 East, Putnam County, Florida, containing 140 acres of land, more or less.

The West one-half (W1/2) of the West one-half (W1/2) of Section 5, Township 9 South, Range 27 East, Putnam County, Florida, containing 160 acres of land, more or less.

All of Section 6, lying East of the Seaboard Coast Line Railroad, in Township 9 South, Range 27 East, Putnam County, Florida, containing 555 acres of land, more or less.

All of Section 7, Township 9 South, Range 27 East, less and except the following described tract of land containing 60 acres of land, more or less, to-wit: The South one-half (S1/2) of the South West quarter (SW1/4) of the South West quarter (SW1/4) and the South East quarter (SE1/4) of the South West quarter (SW1/4), Putnam County, Florida, containing 580 acres of land, more or less.

The West one-half (W1/2) of the West one-half (W1/2) and the South three-quarters (S3/4) of the East one-half (E1/2) of the West one-half (W1/2) and the South three-quarters (S3/4) of the West one-half (W1/2) of the East one-half (E1/2) of Section 8, Township 9 South, Range 27 East, Putnam County, Florida, containing 400 acres of land, more or less.

Government Lot 4, or the Northwest quarter (NW1/4) of the Northwest quarter (NW1/4), and the West 66 feet of Government lot 5, or the West 66 feet of the Southwest quarter (SW1/4) of the Northwest quarter (NW1/4) of Section 17, Township 9 South, Range 27 East, Putnam County, Florida, containing 42 acres of land, more or less.

Government lots 1 and 2, or the North one-half (N1/2) of the North East quarter (NE1/4), of Section 18, Township 9 South, Range 27 East, Putnam County, Florida, containing 80 acres of land, more or less.



(Parcel One continued)

The Southeast quarter (SE1/4) of the Southeast quarter (SE1/4) lying East of the East line of the Seaboard Coast Line Railroad, Section 1, Township 9 South, Range 26 East, Putnam County, Florida.

The Northeast quarter (NE1/4) of the Northeast quarter (NE1/4), lying East of the East line of the Seaboard Coast Line Railroad, Section 12, Township 9 South, Range 26 East, Putnam County, Florida.

Parcel Two:

A parcel of land situate lying and being in the South West quarter (SW1/4) of Section 18, Township 9 South, Range 27 East, more particularly described as follows:

Begin at the point of intersection of the South right-of-way line of State Road 209 and the East line of the South West quarter (SW1/4) of Section 18, Township 9 South, Range 27 East, thence run West along the South right-of-way line of said State Road 209 a distance of 200 feet to the point of beginning of the land herein described; from said point of beginning, run South to the St. John's River and Point A, thence begin again at the point of beginning and run West along the said South right-of-way line of State Road 209 a distance of 200 feet, thence run South to the St. John's River, thence run North and Easterly along said river to Point A, thence run North from Point A to the point of beginning of the land herein described.

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4.5 NOISE IMPACTS

4.5.1 Construction Noise Sources

To estimate ambient sound levels during construction, sound levels due to construction activity are extrapolated to the background ambient sound level survey locations using hemispherical sound radiation and attenuation due to foliage (dense woods). The assumption of hemispherical radiation does not include attenuation due to air absorption or ground effects and is therefore conservative.

Construction of the proposed steam-electric generating station is scheduled to begin in late 1979 and to continue to mid-1985. A seven-day work week is planned, but no night work is scheduled. A fifteen-hour work day is assumed.

The sound level contribution due to construction activity is estimated using a preliminary construction equipment schedule and equipment sound levels and usage factors presented in a U.S. Environmental Protection Agency (EPA) publication (EPA, 1975) and in a Construction Engineering Research Laboratory report (CERL, 1978).

The construction process is quite complex. Construction site noise varies with space and time and cannot be easily described. The methodology used for this analysis considers the average acoustic energy emitted by the equipment during the construction process. Equivalent sound levels, L_{eq} , are computed using the maximum sound level emitted by the equipment and the fraction of time that the maximum level is emitted. This method was developed by the EPA (1971). Details of this procedure are presented in Appendix G.

Table 4.5-1 presents a list of the equipment intended for use in construction of the facility. Equipment sound levels at 15 meters (50 feet) and their usage factors are also provided in the table.

The data presented in Table 4.5-1 were used to compute the yearly average equivalent sound levels emitted from the construction site. The yearly equivalent sound levels for the construction years 1979 through 1985 are presented in Figure 4.5-1. Highest annual equivalent sound levels will be emitted in 1982. The subsequent noise impact assessment is based on construction site noise emitted during 1982.

Some of the Putnam Site foliage will be cleared for construction. However, a border of at least 90 meters (300 feet) of trees will be left around the circumference of the site (Figure 3.1-3). The sound attenuation due to various types of woods is 10 to 25 decibels (dB) per 100 meters (328 feet) (Beranek, 1973). Construction site sound levels were extrapolated to offsite locations (baseline measurement locations, Figure 2.6-1) using an attenuation due to foliage of 10 dB per 100 meters, a conservative assumption.

Table 4.5-2 contains a summary of the estimated equivalent sound levels at offsite locations during the 1982 construction period. Summaries of the background ambient sound levels and construction sound level contributions are included in this table for comparison.

Construction activity will increase ambient sound levels only slightly at adjacent noise sensitive land use areas. The day sound levels at baseline measurement locations 1 and 3 were estimated to increase by 3 to 4 dB. Smaller increases were estimated at the other baseline locations. No night work is scheduled, thus the change in day/night sound levels, L_{dn} will be minimal.

4.5.2 Steam Blowout Noise

Blowout operations will occur during plant startup and will represent one of the major noncontinuous noise sources during construction. Blowout operations will be required to clean the main steam lines and hot and cold reheat pipe lines prior to commencing plant operations.

Steam pipe blowout procedures vary little among plants. A common blowout program consists of two phases. The first consists of 40 blows over a 5-day period using 400 pounds per square inch (psi) steam. Each blowout lasts for 3.5 to 6 minutes at intervals of 45 to 50 minutes. The second phase consists of 115 blowouts over a 7-day period, using 800 psi steam. These blowouts occur with the same frequency and duration as the first phase blowout. The maximum noise levels emitted during the blowout operation were estimated to be 107 dB at 300 meters (1,000 feet) for phase one and 117 dB at 300 meters (1,000 feet) for phase two. The maximum sound level was estimated to last for the duration of the blowout. Blowout operations are scheduled for daytime hours only. Table 4.5-3 presents a summary of blowout operation ambient sound levels at the six baseline measurement locations.

4.5.3 Construction Noise Impact

Construction average noise levels will be highest during 1982 as is indicated in Figure 4.5-1. The impact assessment and evaluations were made using EPA guidelines. The State of Florida has not promulgated noise control regulations for construction site noise sources.

The EPA has promulgated information which suggests that ambient sound levels below an L_{dn} of 55 dB do not degrade the public health and welfare (EPA, 1974). Table 4.5-2 indicates that the ambient day/night sound levels, L_{dn} , at noise sensitive land use Locations 2 and 6, before (baseline) and during the 1982 year of construction are slightly above $L_{dn} = 55$ dB. The data also indicate that environmental sound levels at Locations 2 and 6 are not affected by construction site activities. Since many communities' environmental sound levels are specifically higher than $L_{dn} = 55$ dB, the current EPA short term goals are to reduce environmental sound levels to below $L_{dn} = 65$ dB, while their long term goals are to reduce environmental sound levels to below $L_{dn} = 55$ dB (EPA, 1977).

At noise sensitive areas represented by Location 3, Wide Waters Trailer Park, the ambient daytime sound levels will increase by 4 dB, but the resulting day/night sound levels are below $L_{dn} = 55$ dB.

There will be construction activities, such as pile driving, which increase instantaneous ambient sound levels significantly. Pile driving in the St. Johns River will be of relatively short duration, although the high level impact noise may be annoying and may generate some complaints.

Blowout operations are a source of construction noise which also will result in significant impact. As is evident from the sound levels presented in Table 4.5-3, blowout sound levels will increase environmental sound levels significantly. However, the total blowout operation will last for a period of only two weeks per unit, and proper and sufficient community notification should minimize complaints.

Steam blowout operations carried out during normal plant operations will be isolated events, and although they might precipitate some complaints, their impact is considered to be minimal.

Table 4.5-1

Summary of Construction Equipment Types
Sound Levels and Usage Factors^{a, b}

<u>Equipment Type^c</u>	<u>Sound Level at 15 Meters (50 ft.) dB</u>	<u>Usage Factor</u>
50-250 ton Crane	88	.1
25 ton Crawler Pusher	86	.4
75 ton Crawler Pusher	82	.4
Backhoe	85	.4
20-30 cu. yd. Pan Loader	87	.4
D7, D8 & D9 Bulldozers	89	.4
Fuel and Lubrication Truck	88	.16
Water Truck	88	.26
Motor Grader	85	.1
Vibrator/Roller	80	.1
Master Mechanic Truck	88	.16
Flat Bed Truck	88	.26
Dump Trucks	88	.26
Flat Bed Trailers	88	.26
Commercial Tractors	80	.3
Concrete Truck	74	.4
Concrete Pumps	82	.05
Front End Loaders	83	.4
Road Scrapers	87	.08
Automatic Ballast Vibrators	85	.4
River Barge Piledriver	101	.04
50 ton Hoist	83	.2
Air Compressor	82	1.0

^a"Background Document for Portable Air Compressors," U.S. EPA, EPA 550/9-76-004, December, 1975.

^bConstruction Engineering Research Laboratory, "Construction Noise Control Cost-Benefit Estimation Technical Background," Technical Report N-37, January, 1978.

^cSource: Burns and Roe, Inc.

Table 4.5-2
Construction Ambient Sound Levels^a

Location ^b	Background Ambient Sound Levels, dB			Construction Contribution to Ambient Sound Levels, dB ^c	Construction Ambient Sound Levels, dB			Change in Ambient Sound Levels, dB		
	L _d	L _n	L _{dn}		L _d	L _n	L _{dn}	L _d	L _n	L _{dn}
1. Warner Point	43	40	47	43	46	40	48	3	0	1
2. Degeyter Motel	52	51	57	37	52	51	57	0	0	0
3. Wild Waters Trailer Park	47	39	48	48	51	39	50	4	0	2
4. Onsite	43	36	44	--	Onsite			Onsite		
5. Mulberry and Tillman Rds.	47	35	46	43	48	35	47	1	0	1
6. U.S. Route 17	57	49	58	51	58	49	58	1	0	0

^aBased on 1982 Construction Equipment Usage Schedule - Burns and Roe, for 15 hour day.

^bSee Figure 2.6-1 for locations.

^cThese sound levels reflect a 10 dB attenuation due to 90 meters (300 feet) of tree border.

Table 4.5-3.

Blowout Operation Sound Levels

<u>Location</u>	<u>Sound Level*</u> <u>dB</u>
1. Warner Point	86
2. Degeyter Motel	79
3. Wide Waters Trailer Park	91
4. Onsite	--
5. At Mulberry and Tillman Rds.	100
6. U.S. Route 17	92

*Second phase blowout operations 3.5 to 6 minutes duration at 45 to 50 minute intervals.

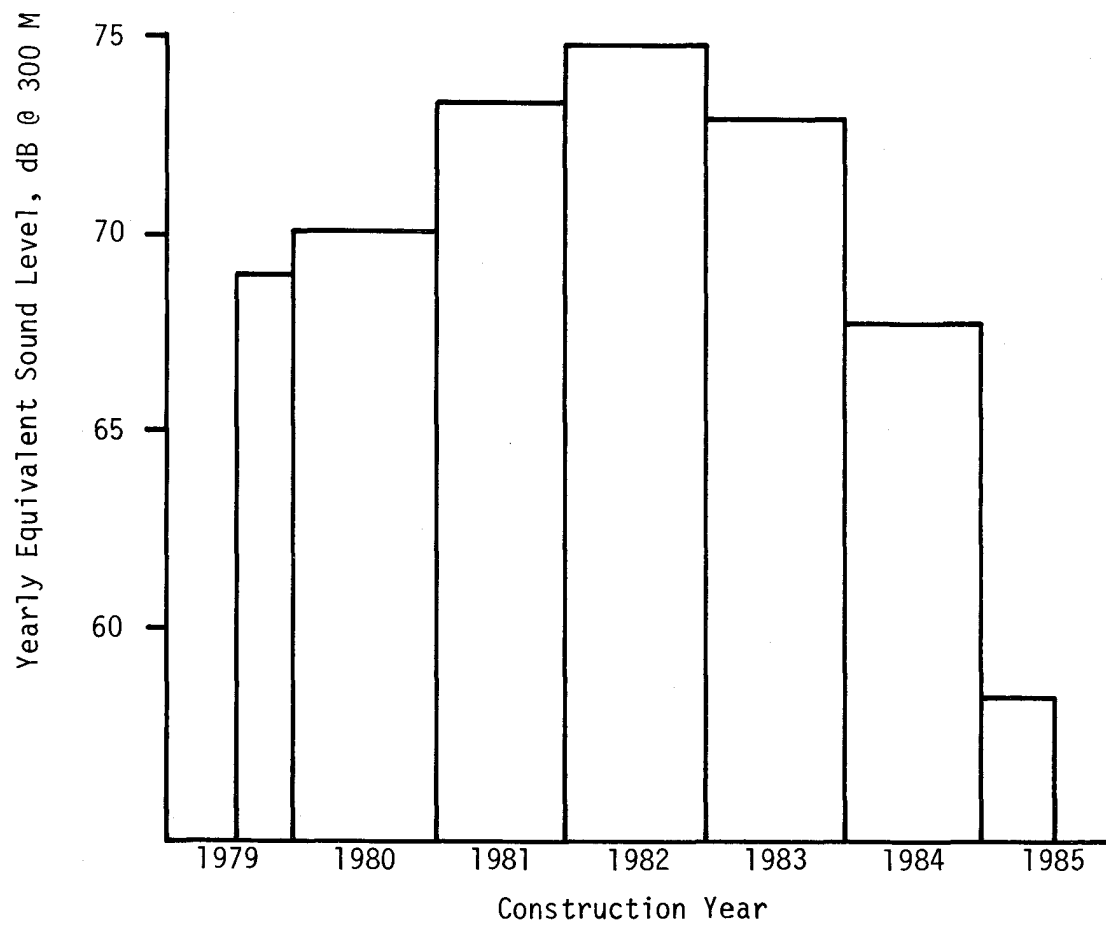


Figure 4.5-1. Yearly Equivalent Sound Levels.

4.6 OTHER IMPACTS

4.6.1 Transportation

During construction of the plant, traffic along U. S. Route 17 is expected to exceed normal levels. Traffic levels will increase in 1979, reach their peak in 1982, and gradually recede until completion of the plant in 1985. At the height of construction activity, approximately 1,000 construction and supervisory personnel will be employed at the plant site. The influx of personnel to the plant site each day is expected to be by private automobile, accounting for the increased traffic levels in the plant vicinity. Most of the traffic associated with arrival of the construction work force will occur in the morning and evening "peak hours" of traffic flow.

It was assumed that each automobile carrying workers to the plant site will carry an average of three persons; therefore, the expected amount of traffic generated at the plant construction site will be approximately 330 cars. In 1977, the Average Daily Traffic (ADT) on U. S. Route 17 in the site vicinity was 3,852 (Table 2.10-16). It was assumed that in 1977 the peak hour traffic on U. S. Route 17 was 10 percent of the ADT, or approximately 400 vehicles per hour. Thus, the additional plant traffic will increase the peak hour traffic to 700 cars per hour. It was estimated that the traffic capacity of U. S. Route 17 in the plant vicinity is approximately 750 cars per hour at Service Level C (manuverability retained). Therefore, with the plant's additional traffic volume, the capacity of U. S. Route 17 at Service Level C will be approached. The absolute capacity of U. S. Route 17 is 1,400 cars per hour. Assuming a 20 percent increase in ADT by 1982, without the Seminole project, the peak hour traffic, combined with the additional plant related traffic, may exceed 750 cars per hour and may exceed the estimated capacity of U. S. Route 17 at Level C, but would not exceed the highway's absolute capacity.

Construction of the four lanes on U.S. Route 17 from State Route S209 to Palatka is scheduled to begin in 1981 and end in 1982. Construction traffic associated with the plant is expected to peak in 1982 and diminishes thereafter so some overlap of these conditions could occur. However, since road construction will not occur along U.S. Route 17 in the immediate vicinity of the plant's main access road, the effects of the overlapping construction periods will be reduced. Replacement of the Rice Creek Bridge is scheduled for 1980 to 1981. The bridge should be completed before plant construction traffic reaches its peak in 1981 to 1982.

In addition to employees' arrival and departure traffic, construction activity at the site will generate traffic associated with material delivery and equipment usage (Table 4.6-1). Defining the amount of trips generated by these activities is difficult; however some estimation of the average number of trips per day during each construction year is possible. Using the construction equipment schedule for vehicles most likely to be used in trips to and from the site (Table 4.6-1), and assuming five trips per day for each vehicle, an estimate of the daily trips was determined. This estimate is shown in the last line of Table 4.6-1. Between 1981 and 1984, the volume of traffic produced by construction activities remains relatively constant varying from 270 to 350 trips per day, with the largest number of trips during 1982. These trips are expected to originate during the daytime but are not expected to increase peak hour traffic levels.

Average Daily Traffic Levels

Average daily traffic along U.S. Route 17 and State Route S209 will be increased during 1979 to 1985 by plant construction traffic. Estimates indicate that employee traffic, at its peak, will average approximately 330 round trips per day during 1982. During this same period, construction traffic will average 350 round trips per day. Thus,

total traffic levels during the day will increase by approximately 680 round trips per day or over 1,360 one-way trips. This total is a 33 percent increase over existing 1977 traffic levels of 3,852. If these additional trips are added to 1977 levels, plus an assumed 20 percent without project increase in traffic, U.S. Route 17 traffic levels may reach as high as 5,300 cars per day. These traffic levels are not expected to exceed daily capacity levels on U.S. route 17 which is presently rated as 14,000 cars per day under best conditions (Section 2.10.4, Transportation).

4.6.2 Land Use

Construction of the plant should not greatly affect land uses in the site vicinity. The natural vegetation surrounding the site will serve to reduce most effects of construction on land uses adjacent to the site property. The vegetation will dampen noise, dust, and smoke from construction operations as well as providing a visual screening barrier. The land necessary for development of the plant will reduce the amounts of rural forested land in the county, but the area developed is fairly insignificant in regard to the amount of such land in the county (Table 2.8-1). Discussion on the losses in productivity and land use alternatives is found in Section 5.7.2.

4.6.3 Historic, Scenic, Cultural, and Natural Landmarks

Construction activities associated with the Seminole Station should not effect any public lands, National Historic Register sites, or other cultural resources discussed in Section 2.8.4. These areas are far enough removed from the site that construction activity will not interfere with their operation or physical settings.

No archeological sites of significance were found on the plant site, nor in the preferred pipeline corridor to the river. The few homestead sites found were in the southern portion of the plant site where little development activity is planned. Thus, no impacts are expected. Discussion of archeological resources on site may be found in Appendix J.

4.6.4 Flooding Impacts

The construction of the Seminole Plant Units No. 1 and No. 2 is expected to have no impacts on high water or flooding levels of the St. Johns River or any tributaries. The reason for this is that no structures, embankments, or fills of any significant size are planned to be placed in site vicinity floodplains that would affect the conveyance capacity of the floodway of any stream.

Table 4.6-1

Schedule for Construction Equipment Likely to be Used Offsite

<u>Description</u>	<u>Equipment-Months</u>						
	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
Fuel/Lub. Truck	2	24	18	24	24	24	4
Wtr. Spray Trucks	2	24	12	24	12	18	4
Master Mech. Truck	4	20	24	24	24	24	-
Pick-up Trucks	16	112	291	331	345	271	60
Flat Bed Trucks	4	16	123	160	41	120	12
Dump Trucks	8	48	48	57	48	60	8
Flat Bed Trailers	-	30	120	143	120	96	-
Commercial Tractors	-	6	44	56	47	36	-
Concrete Trucks	<u>4</u>	<u>22</u>	<u>20</u>	<u>21</u>	<u>20</u>	<u>10</u>	<u>-</u>
Total	40	302	700	840	681	659	88
Estimated Daily Trips	20	130	290	350	280	270	40

Source: Burns and Roe, Inc.

*Based on the assumption that each operating vehicle will make an average of five trips to and from the site each day.

4.7 MITIGATING MEASURES

Fugitive Dust Control

Control of nuisance dusts will be accomplished by the application of water and/or dust suppression chemicals when needed.

Wastewater Treatment and Control

Construction-phase housekeeping regulations enforced by SECI will prevent dumping of any petroleum or other waste materials on the ground or in the sanitary waste system. Sanitary wastewaters will be treated by an extended aeration plant before onsite percolation.

Erosion and Construction Runoff Control

Potential impacts from sediments which escape from the construction area will be negligible because all construction runoff is expected to dissipate on site. Upon completion of construction, the construction area will be vegetated as required to be compatible with existing natural landscape elements. Limiting the amount of site clearing to specific needs will help to reduce erosion potential, particularly in the area of the steepest sloped terrain south and east of the main plant area.

The area to be revegetated, with the exception of that area occupied by the plant components, will be vegetated with native pines and grasses. Slash pine (Pinus elliotii) will be planted in this area and broomsedge (Andropogon virginicus) will be encouraged as the ground cover. Natural revegetation will occur rapidly in the area after site disturbance has ceased. Planted vegetation will be collected from other areas of the site with the pines possible coming from the Florida Forestry Commission or local timber companies engaging in reforestation. Local nurseries or turf farms may be a source of grasses if the site area cannot supply enough excess to revegetate the cleared portion of the site.

Maintaining and Enhancing Onsite Habitat

Existing habitats on the Putnam Site will be maintained as practical in accommodating plant access roads, rail lines, and other

facilities. Revegetating will use indigenous grasses, shrubs, and trees.

Relocating the Gopher Tortoise

Possibly the greatest impact on the terrestrial ecology of the Putnam Site due to site construction and development will be the removal of about 55 percent of the Sandhill Habitat. This will destroy a portion of this habitat important to the gopher tortoise, a threatened species in Florida. Investigations are currently underway to determine the population size of the tortoise colony and the feasibility of trapping and translocating this colony to other areas if the remaining Sandhill cannot accommodate the entire colony. Personnel of the Florida Game and Fresh Water Fish Commission have been asked to help with these investigations and with locating a suitable site for colony transfer.

Disposal of Dredged Spoil

Measures proposed to mitigate potential adverse environmental impacts to the aquatic ecosystem from dredging activities include (1) use of an inland diked spoil disposal area to reduce damage to the aquatic habitat, (2) conducting dredging during the autumn months when biological activity is relatively low and fish spawning has not yet occurred, and (3) use of silt restraining devices around the cutting head of the dredge and at the point of runoff (if any) from the spoil area.

Community Notification of Blowout Operations

The greatest noise impacts during construction will be during the steam blowout at unit startup. This phase of the startup procedure is estimated to last only about two weeks for each unit, and will be carried out during daytime hours. The community will be notified that such noise can be expected but will be temporary.

4.8 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Listed below is a brief summary of the adverse environmental impacts expected during construction of Seminole Plant Units No. 1 and No. 2 that cannot be avoided by any practical means. Except as noted, these impacts are considered to be minor or negligible.

1. Temporary escape of fugitive dust from the site.
2. Temporary escape of vehicle exhaust emissions from the site and along area roads due to traffic increases.
3. Slight lowering of the potentiometric surface of the Floridan Aquifer locally.
4. Increase in soil erosion rates from about 420 acres during construction until completion of revegetation efforts. However, no offsite impacts are expected.
5. A significant impact will be the loss of about 290 acres of Sandhill Community habitat. This represents about 55 percent of this habitat that presently exists on the Putnam Site.
6. Loss of some Pine Flatwood and Cypress Dome habitat.
7. Temporary dredging impacts including increases in turbidity and suspended sediments. Also, a permanent loss of macrophyte habitat is expected.
8. Temporary increases in ambient noise levels will be felt in the site vicinity. The most noticeable will be the steam blowout operations that will be intermittent and will last only about two weeks per unit.
9. Increased vehicular traffic will be experienced on nearby highways.

These unavoidable impacts are discussed in detail in Sections 4.1 through 4.6, and proposed mitigating measures to reduce them are discussed in each section with a summary in Section 4.7.

4.9 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The most severe impact of the construction of Seminole Plant Units No. 1 and No. 2 is the loss of about 55 percent of the onsite Sandhill Community habitat (Section 4.3.2). However, this loss is not necessarily "irreversible and irretrievable" since after the station is retired, the structures could be removed and natural vegetation allowed to be reestablished. Although this could require a considerable period of time, and some Sandhill species may have to be translocated to the site in order to accomplish a complete recovery, it is a possibility.

Commitment of resources that will truly be irreversible and irretrievable will include the use of materials and energy to construct the facilities. It should be noted that, given the necessity for additional electric power capacity in the State of Florida, the expenditure of these material and energy resources would have to be made elsewhere if not made by Seminole Electric Cooperative, Inc. at the Putnam Site.

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5.0 ENVIRONMENTAL EFFECTS OF STATION OPERATION

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5.0 ENVIRONMENTAL EFFECTS OF STATION OPERATION

5.1 AIR EMISSION SYSTEM

The effects of air emissions from Seminole Plant Units No. 1 and No. 2 have been previously evaluated and submitted to the U. S. Environmental Protection Agency (EPA) and to the Florida Department of Environmental Regulation (DER) in the form of a Prevention of Significant Deterioration (PSD) permit application. The information reported to EPA and DER is presented in this section.

5.1.1 Description of Air Emissions

Generating Unit Emissions

The Seminole Station will be a base-load station and will operate at various levels depending on system demand. Coal burning rates and emission rates are summarized for selected operating levels in Table 5.1-1. Both maximum and minimum emission rates, corresponding to extremes in the range of coal characteristics, are shown. However, only maximum emission rates were considered in the modeling analysis used to evaluate ambient air quality impacts. The rates in Table 5.1-1 are based on both generating units operating simultaneously at the levels indicated.

The exhaust gases from each generating unit boiler will be emitted to the atmosphere through a single dual-flue stack. Exit conditions applicable to the total plume released from the stack are listed in Table 5.1-2. The FGD system is being designed for the highest availability possible. The FGD system will be designed with one complete spare module, one spare slurry pump, and selective materials that can withstand the FGD environment. Current availability figures released by the EPA for the wet limestone system indicate 82 percent availability. The current system which SECI has proposed in its PSD application should have an operational availability approaching 100 percent. This high availability value is a result of extensive spare components used throughout the system. Additional information on air emissions is provided in Appendix F.

Emissions from Other Station Sources

In addition to emissions from the main boiler stacks, there will be minor emissions from other sources. One type of particulate emission will be drift (small water droplets) from the cooling towers. Due to the efficiency of modern drift eliminators, the quality of water lost by drift is an extremely small percentage of the circulating water flow. Dissolved and suspended solids constitute only a small fraction of total droplet mass, particularly since a fresh water source (the St. Johns River) will be used for cooling tower water supply.

Another potential type of emission is fugitive dust from coal handling operations, sludge and ash disposal, and onsite traffic. Control measures that will be taken to reduce these emissions are described in Section 3.3 and in Appendix F.

5.1.2 Primary Effects of Stack Emissions

The effects of stack emissions on ambient air quality concentrations of SO_2 , TSP, and NO_x were evaluated using computer modeling techniques. There are four primary objectives toward which the modeling analysis was directed:

- (a) Evaluate compliance with PSD Class II increments.
- (b) Evaluate compliance with Federal and State Ambient air quality standards.
- (c) Determine effect of Seminole Station particulate emissions on the Jacksonville TPS attainment area.
- (d) Verify to the extent allowed by modeling distance limitations that Class I increments will not be exceeded within the nearest Class I area.

Because of the nature of other sources in the area, PSD increment analysis was accomplished using a single-source model considering only projected emissions from the Seminole Station. The same is true for the evaluation used to determine impacts on the Jacksonville TPS non-attainment area. Multiple-source modeling was used to assess compliance with ambient air quality standards.

5.1.2.1 Model and Input Data

A description of the modeling techniques and input data is contained in Appendix F. EPA models used were the Air Quality Display Model (U. S. Public Health Service, 1969) and the CRSTER Model (EPA, 1977b). These models are based on conventional Gaussian diffusion concepts. Such models should not be used to calculate concentrations at distances beyond 50 km from a particular emission source because of the considerable uncertainty in modeling accuracy at greater distances (EPA, 1977c).

Meteorological input data required for model operation are based largely on surface observations from the Jacksonville National Weather Service station. Upper air data from the Waycross, Georgia, balloon sounding station were also used. These were the nearest weather stations to the Putnam Site that record the detailed data needed for modeling analysis. Approval of meteorological data used was obtained from EPA Region IV and from Florida DER prior to model application.

Information on existing emission sources within the Putnam Site are of interest was obtained from the Florida DER (St. Johns River Subdistrict Office). Seminole Station emissions source data were developed by Burns and Roe, Inc., the architect/engineer for Unit No. 1.

5.1.2.2 Modeling Results

A review of regional emission source data supplied by DER indicates that the only facility which must be considered in assessing compliance with PSD increments is the Seminole Station. The PSD analysis results refer only to Seminole Station emissions. Evaluation of compliance with ambient air quality standards considers other sources in addition to the Seminole Station.

Compliance with PSD Increments - Annual Average Concentrations

Annual average SO₂ and TSP concentrations have been calculated using the Air Quality Display Model based on a load level of 75 percent

of rated capacity with both units in operation. Concentrations were determined to a distance of 50 km from the Putnam Site. Maximum concentrations computed are shown in Table 5.1-3 with applicable Class II increments. Highest concentrations are negligible in comparison with the increments.

The pattern of annual concentrations, as is typical for tall stack sources, consists of almost no effect at close distance and a slight increase in concentrations at distances of about 40 to 50 km, in this case to the east of the site. However, the concentrations calculated are so low in relation to the accuracy of the model that the only firm conclusion which can be drawn regarding geographic distribution is that concentrations are estimated to be uniformly low for all directions and distances.

Compliance with PSD Increments - 24-Hour Concentrations

SO₂ and TSP 24-hour concentrations were calculated with the CRSTER Model using 6 years of meteorological data based on operating levels of 50, 75, and 100 percent of rated capacity. Results provided by the CRSTER Model for each year of meteorological data processed include a listing of the highest and second-highest concentration at each receptor point. This distinction is important because short-term (3-hour and 24-hour) increments represent increases which can be exceeded once a year. Likewise, short-term ambient standards can be exceeded once a year. To avoid confusion in the following discussion, highest concentrations for any individual year of meteorological data will be referred to as "maximum" concentrations, and second-highest values will be termed "second-high" concentrations. When comparing concentrations computed for different years of data, the modifier "greatest" is used to indicate that the maximum or second-high concentration for one year exceeds the maximum or second-high values for other years.

Second-high SO₂ concentrations for each year of meteorological data are presented in Table 5.1-4 and equivalent TSP results are shown in Table 5.1-5. (The modeling was actually conducted using SO₂

emission rates and the results used to obtain TPS concentrations by applying the ratio of TSP and SO₂ emission rates.) These tables also show the operating level, distance, and direction associated with points of greatest concentration.

From Table 5.1-4, the greatest second-high 24-hour SO₂ concentration is 60 $\mu\text{g}/\text{m}^3$ which represents 66 percent of the Class II increment. Since six years of meteorological data were used in the analysis, the greatest second-high concentration is the appropriate concentration to compare with the increment. It will also be noted that the distances at which highest concentrations are calculated are very close to the Putnam Site. At greater distances (and in different directions), a lower percentage of the increment would be consumed by Seminole Station emissions. Furthermore, it should be remembered that emissions used for modeling are based on the extremes of the coal characteristics range (lowest heat value and highest sulfur content).

Examination of meteorological conditions associated with calculated concentrations shows that highest 24-hour concentrations result predominantly from a few hours of unstable conditions. This explains why highest concentrations occur near the site and also implies that the results obtained are somewhat conservative since unstable conditions are basically found near the earth's surface and do not often extend to the level of a buoyant plume emitted from a tall stack.

Table 5.1-5 shows that predicted second-high 24-hour TSP concentrations are well below the Class II increment. The greatest second-high concentrations, 2 $\mu\text{g}/\text{m}^3$, is only 5 percent of the increment. Again, this result is based on emission rates assuming extremes of coal characteristics (lower heat value and highest ash content).

Compliance with PSD Increments - 3-Hour Concentrations

Second-high 3-hour SO_2 concentrations calculated for each of the six years of meteorological data are shown in Table 5.1-6 with the operating level, distance, and direction associated with each concentration. The greatest second-high concentration considered to be most valid is $437 \mu\text{g}/\text{m}^3$ at a distance of 1.25 km, a concentration which represents 85 percent of the Class II increment. (See Appendix F for more detailed discussion of 3-hour concentrations.) The variation of second-high concentrations from year to year is fairly large, but in almost every case maximum concentrations are calculated at close receptor points. This can be explained by reference to the meteorological conditions which produce these concentrations. In every case, unstable atmospheric stability conditions, which result in highest values at close distances, are responsible for the results obtained.

Qualifying remarks included in the discussion of 24-hour SO_2 concentrations above also apply to 3-hour SO_2 concentrations. That is, the largest consumption of the increment pertains only to a specific distance and direction and is based on emission derived from the lowest heat value and highest sulfur content of the coal characteristics range.

Compliance with Ambient Air Quality Standards - Annual Average Concentrations

Compliance with annual standards was assessed by modeling all of the sources within the Putnam Site area of interest using the AQDM model. Maximum annual SO_2 , TSP, and NO_2 concentrations obtained by this method in comparison with the Florida Ambient Air Quality Standards, are as follows (all concentrations in $\mu\text{g}/\text{m}^3$):

<u>Pollutant</u>	<u>Maximum Calculated Annual Concentration</u>	<u>Florida Ambient Standard</u>	<u>Distance/Direction from Putnam Site</u>
SO_2	28	60	6 km/170°
TSP	3	60	10 km/10°
NO_2	11	100	14 km/140°

In the case of TSP, comparison of calculated concentrations with the Florida ambient standard is not completely adequate since no background concentration resulting from sources other than those modeled is included in the calculated value. Adding a geometric annual average background value of about $35 \mu\text{g}/\text{m}^3$ as suggested by the measured concentrations listed in Table 2.5-3, the total maximum annual average TSP concentration would be about $40 \mu\text{g}/\text{m}^3$ (assuming the calculated arithmetic average to be equivalent to a geometric average). Annual average background concentrations of SO_2 and NO_2 , as indicated by Tables 2.5-4 and 2.5-5, are very low and need not be added to modeled concentrations since the sources included in the modeling analysis are probably largely responsible for measured background concentrations.

An important point to emphasize in this discussion is that the annual concentrations attributable to Seminole Station emissions alone are practically negligible in comparison with ambient standards. The highest SO_2 , NO_2 , and TSP concentrations estimated to result from Seminole Station emissions are 5, 3, and $1 \mu\text{g}/\text{m}^3$, respectively.

In conclusion, it appears very probably that all annual average standards are currently being achieved and that construction and operation of the Seminole Station will not interfere with maintaining standards compliance.

Compliance with Ambient Air Quality Standards - 24-Hour and 3-Hour Concentrations

In performing a modeling evaluation of short-term concentrations resulting from more than one emission source, it is important that time and space factors be kept consistent. In other words, the interactive effects of each source should be calculated at the same receptor points under the same meteorological conditions.

Based on the location and strength of existing SO_2 and TSP emission sources, the only sources which could have significant interaction with the Seminole Station are Hudson Pulp and Paper Company and Florida Power & Light Company (FP&L). Other existing sources are either too far away, have emission rates that are too small, or both.

To assure that time and space considerations are treated consistently, interactions among Seminole, Hudson, and FP&L were computed using a multiple-source variation of the CRSTER Model as described in Appendix F. For reasons discussed in Appendix F, this analysis was performed using 1972 meteorological data, assuming the Seminole Station is operating at 100 percent of rated capacity, and keying on directions within about 30 degrees on either side of the direct angle between the Seminole Station and the other two sources, i.e., directions along which significant short-term interactions could be expected.

The resulting second-high 24-hour and 3-hour SO_2 and 24-hour TSP concentrations from this interaction analysis are presented in Table 5.1-7. The maximum SO_2 concentrations occur near the Seminole Station and are almost entirely due to Seminole emissions. In other words, interaction effects are very minor. In comparison with ambient standards, the second-high 24-hour SO_2 concentration calculated is 23 percent of the Florida standard (and 16 percent of the national standard), and the second-high 3-hour SO_2 concentration is 40 percent of the Florida (and national) standard.

The second-high 24-hour TSP concentration is predicted to occur in the vicinity of FP&L emission sources. This concentration represents only 4 percent of the Florida ambient standard (and national secondary standard). However, if a background concentration of, say, $35 \mu\text{g}/\text{m}^3$ were added to the calculated interactive concentration of $5 \mu\text{g}/\text{m}^3$, the combined concentration would be 26 percent of the standard.

Impact on Duval County TSP Nonattainment Area

To evaluate the impact of Seminole Station particulate emissions on the Duval County TSP nonattainment area, calculations of 24-hour and annual average concentrations were made using the CRSTER Model at receptor points 50 km north of the Putnam Site. A distance of 50 km was selected since this is the distance to the southern boundary of Duval County and also the generally accepted range limit of the CRSTER Model. Six years of meteorological data were considered, and it was

conservatively assumed that the station was operating at 100 percent of the capacity at all times.

For all six years, both the maximum 24-hour and annual average TSP concentrations attributable to Seminole Station emissions were predicted to be less than $1 \mu\text{g}/\text{m}^3$. These concentrations are below the level of significant impact recommended by EPA (see Section 2.5.1 for significant impact levels). It is therefore concluded that the Seminole Station will not significantly affect the Duval County TSP nonattainment area if a condition of nonattainment still remains when the Seminole Station begins operation.

Impacts in Relation to Nearest PSD Class I Area

The PSD Class I area nearest the Putnam Site is the Okefenokee National Wilderness Area, located approximately 105 km north-northwest of the Site. Since this distance is beyond the limit of 50 km normally considered appropriate for standard Gaussian models, no attempt was made to calculate concentrations attributable to the Seminole Station directly within the Okefenokee Class I Area. Instead, calculations were made at a distance of 50 km and compared with applicable Class I increments. These increments are as follows (in $\mu\text{g}/\text{m}^3$):

	<u>SO₂</u>	<u>TSP</u>
Annual	2	5
24-Hour	5	10
3-Hour	25	--

The 3-hour and 24-hour increments are increases in concentrations which can be exceeded once a year.

Concentrations were calculated with the CRSTER Model at receptors located north-northwest and north of the site (directions 320° through 10°) using all six years of meteorological data. The station was assumed to be operating at 100 percent of rated capacity at all time.

All annual average and 24-hour calculated TSP concentrations are estimated to be less than $1 \mu\text{g}/\text{m}^3$ and therefore less than the Class I

increment. Annual average SO_2 concentrations are also estimated to be less than $1 \mu\text{g}/\text{m}^3$. The greatest second-high 24-hour and 3-hour SO_2 concentrations are 9 and $31 \mu\text{g}/\text{m}^3$, respectively, at 50 km from the Putnam Site. (Second-high concentrations are cited because short-term increments can be exceeded once a year.) Since these concentrations are only slightly greater than the Class I increments, no problem is anticipated at a distance of 105 km from the site.

Based on the results of calculations at a distance of 50 km, it is concluded that Seminole Station emissions will have only a minor impact on the Okefenokee PSD Class I Area, an impact which is in compliance with the increases in ambient concentrations allowed in such areas.

5.1.3 Effects of Fugitive Emissions

Fugitive dust emissions may result from coal handling operations, sludge and ash disposal, and onsite traffic even though control measures will be taken to suppress dust formation. Any dust generated will be intermittent and will tend to settle within or very near site boundaries. The impact of fugitive dust emissions on ambient air quality conditions outside plant boundaries is expected to be very slight.

5.1.4 Effects of Sulfur Oxide Emissions on Ambient Sulfate Levels

Gaseous sulfur oxides emitted into the atmosphere can be oxidized to form sulfate aerosols. This conversion process is a complex one which is not well understood or easily evaluated in a quantitative manner. Aside from complexities in the formation of sulfate aerosols, there is also considerable uncertainty concerning the effects of sulfates which are present in the atmosphere. In part because of these uncertainties, no national (or State of Florida) ambient standards for sulfates have been adopted. EPA's current policy on this issue is that research gaps will prevent the establishment of an ambient sulfate standard before a 1981-1982 time frame, and could cause an even longer delay (EPA, 1978). Among the research needs which have been cited are better ambient monitoring programs, a clearer understanding of the relationship between sulfate levels and health and welfare effects, and more research on the transformation and transport mechanisms that affect sulfate concentrations (EPA, 1975). Of particular concern is an improvement in knowledge that will allow more reliable modeling of the effect on ambient sulfate levels of SO₂ emissions from specific sources. Without this understanding, it is extremely difficult to develop a control strategy that will lead to reduced sulfate concentrations if a reduction appears necessary.

Measurements of ambient sulfate levels near Gainesville and Jacksonville over a 3-month period from October through December 1977 indicate that average concentrations were on the order of 5 to 7 $\mu\text{g}/\text{m}^3$ (Florida Department of Environmental Regulation (DER) and PEDCo Environmental, Inc., 1978; Florida Sulfur Oxides Study, Inc., 1978). In the absence of an ambient standard, it is difficult to place these numbers in perspective, but it can be noted that such values are only about a third of average sulfate concentrations measured at urban stations located in the northeastern U. S. (Altschuller, 1976).

There is evidence that the conversion rate of SO_2 to sulfates in a plume released from an elevated stack is initially fairly slow and then increases at greater downwind distances as ambient air is introduced into the plume (EPA, 1975; Wilson and others, 1977). Factors which affect this conversion process are ambient conditions of relative humidity, temperature, and ozone concentration. Also important are characteristics of the emission source such as presence of catalytic substances in the plume and initial moisture characteristics of the plume. For example, if SO_2 control is achieved through the use of wet scrubbers resulting in a moist plume, SO_2 conversion rates may be accelerated.

In any event, a significant portion of the SO_2 initially released from an emission source will not be converted to sulfates until the plume has been transported a considerable distance downwind. Long-range impacts are further enhanced in that SO_2 to sulfate conversion generally results in the formation of very small aerosols (less than 1 micron in diameter) which can be transported over great distances before being removed from the atmosphere. Tall-stack emission sources may also promote long-range transport in comparison with emissions released from nearer the ground (Altschuller, 1976). SO_2 emitted from a low stack comes into contact with the ground more quickly and is likely to be removed by dry deposition or vegetative uptake before converting to an aerosol sulfate. Emissions from a tall stack, although producing lower

ground-level SO_2 concentrations, remain suspended for a longer period of time and are more susceptible to sulfate conversion mechanisms. The possibility of long-range sulfate transport from elevated sources is one of the arguments which has been advanced to explain the observation made in several geographic areas that ambient sulfate concentrations have not declined significantly as local SO_2 emissions decreased (Altschuller, 1976). There is also some indication that sulfates transported from other states may affect ambient sulfate levels in Florida (Winchester and Leslie, 1978). Evidence for this possibility includes an apparent decrease in average sulfate concentrations from Pensacola to Miami, plus the configuration of large-scale air flow trajectories associated with sulfate concentration patterns, both conditions noted during limited duration experimental sulfate measurement period.

Ground-level sulfate impacts resulting from an SO_2 emission source such as the Seminole Station are difficult to assess and must be viewed in terms of both a local and a regional scale. Local sulfate levels could be somewhat more affected by a generating station equipped with a wet scrubbing control system than by an equivalent station without scrubbers; but since the end result of the scrubbing system is to diminish sulfur emissions substantially, impacts on both local and remote areas will be reduced through use of this air emissions control system.

The effects of aerosol sulfates are not well understood. However, it has been determined that a major fraction of the very small particles (0.1 to 1.0 microns) that contribute most to visibility impairment is composed of sulfates (Weiss and others, 1977). Therefore, any sulfate formed due to operation of the Seminole Station could have an effect on prevailing visual range conditions. However, in the southeastern U. S. where high humidity in combination with an abundance of existing natural and anthropogenic aerosol sources already result in visibility restrictions, it is unlikely that the addition of a single new source of sulfur emissions will result in readily perceptible visibility changes.

Another concern is that increased sulfur emissions will lead to the formation of acidic sulfates in rainwater with adverse consequences on surface water bodies, soils, and vegetation. Acid rainfall is another subject which, although undergoing active research, is not well understood either in terms of geographic distribution or effects. Due to the presence of carbonates, "normal" rainfall is already acidic (with a pH of about 5.7), and the focus of acid rainfall concerns is therefore on precipitation more acidic than normal. Measurements of rainfall acidity have not been routinely made over wide areas, but the limited measurements available indicate that lowest pH readings occur in the northeastern U. S. where ambient sulfate levels are higher than in other parts of the country (EPA, 1975). The extent to which emissions from the Seminole Station would cause increased rainfall acidity cannot be accurately calculated.

5.1.5 Effect of Trace Element Releases

Depending on the type of fuel being used, the atmospheric emissions of a coal-fired steam-electric generating station contain varying amounts and types of trace elements. Not all of the trace elements originally present in the coal are emitted. A sizeable fraction of many elements will appear in the ash residue of the combustion process and will be subject to the removal mechanisms applicable to the total ash formed, i.e., deposition as bottom ash and collection by particulate control equipment. Some elements, such as mercury, will vaporize in the combustion zone and can escape in a gaseous form; while others, such as cadmium, lead, and zinc, apparently vaporize and then preferentially adhere to very fine particles which are not collected with the same degree of efficiency as the bulk of the ash material (Klein and others, 1975).

The specific coal supply for the Seminole Station has not yet been determined and therefore it is not possible to estimate coal trace ele-

ment composition or trace element emission rates. Even if more exact information were available, there would still be the difficulty of interpreting the significance of trace element emission releases. As of now there are no Federal or State of Florida ambient air quality standards for trace elements or any National Emission Standards for Hazardous Air Pollutants (NESHAP) specific to coal-fired steam-electric generating stations.

Ground-level concentrations of trace elements resulting from fuel combustion are typically very low, well below the industrial hygiene standards which have been established to control occupational exposure to trace elements. Although occupational standards are established on a different basis and directed toward a somewhat different population than are ambient standards, achieving compliance with occupational standards by a wide margin would indicate that adverse health effects attributable to trace element emissions will be avoided.

Although not in the trace element category, another quantitatively minor class of substances emitted from coal-fired power generating facilities which has caused some concern is polycyclic organic matter (POM). Research is in progress concerning the effects of POM emissions, but it is not now possible to provide a definite statement concerning the impact such emissions from the Seminole Station might have.

5.1.6 Effects on Visibility Conditions

The visibility effects of a coal-fired steam-electric generating station can be divided into three primary categories: (a) plume opacity at the point of release due to direct particulate emissions; (b) plume discoloration at some distance downwind within a relatively intact plume; (c) regional or remote distance visibility impairment.

Plume opacity at the point of release (top of the stack) is regulated by State and Federal New Source Performance Standards (NSPS). Regulated opacity does not include interference of light transmittal due

to any water vapor condensation which may result from the use of wet scrubbers. The efficiency of modern particulate removal systems (such as electrostatic precipitators) generally results in meeting opacity standards with little difficulty.

Many of the substances emitted in flue gases undergo chemical transformation in the atmosphere immediately after release. New products formed during this transformation process are referred to as secondary products because they were not originally present, at least to the same extent, in an emitted plume. As a result of secondary products of combustion forming in the atmosphere, plume discoloration can occur within a plume which is still relatively intact. The major contributor to this effect is the conversion of nitric oxide (NO) to nitrogen dioxide (NO₂) which can impart a brownish hue to a plume. Eventually, either additional reactions occur or a plume becomes so diffuse that any discoloration which may have initially developed is no longer apparent. Prediction of the development and degree of discoloration is complicated by an inability to precisely specify either the secondary reactions involved or the rate at which a plume will be dispersed.

Visibility impairment refers to the situation in which the outlines of a plume are no longer detectable but in which both the substances originally emitted and the secondary products resulting from atmospheric chemical conversions contribute to degradation of visibility when a viewer looks toward a remote object or the horizon. Although the primary particulate emissions resulting from coal combustion can have some effect on visibility impairment, the major effect results from the conversion of gaseous sulfur oxides to aerosol sulfates and the subsequent transport of these aerosols over large distances. Widely accepted methods of quantitatively analyzing the visibility impact of a single new emission source have not been established. Factors which complicate such an analysis in the eastern United States are the occurrence of high relative humidities and the existence of substantial background aerosol concentrations resulting from both natural sources and sources related to human activities.

Aside from the great difficulty of accurately predicting and monitoring the formation, transport, and visibility impairment impact of secondary products caused by the emissions of a single source, no regulatory policies have been established to limit impairment. At the direction of Congress, as expressed through the Clean Air Act Amendments of 1977, in which the main concern is with visibility protection in PSD Class I areas, EPA now has underway a research program aimed at developing visibility impact assessment methods and recommending methods to prevent and control visibility impairment. The results of this ambitious task will not be available for general use until sometime in 1979.

Emissions from the Seminole Station will probably have some effect in terms of plume discoloration and visibility impairment at distances remote from the Putnam Site. However, any attempt to estimate the magnitude of these effects would be conjectural. The emission control design features of the Seminole Station will serve as a definite mitigative measure to reduce visibility impacts. Sulfur oxides removal in particular will act to diminish the subsequent formation of aerosol sulfates which are considered to be key ingredients in the impairment of visual range.

TABLE 5.1-1

COAL BURNING AND EMISSION RATES,
SEMINOLE PLANT UNITS NO. 1 & NO. 2

Operating Level (Percent of of Rated Capacity)	Maximum Coal Burning Rate (ton/h)	Minimum Coal Burning Rate (ton/h)	Maximum SO ₂ Emission Rate (lb/h)	Minimum SO ₂ Emission Rate (lb/h)	Maximum TSP Emission Rate (lb/h)	Minimum TSP Emission Rate (lb/h)	Maximum NO _x Emission Rate (lb/h)
50%	257	234	6484	2852	170	89	3396
75%	386	351	9726	4279	255	132	5095
100%	515	468	12968	5705	340	198	6793

Note: Rates shown are for both generating units combined. Maximum and minimum rates are based on the extremes of the coal characteristics range listed below. Maximum and minimum NO_x emission rates are essentially identical; only maximum rates are listed.

Range of Coal Characteristics

Sulfur Content - 1.5 to 3.0 percent

Ash Content - 6 to 10 percent

Heat Content - 11,000 to 12,500 Btu/lb

TABLE 5.1-2

STACK CONDITIONS,
SEMINOLE PLANT UNITS NO. 1 & NO. 2

<u>Operating Level (Percent or Rated Capacity)</u>	<u>Stack Height (ft)</u>	<u>Stack^a Diameter (ft)</u>	<u>Exit Velocity (ft/s)</u>	<u>Volumetric Flow Rate (ft³/min)</u>	<u>Exit Temperature (°F)</u>
50%	675	50.9	13.74	1,681,898	128
75%	675	50.9	20.6	2,522,848	128
100%	675	50.9	27.55	3,363,797	128

^aEffective stack diameter for combined emissions from both generating units; emissions from each unit actually exit through separate flues within a common stack, each flue being 36 ft in diameter.

TABLE 5.1-3

MAXIMUM PREDICTED ANNUAL AVERAGE CONCENTRATIONS
 ATTRIBUTABLE TO SEMINOLE PLANT UNITS
 NO. 1 & NO. 2 EMISSIONS

<u>Maximum SO₂ Concentration ($\mu\text{g}/\text{m}^3$)</u>	<u>Maximum TSP Concentration ($\mu\text{g}/\text{m}^3$)</u>	<u>Distance/Direction of Maximum Concentration From Putnam Site</u>
5	<1	45 km/90°
PSD Class II Area Annual Average SO ₂ Increment: 20 $\mu\text{g}/\text{m}^3$		
PSD Class II Area Annual Average TSP Increment: 19 $\mu\text{g}/\text{m}^3$		

TABLE 5.1-4

SECOND-HIGH 24-HOUR SULFUR DIOXIDE CONCENTRATIONS
 ATTRIBUTABLE TO SEMINOLE PLANT UNITS
 NO. 1 & NO. 2 EMISSIONS

<u>Year</u>	<u>Operating Level</u>	<u>Second-High 24-Hour Concentration ($\mu\text{g}/\text{m}^3$)</u>
1964	100%	53 (1.0 km/20°) ^a
1970	100%	49 (2.5 km/50°)
1971	100%	54 (1.5 km/130°)
1972	100%	60 (1.25 km/60°)
1973	75%	55 (1.25 km/140°)
1974	100%	60 (1.25 km/60°)

PSD Class II Area 24-Hour SO_2 Increment: $91 \mu\text{g}/\text{m}^3$

^aDistance and direction from Putnam Site at which concentration shown is calculated.

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TABLE 5.1-5

SECOND-HIGH 24-HOUR PARTICULATE MATTER CONCENTRATIONS
ATTRIBUTABLE TO SEMINOLE PLANT UNITS
NO. 1 & NO. 2 EMISSIONS

<u>Year</u>	<u>Operating Level</u>	<u>Second-High 24-Hour Concentration ($\mu\text{g}/\text{m}^3$)</u>
1964	100%	2 (1.0 km/20°) ^a
1970	100%	2 (2.5 km/50°)
1971	100%	2 (1.5 km/130°)
1972	100%	2 (1.25 km/60°)
1973	75%	2 (1.25 km/140°)
1974	100%	2 (1.25 km/60°)

PSD Class II Area 24-Hour TSP Increment: $37 \mu\text{g}/\text{m}^3$

^aDistance and direction from Putnam Site at which concentration shown is calculated.

TABLE 5.1-6

SECOND-HIGH 3-HOUR SULFUR DIOXIDE CONCENTRATIONS
ATTRIBUTABLE TO SEMINOLE PLANT UNITS
NO. 1 & NO. 2 EMISSIONS

<u>Year</u>	<u>Operating Level</u>	<u>Second-High 3-Hour Concentration ($\mu\text{g}/\text{m}^3$)</u>
1964	100%	386 (1.25 km/20°) ^a
1970	100%	253 (1.0 km/310°)
1971	75%	391 (1.25 km/130°)
1972	100%	511 ^b (319) ^c (1.30 km/40°)
1973	75%	437 (1.25 km/140°)
1974	100%	388 (1.25 km/30°)

PSD Class II Area 3-Hour SO₂ Increment: 512 $\mu\text{g}/\text{m}^3$

^aDistance and direction from Putnam Site at which concentration shown is calculated.

^bThe highest concentration for this distance and direction was predicted by CRSTER to be 525 $\mu\text{g}/\text{m}^3$ and could be rejected due to the occurrence of two consecutive calms coincident with Class A stability in a three-hour period. The indicated second-high concentration (511) would then become the highest concentration with the new second-high becoming considerably lower (see footnote c).

^cParenthetical value indicates the greatest second high that results when day 186 of 1972 is excluded from the analysis. The distance and direction of occurrence of this value is 1.5 km at 70° from the Putnam Site.

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TABLE 5.1-7

SECOND-HIGH 24-HOUR AND 3-HOUR CONCENTRATIONS RESULTING FROM
INTERACTION OF SEMINOLE, HUDSON PULP AND PAPER, AND
FLORIDA POWER & LIGHT

<u>Second-High 24-Hour TSP Concentration ($\mu\text{g}/\text{m}^3$)</u>	<u>Grid Center Point</u>	<u>Distance/Direction from Grid Center</u>
5	Florida Power & Light	1.0 km/140°
<u>Second-High 24-Hour SO₂ Concentration ($\mu\text{g}/\text{m}^3$)</u>	<u>Grid Center Point</u>	<u>Distance/Direction from Grid Center</u>
60 ^a	Seminole	1.2 km/ 60°
<u>Second-High 3-Hour SO₂ Concentration ($\mu\text{g}/\text{m}^3$)</u>	<u>Grid Center Point</u>	<u>Distance/Direction from Grid Center</u>
514 ^b	Seminole	1.3 km/ 40°
Florida 24-Hour TSP Ambient Standard: 150 $\mu\text{g}/\text{m}^3$		
Florida 24-Hour SO ₂ Ambient Standard: 260 $\mu\text{g}/\text{m}^3$		
Florida 3-Hour SO ₂ Ambient Standard: 1300 $\mu\text{g}/\text{m}^3$		

^aNo contribution from either Hudson Pulp and Paper or Florida Power & Light is expected in this figure.

^bA negligible contribution of approximately 3 $\mu\text{g}/\text{m}^3$ is expected to have resulted from Hudson Pulp and Paper emission sources.

5.2 HEAT DISSIPATION SYSTEM

5.2.1 Effects of Blowdown Discharge

5.2.1.1 Physical Effects

General

Mineral saturation in the circulating water will be prevented by discharging a portion of the circulating water stream to the St. Johns River (Figure 5.2-1) and replacing that quantity with fresh water. The discharged water, or blowdown (B), is a function of the available makeup water quality and is related to evaporation (Ev) and drift (D) in the following manner (EPA, 1974):

$$B = \frac{Ev - D (C-1)}{C-1}$$

In this equation, C equals cycles of concentrations, a dimensionless number that expresses the number of times the concentration of any constituent is multiplied from its original value in the makeup water. (It does not represent the number of passes through the system.) Four cycles of concentration were utilized in the analysis. Facility blowdown rates under four cycles of concentrations are presented in Appendix C, Att. C-1, Table VII. To ensure conservative results the pollutant redistribution assessment utilized the maximum cooling tower blowdown rate shown in the referenced table. If practical, a portion of the cooling tower blowdown will be utilized for scrubber make-up, thus reducing the areal impact of blowdown discharge presented in the following sections.

The blowdown will contain heat and chemical constituents in amounts greater than the ambient levels of the St. Johns River. The thermal impact of the blowdown will vary significantly during a yearly meteorological cycle with the greatest blowdown/ambient temperature differential occurring during the winter and maximum temperatures occurring during the summer. The chemicals in the blowdown will consist primarily of those native to the St. Johns River (Appendix C, Table C-8) but at 4 times the naturally occurring levels. Chlorine and sulfuric acid will be periodically added to the circulating water system to prevent organic

growth and scale. In addition, chemical constituents in the ash pond wastewater and in the effluent from the sanitary treatment plant will be mixed with the blowdown before discharging to the St. Johns River. The constituents present in these two waste streams prior to mixing with the blowdown are discussed in Section 5.4.

Consistent with the requirements of the Florida Water Quality Standards (Section 2.3.1.4), the effects of wastes on a receiving stream are determined after reasonable opportunity for mixture of wastes with receiving waters has been allowed.

The investigation of discharge into the St. Johns River utilized separate, though interrelated, calculation procedures described below for the near- and far-field regions. The near-field region is defined as the immediate vicinity of the point of discharge (POD) wherein complex exchanges of momentum and energy take place due to the discharge jet velocity. The far-field region is defined as the portion of the river removed from the POD and the associated turbulent mixing from the discharge jet, yet still subject to effects from the discharge.

Model Identification

The estimate of the near-field impact and dilution was obtained by a well-tested buoyant plume model (Shirazi and Davis, 1974). The far-field impact and circulation patterns were estimated with two computer models developed by Dames & Moore specifically for such applications. Both models are depth-averaged, two-dimensional numerical models suitable for shallow estuarine water bodies. These far-field models are:

1. A hydrodynamic model, TIDAL2, to simulate the flow of the tidally-influenced St. Johns River in the region of the intake and discharge locations.
2. A water quality model, WQUAL2, to simulate the distribution of temperature and dissolved constituents around the POD under selected discharge conditions.

Detailed descriptions of the three models are given in Appendix Section C.4.

Thermal Impacts

An assessment of thermal impacts was conducted for worst-case scenarios of blowdown/ambient incremental water temperature and maximum temperature. As shown in Appendix C, Att. C-1, Table VI, the worst-case incremental temperature between the blowdown and ambient waters is associated with winter conditions and the maximum temperature of both waters is associated with summer conditions.

The assessment of thermal impacts resulting from blowdown discharge was based on two conservative assumptions. First, no temperature reduction of blowdown was assumed from mixing with the chemical and sanitary streams prior to discharge. Second, heat present in the effluent was considered to be a conservative substance, that is, no heat loss to the atmosphere.

The surface area impacted by the thermal discharge is dependent not only on the blowdown and ambient temperatures but also on the ambient flow vector. Under a given steady state flow condition, a plume configuration will form as shown in Figures 5.2-2 and 5.2-3 for winter and summer conditions respectively. From the figures, the location and size of the area affected by the plume will vary depending on the ambient flow conditions. As discussed in the following three sections, the size of the thermal mixing zone for various steady state flow conditions was determined with the near-field model, the fraction of the river cross-section experiencing elevated temperature was assessed with the far-field model, and the total area affected by a mixing zone over a complete tidal cycle was estimated with an interpolation between the near-field/far-field models.

Near-Field Analysis

Design winter conditions were assumed to be an incremental rise of 27°F with an ambient temperature of 59°F. This scenario includes a significant factor of safety for assessment of required winter mixing zones as it requires the simultaneous occurrence of the lowest water temperature in 20 years of record and the greatest winter dry bulb/wet bulb

temperatures in 34 years of record. In addition the maximum temperature rise across the condensers is expected to be closer to 20°F than 27°F.

Design summer conditions were assumed to be an incremental rise of 3°F with an ambient temperature of 90°F. As above, this scenario is conservative as it involves the simultaneous occurrence of extreme recorded summertime river water temperature and meteorological conditions.

From Figures 5.2-2 and 5.2-3 the effluent plume will be oriented with the ambient current and will experience greater spreading under conditions of upstream flow or flow reversals. However, jet inertia force and the attendant turbulent mixing is dissipated more rapidly under upstream flow. The greater the upstream velocity, the closer to the POD is the elimination of the jet inertia forces. For example, during an upstream velocity of 0.2 fps, zero jet velocity occurs 300 feet from the POD. Under the extreme condition of an upstream flow velocity of 1.0 fps, the jet inertia forces are reduced to zero within 35 feet of the POD. Spreading of the plume after the jet velocity dissipates is governed by the slower mechanisms of diffusion and buoyancy which are assessed with the far-field models.

The average upstream velocity of approximately 0.2 fps was used to determine the pattern of maximum steady state spreading of various isotherms in the near-field. The maximum areas encompassed by different isotherms during both summer and winter design temperatures and an upstream velocity of 0.2 fps are given in Table 5.2-1. Additional information concerning the near-field thermal assessment is provided in Appendix C, Section C.3.4.

Far-Field Analysis

Once the jet inertia forces are reduced to zero, the dispersion of the effluent plume was assessed with the far-field models. The far-field analysis assessed the plant wastewater dispersion during a seven-day period of near oscillatory flow in the St. Johns River (7-day MAF; Section 2.3.1.1) with a temperature differential equivalent to the maximum between average monthly ambient and blowdown temperatures (Appendix C, Att. C-1, Table VI). This differential of 12°F with an ambient of 63°F was

determined to be the most realistic worst-case design condition for a longterm (7-days) thermal assessment. Assessment of summer conditions was not conducted as the 3°F increment between ambient and blowdown temperatures would be undetectable by the far-field WQUAL2 simulation.

As shown in Figure 5.2-4 the wastewater temperature is computed to be less than 0.1°F above ambient within 500 feet of the POD. With an assumed intake/discharge structure separation of 450 feet, the build up of heat at the intake will be negligible. Because of conservative assumptions stated earlier, temperatures would actually be lower than calculated due to heat exchange between the heated plume and the atmosphere. In addition, 0.1°F represents the maximum ΔT occurring at the intake during the 7-day MAF. This maximum would persist in the vicinity of the intake for a limited portion of the tidal cycle. During the major portion of the tidal cycle the ΔT at the intake would be less than 0.1°F.

Based on the far-field analysis, the blowdown discharge will comply with the Florida Water Quality Standard which limits thermal plume dimensions to no more than one-third of a stream's surface width and one-fourth of its cross section. From Figure 5.2-3, the maximum temperature outside of the one-third surface width is only 0.05°F above ambient. This increase is less than one-third the accuracy of 0.1°C (0.16°F) of field measurements of the St. Johns River temperature data base.

Total Area of Thermal Impact

An estimate was obtained of the total area effected by a thermal mixing zone over a complete tidal cycle by assuming that the thermal component is a conservative substance and applying the dimensionless near-field/far-field interpolation model described in Section C.3.5 of Appendix C. For a given ratio of excess constituent concentration versus initial excess, the model provides the total area that may experience that excess constituent ratio or greater during at least a portion of the tidal cycle.

The results of the assessment are provided in Table 5.2-1 and Figure 5.2-7.

Chemical Constituents

Apart from chemical additives, cooling tower blowdown will contain the same dissolved chemicals native to the St. Johns River (Appendix C, Table C-8) but at 4 times the naturally occurring concentrations. In addition, chemical constituents present in the wastewater from the chemical and sanitary treatment facilities (Figure 3.4-1) will mix with the blowdown before it is discharged into the St. Johns River. The range of total concentrations of the various chemical constituents in the wastewater reaching the St. Johns are shown in Appendix C, Att. C-1, pages II-6 and II-7.

Near-Field Analysis

The increase in concentration of chemical constituents over ambient conditions under different ambient velocities in the near-field is shown in Figure 5.2-5 in terms of the ratio between the effluent plume's original excess concentration and the remaining excess concentration. The ratio is shown with an isopleth representing a line of equal excess concentration along the plume trajectory. As explained under the preceding section, an upstream velocity of approximately 0.2 fps may be used to determine the pattern of maximum spreading of the wastewater plume in the immediate vicinity of the POD.

Far-Field Analysis

After the jet inertia forces are reduced to zero, the dilution and dispersion of the effluent stream was defined with the far-field analysis for the design flow regime or 7-day MAF. The excess concentration of each chemical constituent is diluted to 2.4 percent of its initial value within 500 feet of the POD (Figure 5.2-6).

Chemical Constituent Mixing Zones

The required mixing zones for each constituent were defined as being the total area experiencing constituent concentrations in excess of state standards. The mixing zones for those constituents which may be discharged at concentrations in excess of state standards were estimated

with an interpolation model of the near-field/far-field assessments (see Appendix C, Section C.3.5).

Table 5.2-2 shows the estimated mixing zones required under given steady state ambient constituent concentrations. Except for lead, cadmium, mercury, zinc and oil and grease the ambient concentrations represent the maximum concentrations measured at the USGS Palatka water quality station (EPA, 1978). From Table 2.3-1, the maximum measured ambient chemical concentrations of the five constituents listed above exceed the limits of the Florida DER criteria. As a result, under certain ambient concentrations the wastewater chemical constituents cannot be diluted to concentrations within the criteria. However, generally, the ambient concentrations of the metals are well below the state standards. For oil and grease the data base of only two measurements is too limited to determine the general background conditions. The ambient concentrations shown in Table 5.2-2 for the five constituents are the concentrations at which the facility effluent will be diluted to within state standards within a 31.0 acre mixing zone.

Constituent Buildup at Intake

Assuming the intake point will be at the edge of the maximum allowable 31.0 acre mixing zone (Appendix C, Section C.3.6) the maximum buildup of constituents at the intake should be less than a 7 percent increase over ambient concentrations. The 7 percent value is based on the assumption that an oscillatory flow coupled with a steady on-shore wind persists for a period of time equivalent to four complete cycles of recirculating water replacement. The build-up above seven percent becomes insignificant for greater periods of time. The analysis is described in Appendix C Section C.3.7 and the results summarized in Table 5.2-3.

The buildup indicated in Table 5.2-3 is an upper limit value that is highly unlikely to occur. No evidence exists from the meteorological data that an on-shore wind would persist for the several days necessary for a four-fold replacement of recirculating water. The likelihood of

such a meteorological conditions if it did exist occurring along with the MAF is quite remote.

Turbidity, DO, pH

Other water quality parameters to which numerical Florida Water Quality Standards apply include turbidity, dissolved oxygen (DO), and pH. Since turbidity is measured in Jackson Turbidity units (JTU) which are not equivalent to dissolved chemical concentrations, the near- and far-field analysis may not be applied to compute the increase in turbidity resulting from blowdown discharge. A slight increase in turbidity in the St. Johns River may occur, but the resulting impacts were not quantified and will probably be negligible.

With regard to DO, cooling tower blowdown will probably be at near-saturated DO levels due to the continuous aeration of the recirculation water. The maximum blowdown temperature of 93°F would result in the minimum DO concentration of 7.5 mg/liter at saturation. The 5.0 mg/liter of BOD₅ in the sanitary wastewater will be diluted to .018 mg/l in the combined wastewater stream and should produce only slight reduction in the DO. Even if the sanitary and chemical waste streams had no DO and all the BOD₅ was satisfied in the combined waste stream prior to discharge, the concentration of DO would still be greater than 7.0 mg/liter. This value is greater than the minimum allowable ambient DO concentration of 5.0 mg/liter, blowdown discharge should not cause DO concentrations in the St. Johns to fall below the Florida limit.

With regard to pH, the analysis methodology discussed in Appendix C, Section C.3.3 was used to compute the pH of the combined wastewater stream. The pH of the blowdown will be within the range of 7.0 to 7.5. After mixing with other wastewater streams, it should be from 7.5 to 6.8. As these extremes are within the Florida limits of 6.0 to 8.5, the wastewater stream should have no adverse impact on pH levels in the St. Johns River.

Chemical Additives

In order to control biological growths in the condenser that would reduce unit efficiency, chlorine will be added intermittently. Only

enough chlorine to provide a residual of 0.5 to 1.0 mg/liter total chlorine at the condenser discharge will be used. Four to six applications per day for a period of 15-30 minutes will be used. In order to comply with 40 CFR 423, the cooling tower blowdown valves will be closed during chlorine application, and for a sufficient time afterwards, to limit chlorine in the blowdown water to an average of less than 0.2 mg/liter for a total period not to exceed 2 hours per day per cooling tower.

From Table 5.2-2, the calculated chlorine concentration in the river resulting from the discharge of the cooling tower blowdown would be less than 0.01 mg/liter within an area of 3.0 acres.

The water treatment to be employed at the plant to control scale formation will be sulfuric acid. Calcium bicarbonate is converted to the more stable and more soluble calcium sulfate. The application of sulfuric acid will increase the sulfate concentration of the blowdown stream. The methodology used to determine the resulting sulfate concentration is presented in Appendix C, Section C.3.2. The results indicate a maximum total sulfate concentration discharged to the St. Johns of 940 mg/liter.

Discharge Criteria

Standards of performance to control the quantity or quality of pollutants discharged as a result of cooling tower blowdown are contained in "Effluent Guidelines and Standards for Steam Electric Power Generating Point Sources" (40 CFR 423). These guidelines include criteria for the following discharges: chlorine, corrosion inhibition, and water temperature. These criteria for cooling tower blowdown will be met by the design and operation of the plant's recirculating cooling system.

5.2.1.2 Biological Impacts

The blowdown discharge imparts a thermal and a chemical change on the aquatic environment, either of which may influence the biota of the St. Johns River.

Changes in temperature may prescribe localized changes in an aquatic community. Thermal gradients produced by cooling tower blowdown, may cause some aquatic organisms to selectively avoid or to be attracted to affected areas. Other possible effects, associated with increases in temperature above ambient, include changes in community structure, to include shifts towards nuisance organisms; and decrease in dissolved oxygen, resulting from increased organic decomposition and decreased oxygen solubility (EPA, 1974). None of these effects, however, are likely to occur as a result of the small fraction of the river influenced and the rapid rate of dilution with river water.

The maximum ΔT between ambient and the blowdown discharge during plant operation in the summer will be 18° (10°C); winter blowdown, produces a ΔT of 27°F (15°C) over ambient. These may impact the aquatic community in several ways.

Although more data are generally available on fish than on other aquatic organisms, some generalizations on thermal influences can be made that apply to these other major aquatic groups.

The effects of temperature increases in phytoplankton and zooplankton will be primarily to enhance metabolic rate, and thereby, may promote growth and reproduction. Churchill and Wojtalik (1969) and Heink (1969) reported warm discharges could sufficiently stimulate reproduction of some plankters to replace their numbers within a few hours. Some planktonic organisms may be damaged by higher temperatures. However, the fraction of the population affected and the length of time are so small as to minimize the effect. The thermal plume, therefore, would have little adverse effect on the plankton passing through it. Higher temperatures, also may have the effect of increasing productivity of nuisance organisms, primarily the blue-green algae. However, Cairns (1956) suggested that these algae require temperatures over 95°F (35°C) for such a shift in dominance to occur. This is higher than any thermal discharges anticipated for the Seminole Station.

Benthic organisms have also been studied very little with respect to thermal responses. In general, their numbers and distribution decreases

with increases in water temperature (Federal Water Pollution Control Administration [FWPCA], 1967). However, a balanced benthic population can still tolerate temperatures up to about 90°F (32°C) (FWPCA, 1967). This temperature is exceeded slightly during summer months, but the direction of the discharge away from the bottom and rapid mixing with the river water should prevent thermal impacts on the benthic community. Aquatic macrophytes exhibit valued resources to increase temperatures but as with benthic invertebrates, the rapid mixing of effluent with the river water will prevent any significant alterations in macrophyte communities. In the immediate vicinity of the discharge, there may be shifts in community structure to more tolerant species. Macrophytes, however often vary in their growth patterns, and major shifts in community structure may occur for a variety of reasons, other than from the thermal effects (Hynes, 1972).

Fish generally show a behavioral response to thermal discharge either by moving rapidly through the plume or migrating along the discharge zone to temperature ranges for which they are best adapted. There are two primary thermal effects that are important in assessing impacts on fish communities. One of these effects is described by the T obtained in the summer where thermal additions from blowdown discharge may elevate temperatures above the tolerance unit for some species. The area impacted will be most pronounced during incoming tides (Figure C-9). Under "worst case" conditions, a maximum temperature at the POD will be 93°F (33.9°C). However, under the tidal flow conditions defined as "steady state" (Section 5.2.1.1), the temperature will be reduced to 91°F (32.8°C) within an area of 200 square feet. The mixing with ambient, at a maximum of 90°F (32.2°C), will reduce the temperature to 91°F (32.8°C), and at the boundary of a total area of 240 square feet, this will be further reduced to 90.5°F (32.5°C).

The increase in temperature provided by the blowdown will not in itself produce stress for most of these aquatic vertebrates (NAS, 1974). The movement of fish through a thermal plume, however, can produce stress if a substantial difference exists between the plume and ambient

temperature. Organisms that preferentially stay in these warmer waters are vulnerable to stress during interruption of plant operation. The maximum ΔT under "worst case" conditions (Section 5.2.1.1, Thermal Impacts) is 27°F (15°C), although rapid dilution occurs and the temperature quickly returns to ambient. Thus, under steady state tidal flow (Section 5.2.1.1) in an area occupying 8 square feet from the POD, the maximum ΔT is 15°F (8°C) and at the limits of an area encompassing 155 square feet from POD, the ΔT is only 5°F (2.5°C). There are inadequate data to clearly demonstrate the variance in temperature above ambient necessary to elicit stress (NAS, 1974). Figure 5.2-8, however, illustrates EPA recommendations for allowable winter time differences. This shows that for an ambient minimum temperature of 59°F (15°C), a winter discharge temperature would be allowed that is well above the maximum of 86°F (30°C) projected for this station. Because of the small proportion of the river cross section affected by the plume, however, most fish will rarely incur any ΔT resulting from this blowdown discharge.

Chemical Effects

Chemicals in the blowdown will contain a mixture of the constituents of the St. Johns River (at 4 times concentration), residual chlorine, additional sulfate, chemical and sanitary treatment plant effluent. The effects of these substances on aquatic organisms depend upon several factors:

1. The location and mobility of the organisms. Those located nearest the discharge and unable to move, such as benthic macroinvertebrates, may be subjected to the highest concentrations and be stressed. Organisms capable of moving away from the effluent plume will avoid harmful concentrations. Since the plume will be directed away from the bottom, however, there should also be minimal impact upon benthic organisms.
2. The time that organisms are in contact with effluent. The prolonged or chronic effects of certain chemicals may produce adverse responses in aquatic organisms. However, planctonic forms will be rapidly carried into more dilute regions of the

river, and larger nektonic species can move away from the plume.

Generally, the response of an aquatic organism to varying concentrations of specific chemicals is determined by a 96-hour, LC_{50} (lethal concentrations for 50 percent of individuals in 96 hours) under defined laboratory conditions. However, the LC_{50} for relatively few species has been determined, and the laboratory responses may not mimic field conditions. Nevertheless, the maximum recommended concentrations of selected chemicals are noted in Table 5.2-5. These values were not all obtained by a 96-hour, LC_{50} analysis, but they do represent the best estimates currently available of concentrations above which detrimental effects may occur.

Of the chemical constituents related to the effluent, all will be below the recommended units at the boundary of the 31-acre mixing zone when the ambient values are the same as shown in Appendix C, Table C-17. The paucity of bioassay data for organisms likely to encounter the plume makes it impossible to predict overall impacts on specific organisms. Those species present in the St. Johns River may have a preadapted tolerance for these high levels, since the background concentrations were sometimes above recommended levels. Long term impacts, however, from bioconcentration and bioamplification may impose reduction in productivity and reduce the numbers of individuals. The majority of aquatic organisms, however, will not pass through these higher concentrations, however, since the area where these levels occur encompass a small fraction of the river cross-section. Additionally, rapid mixing of the discharge with the river will rapidly reduce these chemicals to ambient concentrations.

5.2.2 Effects of Intake Structure Location, Design, and Capacity

5.2.2.1 Effect of Water Use

The impact on overall St. Johns River Basin water resources of the withdrawal of cooling tower makeup is considered negligible. The rationale for this determination is based on a comparison of withdrawal rate and the volume of unused freshwater available in the St. Johns River.

28.4 MGD

As documented in Section 2.3.1.1, two characteristics of the river tend to make it an enormous source of suitable water for makeup. First, the average flow is 7,613 cfs compared to a maximum intake rate of ~~44~~ cfs. Thus, the maximum plant use will be less than one-half of one percent of the river flow. Second, the estuarine nature of the river provides a large storage capacity in the channel. The river functions similar to a reservoir, providing a large volume of freshwater during periods of low basin runoff.

5.2.2.2 Biological Aspects of 316(B) Intake & Siting

The Development Document (EPA, 1976) sets forth certain recommendations for the design and location of cooling water intakes. In the intake design and siting of the proposed Seminole Plant Units No. 1 and No. 2, the applicant and its consultants have made every effort to address these and provide a design and siting which may correspond to Best Available Technology.

There are basically two ways in which a cooling water intake can adversely affect aquatic organisms. The first is through entrapment or impingement onto water screening devices. The second is entrainment into the cooling water system of the plant.

Entrainment will potentially impact all free floating organisms small enough to pass through the intake screening system. Entrainable organisms will potentially include phytoplankton, zooplankton, some smaller macroinvertebrates, fish eggs, larvae, and some juveniles. The size of organism impacted will be controlled by the intake screening openings. The numbers of organisms affected will depend upon the volume of water withdrawn, location of the intake, area of intake, hydraulic influence, and abundance of the organisms.

In general, the impact to the smaller non-screenable organisms will depend largely on their abundance and the volume of water withdrawn. Where water volumes withdrawn are low, the potential for impact is also low and roughly proportional to the percentage withdrawn from the source water body.

Capacity

The volume of cooling water flow is generally related to the potential for entrainment impact. Reduction of cooling water flow is recognized as an effective means (EPA, 1976) for reducing the potential for entrainment. The proposed Seminole Plant Units No. 1 and No. 2 will utilize close-cycle cooling in order to reduce cooling water intake flows. The lessening of intake flow will result in a reduction in the potential number of organisms encountering the intake and hence a reduction in the number of organisms potentially impactable by either entrainment or impingement (EPA, 1977). As noted in Section 5.2.2.1, the proposed intake cooling water flow represents a very small percentage of the river flow; therefore, only a very small percentage of organisms present will be even potentially available for any potential impact by the proposed plant.

Velocity

The maintenance of low intake velocities can prevent the impingement or entrapment of organisms or allow the escape and survival of any which become entrapped (EPA, 1977). Lower velocities also effectively reduce the area influenced by the intake. The design objective for the proposed Seminole Plant Units No. 1 and No. 2 intake will be to maintain a maximum approach velocity of 0.5 feet per second; this will be achieved by designing the screens to pass the maximum expected inflow rate at 0.5 feet per second maximum (net) velocity through the screens. The Development Document (EPA, 1976) notes increased impingements when intake approach velocities are greater than 0.8 foot per second and notes the desirability of intake approach velocities no greater than 0.5 foot per second. As noted in the Development Document, approach velocities are always lower than velocities through the screens (new velocities). Approach velocities at the proposed Seminole Plant Units No. 1 and No. 2 will, therefore, be substantially less than those discussed in the Development Document and as discussed by U. S. Fish and Wildlife Service (1974) for protection of fish. Low intake velocities should substantially reduce any potential for adverse impact in fish and macroinvertebrate

populations. In particular, neither healthy adult fish nor older juveniles should become entrapped on the screens.

Intake Location

Three potential intake corridors (Section 9.3.2) were selected as potential sites for intake locations. Aquatic sampling (Section 2.7.2) was performed at each of these sites and results presented (Appendix B, Tables B-29 to B-35, B-37). These sites and data were reviewed for the purpose of siting the intake to minimize potential adverse impacts.

In examination of all fish captured for the three corridors presented in Section 2.7.2, Tables B-29 through B-35, the lowest number of captures by all techniques was found at Corridor A (Transect B). Captures of food, game, and commercial species were also examined. These species are of great interest because of their importance in the food web and to man. For these species, the lowest numbers of captures were also made at Corridor A. Due to particular interest in the commercially and recreationally important anadromous species (American shad and striped bass) captures of all adult, juvenile, and larval fish were examined. Only one American shad was collected during this program upstream of all three corridors at the control transect. No adult striped bass were collected during the sampling program; however, some captures of striped bass were made at Corridors B and C (Transects C and D) during the larval net sampling program. Densities collected were low, between 0.4 and 0.6 fish per 100 cubic meters.

Due to the extremely low net intake velocity which will be used at the proposed plant, concern for intake placement to protect later life stage fish and macroinvertebrates is not as important as placement to avoid entrainment of younger life stages. A fish sampling program aimed at larvae, eggs, and juveniles was conducted and results reported in Section 2.7.2.3.3. Examination of the capture data reveals that the lowest overall total captures were found at Corridor A. These were dominated by the bay anchovy, a common forage species, which accounted for between 88 and 99 percent of the larval net captures at Corridor A. The bay anchovy is extremely abundant in the St. Johns River (Section 2.7.2.3.3), and the

potential loss will be kept very low due to intake capacity, design, velocity, and placement.

The presence of macrophytes in an area within 250 feet of the shoreline has been noted, and a study is underway to determine their significance.

Due to the above considerations, and taking cognizance of recommendations by EPA (1977) to avoid areas of high biological value, Corridor A was selected as the intake site most likely to minimize potential adverse impacts.

The placement of the intake at Corridor A relative to the shoreline was also examined. Since the intake is unlikely to have an adverse impact on later life stages of fish, examination was aimed principally at earlier life stages. No significant difference between offshore and nearshore collections of younger life stages could be detected. Variations of densities of macrobenthos between nearshore and offshore areas did not show consistently significant differences. Although the presence of a depauperate aquatic habitat nearshore makes it less likely to be utilized than offshore areas, there is no strong biological preference for either area at Corridor A.

Field Test to Determine Screen-opening Size

The most desirable intake for protection of biota is one that would have the minimal potential adverse impact. Ideally, this would consist of an intake with fine enough screening to prevent the entrainment of eggs, larvae, juveniles, and adults of all species, and a small enough intake velocity so that organisms could escape from the screens. Such a design would also have to be practical for both an engineering and cost viewpoint as recognized by EPA (1976).

The proposed design uses fine mesh wedge-wire screening to prevent entrainment of various sized organisms and low intake (net) velocities to allow organisms to escape the screens. It is SECI's proposed plan to use the smallest opening wedge-wire screens that can be utilized under engineering feasibility criteria (technology available) for this purpose. The exact size of the screens will be determined by an in situ

engineering feasibility study. The biological aspects of the test are discussed in detail in a Plan of Study, Aquatic Biology Program to Monitor in situ Intake Screen Testing (the Plan of Study is contained in Appendix B). The Plan of Study was reviewed by the U. S. Fish and Wildlife Service (National Power Plant Team), the U. S. Environmental Protection Agency, the Florida Department of Environmental Regulation, and the Florida Game and Freshwater Fish Commission before it was finalized. The work described in the Plan was begun in January 1979.

5.2.3 Atmospheric Effects of Cooling Towers

Emissions from natural draft cooling towers occur in essentially two forms. The first, and by far the larger, is water vapor emitted as the result of evaporative cooling processes. Evaporation losses from the two natural draft towers to be operated at the Putnam Site are estimated to be about 8,250 gallons per minute (gpm). This water vapor may later condense to liquid droplets after leaving the towers, but such droplets will be in an essentially pure form and will contribute nothing to ambient solid particulate concentrations.

The second type of emissions from cooling towers consists of very small droplets referred to as drift. Modern towers are equipped with efficient drift eliminators that limit drift loss to a very small fraction of the circulating water flow. The drift emission rate for the Seminole Station towers is estimated to be only 0.005 percent of the circulating flow or 29 gpm. The significance of drift losses from an ambient air quality standpoint is that drift droplets normally contain dissolved solids which, following droplet evaporation and deposition, can add to ambient ground-level particulate concentrations.

A conservative method of estimating the solids fraction of drift emissions is to assume that the total dissolved and suspended solids content of drift droplets is equivalent to levels found in cooling tower blowdown discharges. Blowdown from the Seminole towers is expected to contain a maximum of 3740 mg/liter total dissolved solids and a maximum of 184 mg/liter total suspended solids, for a total of 3924 mg/liter.

Combined drift emissions from the two natural draft towers to be operated at the Putnam Site is estimated to be 39,000 gpd. Combining the 3924 mg/liter solids content with the 39,000 gpd total drift emissions from both towers, it can be conservatively estimated that the total maximum solids equivalent emission rate from both cooling towers is 1,286 lb/day ($39,000 \text{ gal/day} \times 8.4 \text{ lb/gal} \times 0.003924 \text{ solids fraction}$). This is equivalent to 54 lb/hour. In comparison, particulate emissions resulting from combustion of high ash coal with both generating units in operation at rated capacity is expected to be 264 lb/hour, nearly 5 times greater than maximum cooling tower emissions.

Modeling of particulate emissions from coal combustion has indicated that the impact of such emission on ground-level concentrations will be only a small percentage of the standards established to regulate these concentrations. While an evaluation of drift ground-level impact cannot be accurately made, some perspective can be gained by comparing stack particulate emissions with cooling tower drift.

The height of release and plume rise of cooling tower emissions differ from those of the boiler stacks. More importantly, liquid droplets released from cooling towers behave differently than fly ash particles emitted from a stack, and therefore, the same modeling techniques are not appropriate for both types of emissions. Fly ash particles are assumed to be small enough to behave in accordance with the diffusion properties of a gas. Drift droplets, on the other hand, have a much wider size distribution. A considerable percentage of these droplets are large enough to have an appreciable settling velocity, and their paths can be assessed initially by a trajectory analysis until droplet size is reduced by evaporation at which time something on the order of the Gaussian diffusion analysis becomes more appropriate. The end result of this complex behavior is that maximum ground-level particulate concentrations traceable to cooling tower emissions tend to occur at closer distances than those from tall-stack fly ash emissions. The relatively small quantity of solids equivalent emissions from the Seminole cooling towers (less than 150 tons per year based on an average blowdown discharge solids content of 2344 mg/liter and an annual average station operating

level on the order of 70 percent of rates capacity), to be released from source which are approximately 450 ft in height and at least 1400 feet from the nearest site boundary, suggest that ground-level impacts beyond site boundaries will be minor.

With regard to the interaction or intermingling of cooling tower and stack plumes, the first point to note is that complete intermingling will not occur continuously. Because of such factors as directional orientation, separation distance, structure height difference, and plume rise difference, there will frequently be only partial interaction. Also, the effect when interaction does occur is uncertain. Conceivably, the mixture of stack SO_2 emissions with a moist cooling tower plume can lead to accelerated formation of acidic aerosols. Whether or not these aerosols reach the ground any earlier because of plume mixture is not evident. Further, the SO_2 content of Seminole Station stack emissions will be greatly depleted after passage through wet scrubbers. These scrubbers will create a moist environment for stack emissions independent of any interaction with cooling tower plumes. Therefore, any stack/cooling tower interaction which occurs is not expected to add appreciably to impacts which would occur in the absence of this interaction.

5.2.4 Visibility Effects of Cooling Towers

Because of the tremendous quantity of water vapor released from large generating station cooling towers, there is a potential for the formation of large visible plumes. If the saturation deficit of the atmosphere is low, then the water emitted from a cooling tower can supply the deficit and a visible plume will result. Aside from aesthetic considerations, the only potential impact that a visible condensed water vapor plume poses is one of safety. A visible plume which reaches the ground beyond station boundaries can obstruct visibility and create a hazard.

A general conclusion drawn from cooling tower plume visibility studies is that tall natural draft towers produce a longer visible plume than do shorter mechanical draft towers, but on only rare occasions does

a visible plume from a tall natural draft tower reach the ground (Roffman, 1975). The release point of evaporative emissions from a natural draft tower is 450 feet above ground level, and release of the latent heat of vaporization as condensation occurs imparts a buoyancy force which causes the plume to rise well above the point of release. One effect of this is that the plume will often rise above any shallow surface - based on inversion layers which may be present, and will not be trapped near the ground.

The infrequent occurrence of a visible plume from a tall natural draft cooling tower reaching ground level is cited by Hosler (1972) in his review of a study made at the Keystone Plant in Pennsylvania. During a two-year period of intermittent measurements, only one case of a plume reaching ground level was observed. Similarly, observations made in England near large natural draft cooling towers revealed no cases of fog (visible plume) at ground level which could be attributed to evaporative emissions from cooling towers (Moore, 1975).

In summary, the two natural draft cooling towers to be operated at the Seminole Station will be the most noticeable features of the installation, because of the size of these structures and because of evaporative emissions which will frequently produce visible plumes. The length of these plumes will at times extend past site boundaries, but plume release height and buoyancy will be such that the potential for creation of an offsite ground-level traffic hazard due to obstruction of visibility is very minor.

TABLE 5.2-1
THERMAL MIXING ZONES AREAS^a

SUMMER CONDITIONS		WINTER CONDITIONS	
ISOTHERM °F	MAXIMUM AREA (sq. ft.)	ISOTHERM T°F	MAXIMUM AREA (sq. ft.)
92.0	7.	15	8.
91.5	11.	10	26.
91.0	38.	5	155.
90.5	240.	2.5	1000.
90.1	16000. ^b	1.0	16000. ^d
MAXIMUM TOTAL AREA IMPACTED OVER COMPLETE TIDAL CYCLE ^d			
92.0	261	15.0	655
91.5	1000	10.0	2440
91.0	3223	5.0	11000
90.5	13500	2.5	43560
90.1	413800	1.0	326700

^aBased on near-field modeling assessment.

^bCorresponds to isotherm C, Figure 5.2-3.

^cCorresponds to isotherm C, Figure 5.2-2.

^dBased on near-field/far-field interpolation model discussed in Appendix C, Section C.3.5. See Figure 5.2-6.

TABLE 5.2-2
MIXING ZONES

<u>Parameter</u>	<u>Units</u>	<u>Ambient Concentration</u>	<u>Mising Zone</u>
Iron	mg/l	.56	0.5
Chlorine			
1 unit	mg/l	0	23.0
2 units	mg/l	0	3.0
Specific Conductance	μmhos/cm	510	4.0
Ammonia (un-ionized)	μg/l	11.4	10.5
Aluminum	mg/l	.15	19.2
Copper	μg/l	10.0	1.0
Cadmium	μg/l	.87	31.0
Lead	μg/l	28.	31.0
Mercury	μg/l	.18	31.0
Zinc	μg/l	25.	31.0
Oil & Grease	mg/l	4.67	31.0
Phenolic Compounds	μg/l	.28	50 sq. ft.
Selenium	μg/l	10.0	900 sq. ft.

^aArea in acres except where noted.

TABLE 5.2-3

CHEMICAL CONSTITUENTS
MAXIMUM BUILDUP AT INTAKE¹

<u>Parameter</u>	<u>Units</u>	<u>Ambient Concentration</u> ²	<u>Maximum Buildup</u> ³
Iron	mg/l	.56	.60
Copper	µg/l	10.0	10.7
Specific Conductance	µmhos/cm	510.	545.
Ammonia	µg/l	11.4	12.2
Aluminum	mg/l	.15	.16
Selenium	µg/l	10.0	10.7
Cadmium	µg/l	0.87	.934
Lead	µg/l	28.	30.08
Mercury	µg/l	.18	.193
Zinc	µg/l	25.	26.85
Oil & Grease	mg/l	4.67	5.02

¹Values represent maximum buildup of constituents at the intake during a period of upstream flow lasting longer than several intake/outfall recirculation cycles.

²Ambient values from Table 5.2-2.

³Upper limit of buildup of conservative substances at the intake.

TABLE 5.2-4

Recommended Concentration Limits for Selected Parameters
to Provide Minimal Effect on Aquatic Organisms

<u>Parameter</u>	<u>Recommended Maximum Concentration</u>	<u>Remarks</u>	<u>Reference</u>
Aluminum	100 µg/liter		EPA (1973)
Ammonia	20 µg/liter	Toxicity decreases with decrease in pH on temperature.	EPA (1976) DER (1978)
Arsenic	50 µg/liter		EPA (1976) DER (1978)
Cadmium	1.2 µg/liter	Toxicity depends on hardness and alka- linity of water. Less toxic in hard water and/or water of high alkalinity.	EPA (1976) DER (1978)
Chromium	100 µg/liter		EPA (1976)
Copper	30 µg/liter	More toxic to algae and mollusks than to other aquatic organ- isms.	EPA (1976)
Iron	1.0 µg/liter	Field data suggest adverse effects at concentrations con- siderably above 1000 µg/liter.	EPA (1976) DER (1978)
Lead	30 µg/liter	Toxicity depends on hardness and alka- linity of water. Less toxic in hard water and/or water of high alkalinity.	EPA (1976) DER (1978)
Mercury	0.02 µg/liter		EPA (1976) DER 1978
Nickel	100 µg/liter		EPA (1976)
Oil & Grease	15 mg/liter	Toxicity depends upon specific component.	EPA (1976)

TABLE 5.2-4 (Continued)

<u>Parameter</u>	<u>Recommended Maximum Concentration</u>	<u>Remarks</u>	<u>Reference</u>
Residual Chlorine	10 µg/liter	Aquatic organisms tolerate short term exposure to higher concentrations.	EPA (1976) DER (1978)
Selenium	25 µg/liter		DER (1978)
Zinc	30 µg/liter	Influent of pH and other factors pre- clude setting a gen- eral limit for all aquatic organisms. Chronic toxicity re- ported at concentra- tions over 100 µg/liter.	Becker, and others, (1973)

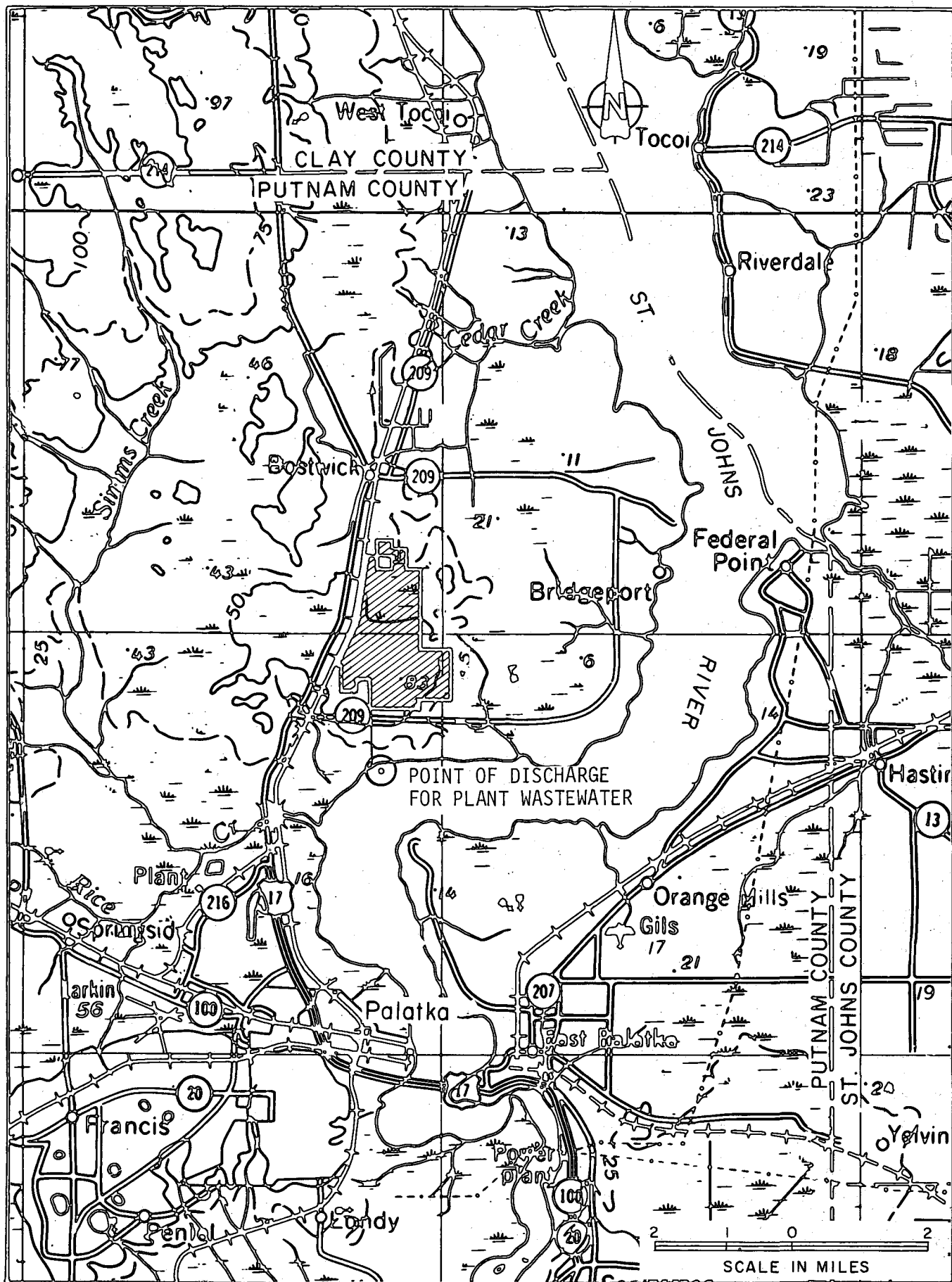


Figure 5.2-1. Location of Discharge for Plant Wastewater.

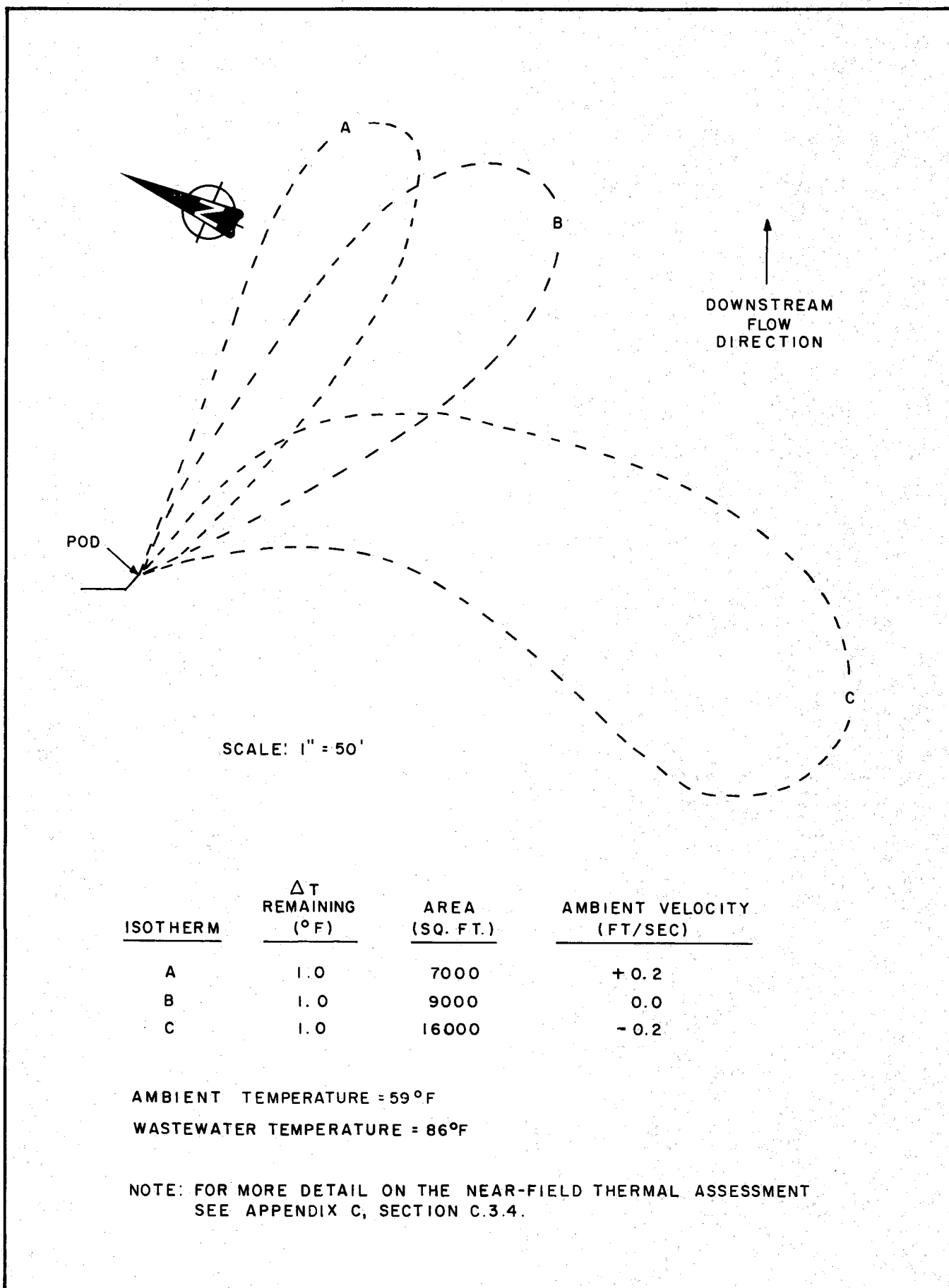
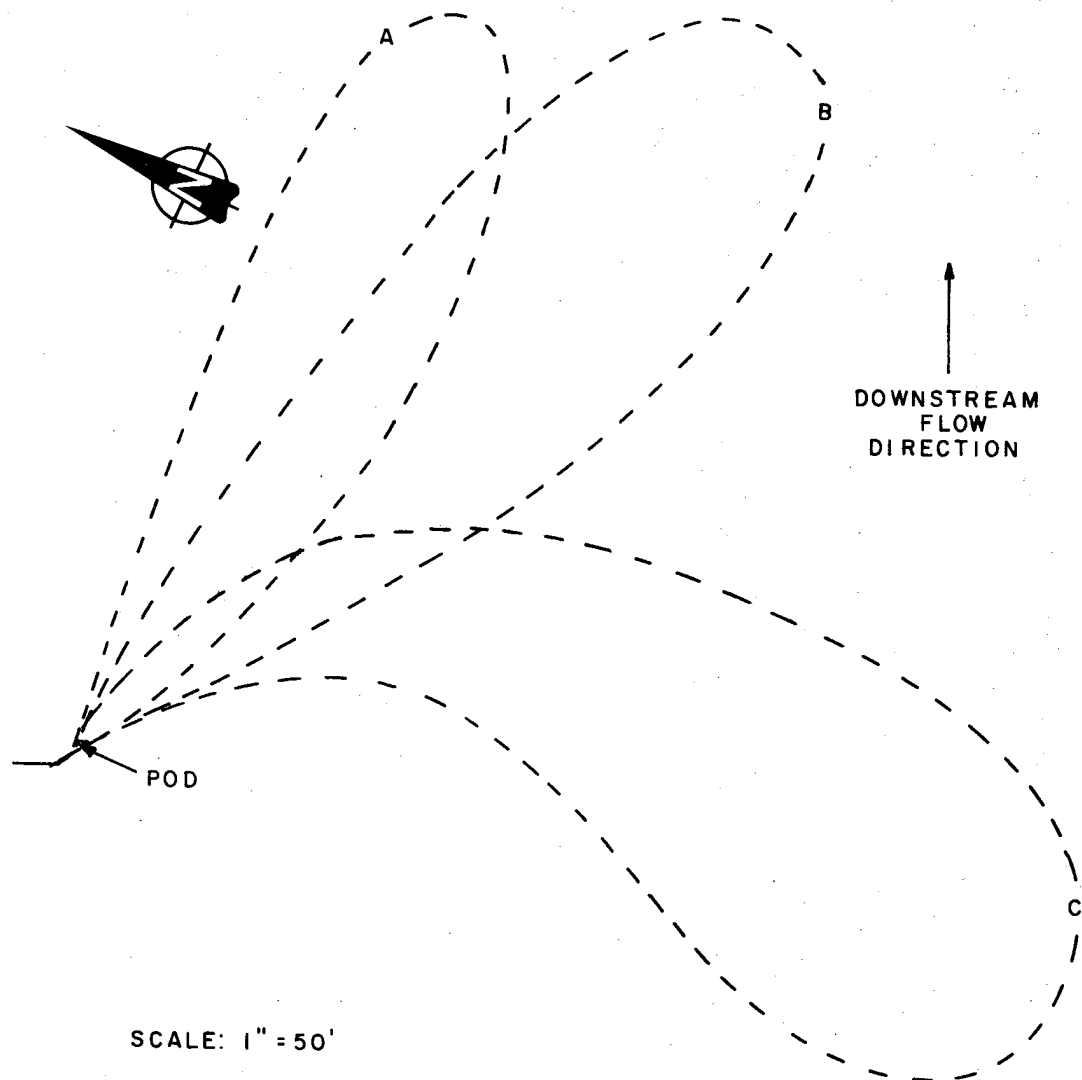


Figure 5.2-2. Near-Field Thermal Assessment, Winter Conditions.

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<u>ISOTHERM</u>	<u>°F TEMPERATURE</u>	<u>AREA (SQ. FT.)</u>	<u>AMBIENT VELOCITY (FT/SEC)</u>
A	90.1	9500	+ 0.2 DOWNSTREAM
B	90.1	13000	0.0
C	90.1	16000	- 0.2 UPSTREAM

AMBIENT TEMPERATURE = 90°
WASTEWATER TEMPERATURE = 93°F

NOTE: FOR MORE DETAIL ON THE NEAR-FIELD THERMAL ASSESSMENT
SEE APPENDIX C, SECTION C.3.4.

Figure 5.2-3. Near-Field Thermal Assessment, Summer Conditions.

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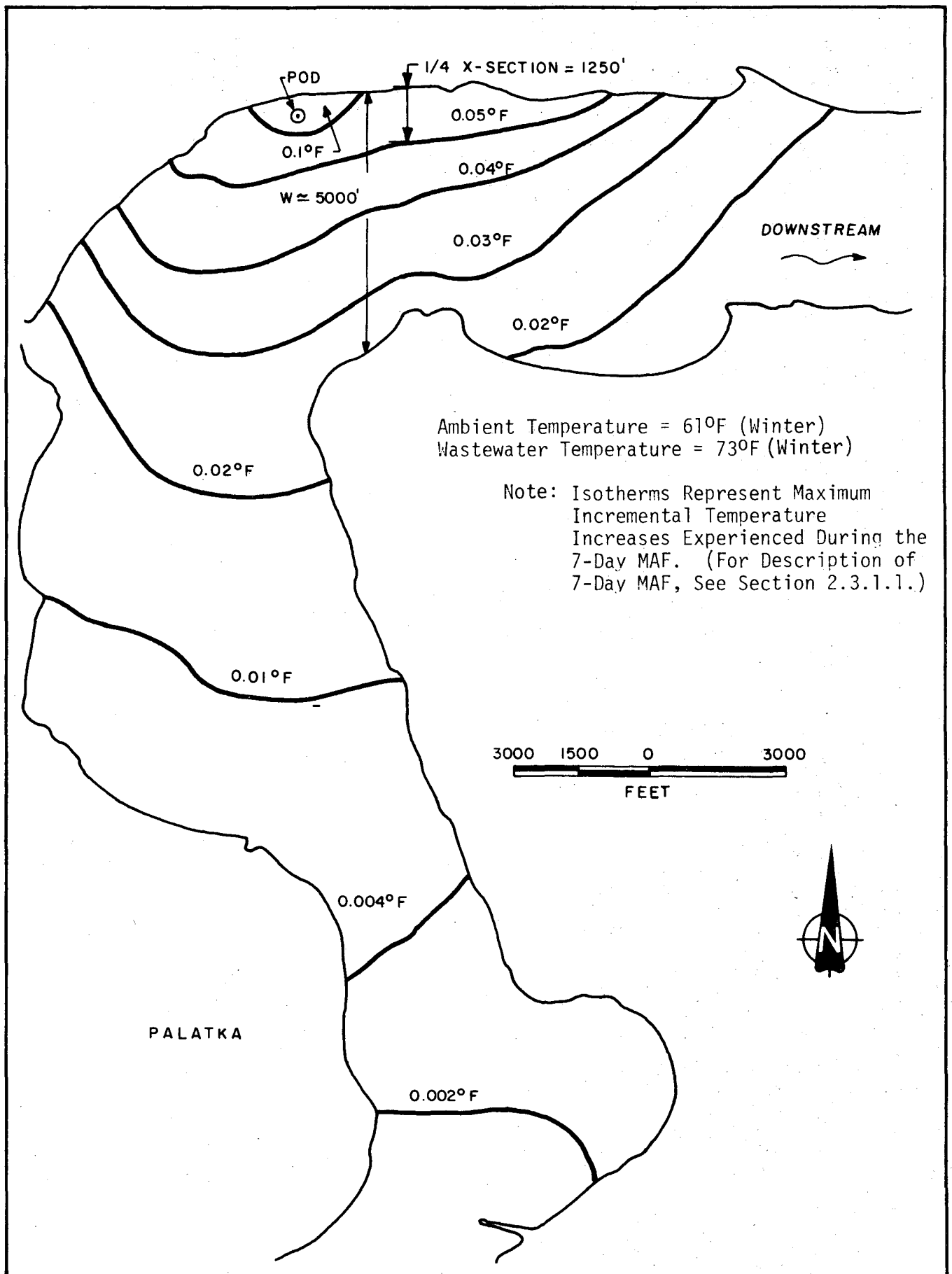
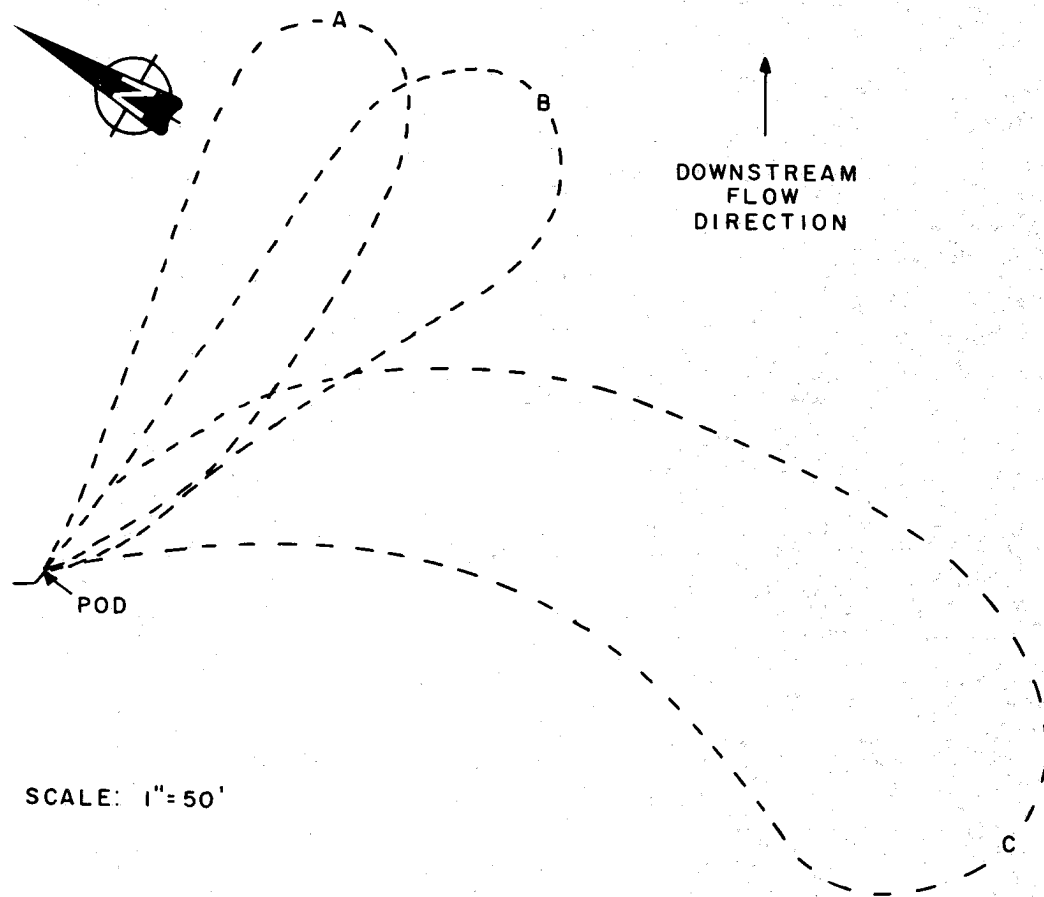


Figure 5.2-4. Thermal Impacts-Far Field Analysis.

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ISOPLETH	% OF ORIGINAL EXCESS REMAINING @ ISOPLETH	AREA (FT ²)	AMBIENT VELOCITY (FT/SEC)
A	4	5600	+ 0.2 DOWNSTREAM
B	4	7000	0.0
C	4	15000	- 0.2 UPSTREAM

Figure 5.2-5. Conservative Substance Isopleths, Near-Field Assessment.

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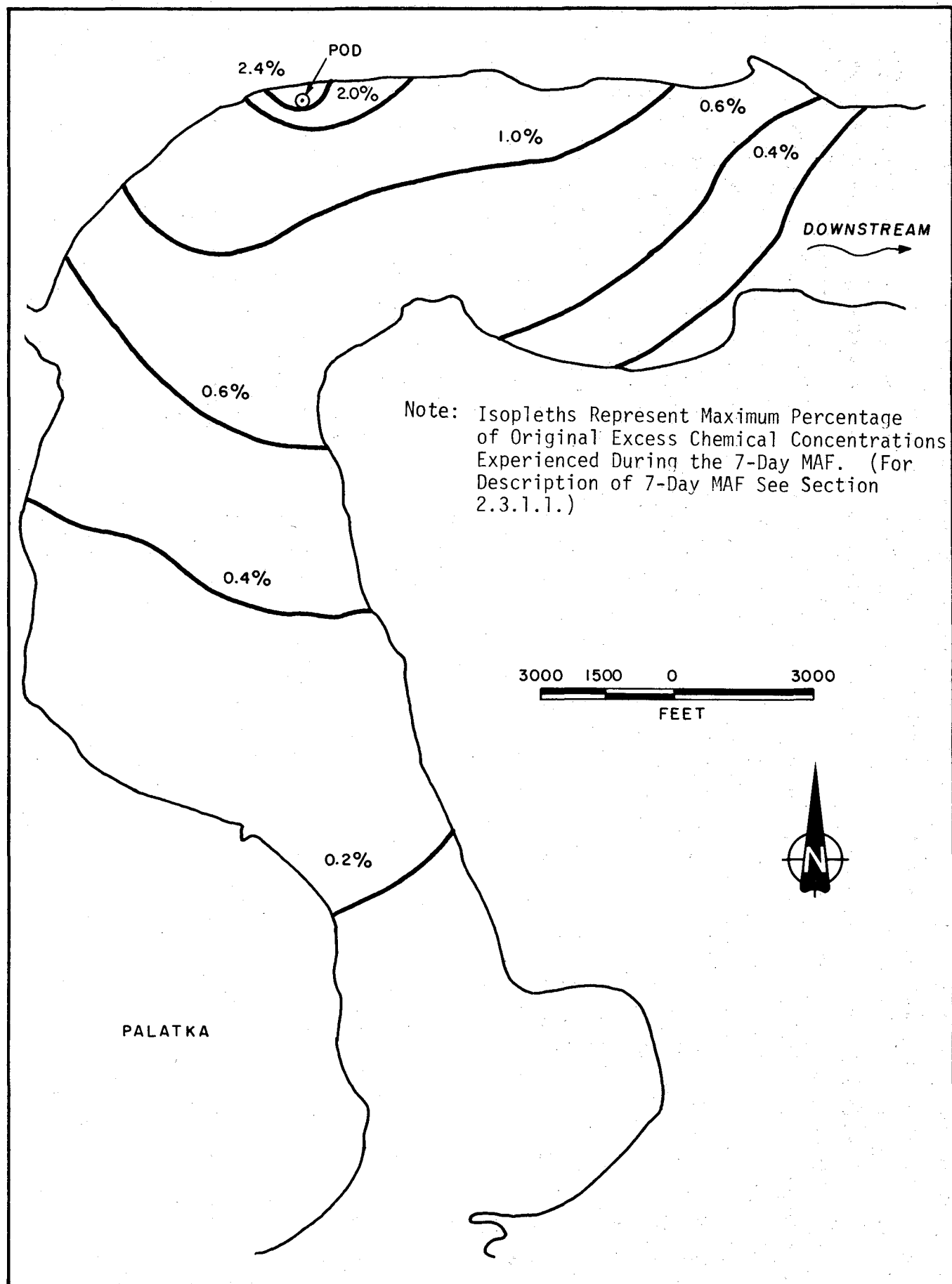


Figure 5.2-6. Chemical Impacts-Far Field Analysis.

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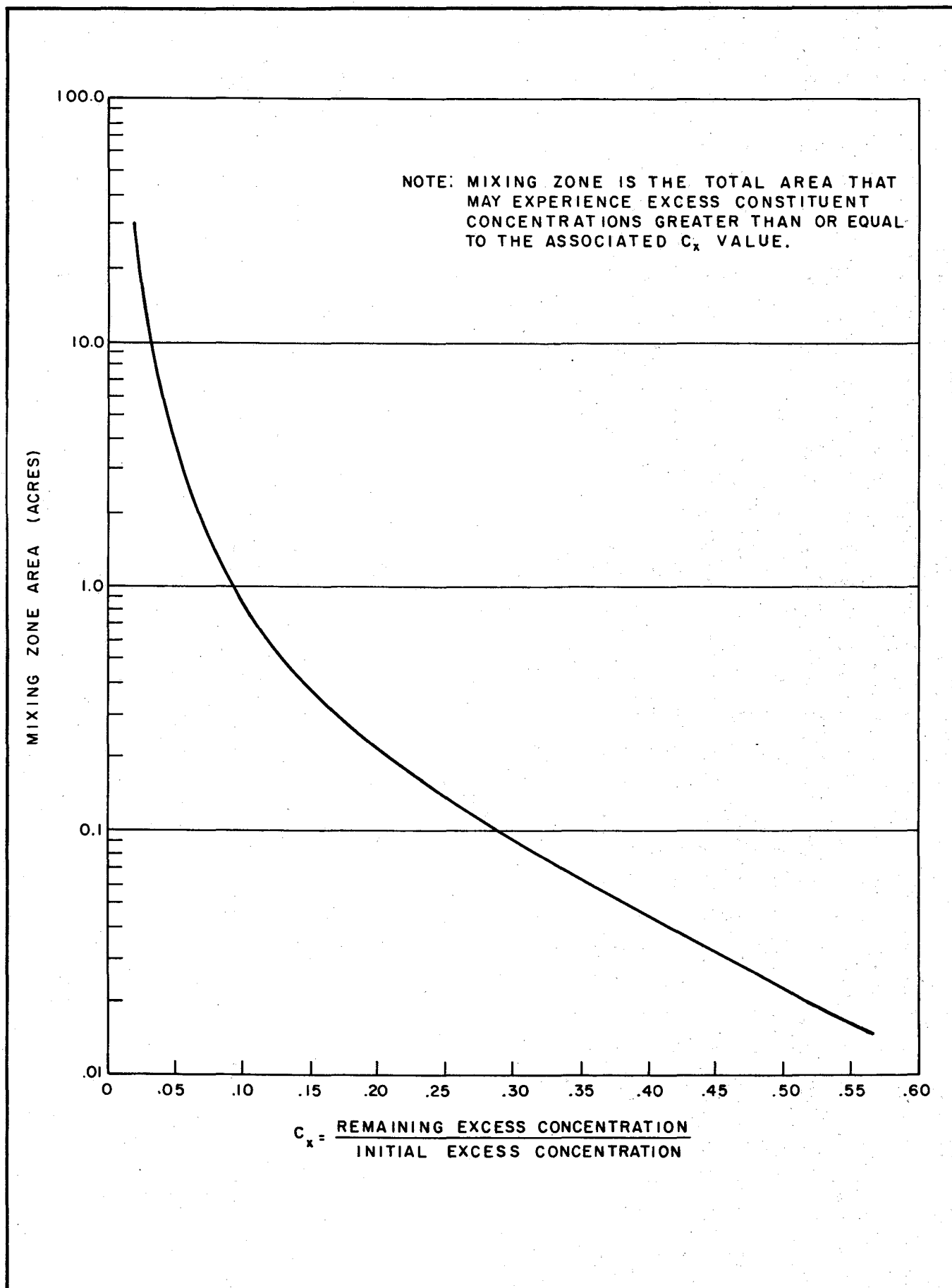


Figure 5.2-7. Remaining Excess Constituent Concentration Versus Mixing Zone.

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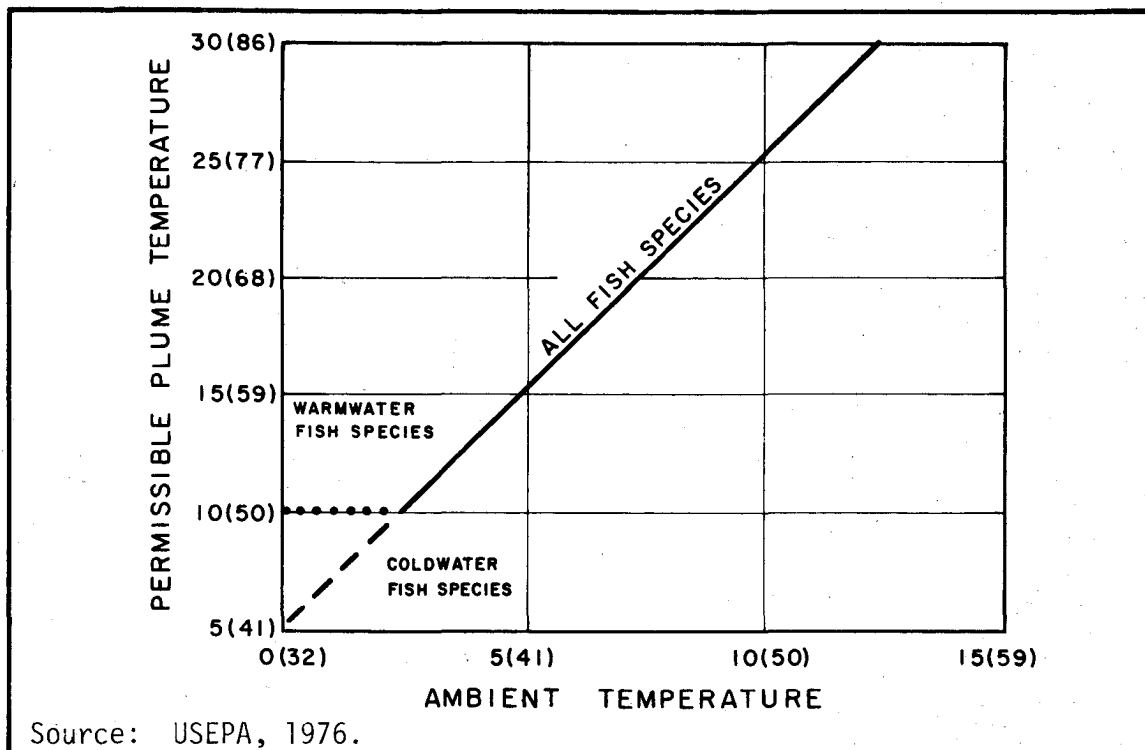


Figure 5.2-8. Nomograph to estimate maximum winter weekly average permissible temperature of plumes for various ambient temperatures, °C (°F).

5.3 PLANT SERVICE WATER SYSTEM

The plant service water will be supplied by two Floridan aquifer wells. The average daily withdrawal rate will be 590 gpm (0.85 MGD) and the well pumps will have a 1500 gpm capacity for peak requirements.

Computations were made of the projected drawdowns resulting from ground water withdrawals of 410 gpm from two Floridan aquifer wells. The computations were based on a transmissivity of 46,000 gpd/ft., a storage coefficient of 0.001, and a leakance factor of 0.001 gpd/ft³ (Appendix L). A 30-year pumping period was assumed. The projected drawdowns were calculated using the unsteady leaky artesian equation (Hantush and Jacob, 1955).

Potential lowering of off-site potentiometric levels is minor. The nearest inventoried off-site wells that withdraw water from the Floridan aquifer are A-21 (a livestock well) approximately 3800 feet north the Production Test Well (PTW); D-1 (domestic well) approximately 5800 feet south of PTW; and A-6 (domestic well) located approximately 7000 feet north of PTW (Appendix D, Figures D-7 and D-9). At least one domestic well also exists near A-21. The projected drawdowns in these wells from pumping 205 gpm in each of two plant service water wells was computed not to exceed 1.75 feet and 2.5 feet in wells A-21 and D-1, respectively, and not to exceed 1.0 feet in well A-6.

The potential lower potentiometric levels in off-site wells should not cause a significant increase in the power required for pumping lifts. The projected drawdowns are not expected to result in any significant upconing of salt water beneath the plant service water wells or lateral migration of higher chloride Floridan aquifer water from the east.

5.4 PLANT LIQUID EFFLUENT SYSTEM

5.4.1 Chemical Waste System

The flow diagram of plant chemical wastewater sources is shown in Figure 3.4-1. Based on the methodology given in Appendix C.3.1, the chemical quantity of the ash pond effluent before and after treatment is given in Appendix C, Att. C-1, Table VB. The ash pond effluent will be discharged at an average rate of approximately 500 gpm (1.1 cfs) with a maximum of 1200 gpm (2.7 cfs).

Discharge Criteria

Standards of performance to control the quantity or quality of pollutants discharged in the chemical waste streams entering the bottom ash pond are contained in "Effluent Guidelines and Standards for Steam Electric Power Generating Point Sources" (40 CFR 423). These guidelines include criteria for discharges from the following waste streams entering the bottom ash pond: low volume wastewater, bottom ash transport water, metal cleaning wastes, boiler blowdown, and contaminated runoff. Criteria exists for pH, TSS, oil and grease, copper, and iron. The standards specify that in the event waste streams from various sources are combined for treatment or discharge, the quantity of each pollutant or pollutant property attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

The 500 gpm (1.1 cfs) of treated chemical wastewater will be discharged to the St. Johns River along with the cooling tower blowdown and sanitary wastewater. The chemical concentrations in the total plant wastewater stream discharged into the St. Johns River are shown in Appendix C, Att. C-1, p. II-6 and II-7.

5.4.2 Sanitary Waste System

The sanitary wastewater treatment system will have an average flow of 6.25 gpm (.001 cfs) with a maximum of 9.7 gpm (.0022 cfs). Trace elements present in the ground water utilized in the plant potable water supply will be present in the sanitary effluent. In determining sanitary

effluent quality, the maximum ground water chemical constituent concentrations were utilized assuming no reduction by the well water pretreatment system. Further, it was assumed that only TSS, phosphorus, nitrate and BOD₅ will be controlled in the sanitary treatment facility. The water quality of the ground water and the effluent from the treatment facility is summarized in Appendix C, Att. C-1, Table VC.

The 500 gpm of treated sanitary wastewater will be discharged to the St. Johns River along with the cooling tower blowdown and ash pond wastewater. The chemical concentrations in the total plant wastewater stream discharged into the St. Johns River are shown in Appendix C, Att. C-1, p. II-6 and II-7.

5.5 GROUND WATER HYDROLOGY IMPACTS

5.5.1 Sources of Potential Impacts

There are four potential sources of impacts to ground water at the site. These are: (1) Disposal via landfilling of coal combustion and flue gas desulfurization wastes (fly and bottom ash, and scrubber sludge); (2) disposal via percolation field of stack wash, air pre-heater wash, boiler fireside wash and the boiler blowdown tank; (3) seepage from the coal storage area; and (4) seepage from the dredge disposal area. The potential impacts relative to dredge disposal are discussed in Section 4.4. The approximate locations of these areas are shown on Figure D-10 (Appendix D) in relation to the surface drainage basins in which they are located and the general direction of ground water flow.

5.5.2 Methodology

The evaluation of potential ground water impacts addressed in this section considers site specific parameters such as ground water velocity and flow rates, chemical properties of the soil (cation exchange, etc.) and dilution potential. The coal source has been identified and the chemical analyses of the coal served as input to an analytical evaluation of the potential impacts upon the ground water system and the ability of the site to assimilate the proposed method of plant operation. The principal criteria used in evaluating the site with respect to ground water was to determine the impact upon ground water quality at the property boundary in the direction of ground water flow.

5.5.3 Waste Storage Area

When filling is complete, the area will encompass 275 acres and will have an average thickness of approximately 58 feet. Approximately 16,000 acre-feet of waste material will be disposed of which approximately 30 percent will consist of fly and bottom ash and 70 percent will consist of SO₂ scrubber sludge. The bottom ash and the scrubber sludge will be dewatered prior to disposal and the water will be returned to the plant water system. The sludge and bottom ash will be

dewatered further by mixing with dry fly ash until a solids content ranging from 55-80 percent is attained. This material is normally referred to as being "physically stabilized." Part of this material will be mixed with lime or cement to form a cementitious product (typically referred to as chemically stabilized) which will be used to form the base and the dikes of the waste storage area (Section 3.8).

The degree of impact of the waste storage area upon ground water will depend, in part, upon the ability of precipitation to infiltrate the disposed waste and permeate to the underlying water table aquifer (Layer 1). The permeability of the cementitious base is low and should act to retard the movement of constituents to the water table aquifer. During the early stages of filling, when the cementitious base is being deposited, the seepage to the water table should not exceed 2 in/yr; as the thickness of the disposal area increases, the seepage potential should eventually increase to a maximum of approximately 6 in/yr.

The potential migration of leachate from the waste storage area was evaluated using the site hydrogeologic parameters, and the analytical techniques presented in Appendix D.7. The results of the leachate migration analysis is given on Table D-22 (Appendix D). The assumed concentrations of the chemical constituents are given. Also given are the estimated concentrations of the constituents at the boundary of the site. The concentrations of all the chemical constituents evaluated were estimated to be within State of Florida ground water quality criteria, and significant impacts to off-site ground water quality are not anticipated with respect to the waste storage area.

5.5.4 Coal Pile Storage Area

The coal pile encompasses approximately 50 acres. The majority of the coal will be stored in the inactive (dead storage) pile. The coal will be maintained at a height of approximately 45 feet.

A large percentage of the precipitation falling on the pile will tend to infiltrate the pile due to its porous nature. The infiltrating water should move rapidly through the pile and upon reaching the original ground surface will either infiltrate to the ground water

table or drain along the base of the pile to collection ditches located around the perimeter of the area. The potential for impact to ground water will be a function of the quantity of water which is able to infiltrate the original ground surface and permeate to the water table. It is estimated that approximately 9 in/yr will eventually reach the water table.

The analysis of the impacts upon water quality are summarized on Table D-25 (Appendix D). Of the chemical constituents evaluated, all are below the State of Florida water quality criteria at the property boundary. Sulfate concentrations were computed to increase background concentrations at the property boundary by approximately 730 mg/liter. The analysis indicated a potential impact on a nearby residential supply well. Assuming that the hydrogeologic conditions at the well are similar to those on the plant site, the increase in sulfate concentration after 35 years was calculated to be approximately 500 mg/liter.

5.5.5 Percolation Field

At this time, the design of the percolation field has not been finalized, therefore the size and shape of the field, as shown on Figure D-10 (Appendix D), is approximate.

The waste water to be disposed of in the percolation field will originate in the plant as boiler blowdown, boiler fireside wash, air preheater wash, and stack wash. The quantities to be disposed of are a continuous 40 gpm for the boiler blowdown and a batch volume of 270,000 gallons four times a year for the remaining three items.

The quantity of the waste water is variable. The boiler blowdown is projected to have a total dissolved solids content of less than 5 mg/liter, with approximately 1 mg/liter of iron, and small amounts of ammonia (Burns and Roe, Inc., 1979, personal communication). The quality of the remaining three items (the batch volume) should be similar to bottom ash sluice water. Therefore, the maximum potential

impact to ground water will be the batch volumes disposed of four times per year.

The results of this analysis are summarized on Table D-23 (Appendix D). Significant impacts to ground water beyond the site boundary are not anticipated.

5.6 NOISE IMPACTS

5.6.1 Operation Noise Sources

Noise sources at large steam-electric generating stations were reviewed, and the principal indoor and outdoor noise sources were selected. The average sound levels for these sources are shown in Table 5.6-1. Outdoor noise from indoor sources was found to be negligible after the anticipated noise reduction due to building walls and is therefore not included in the table. Sound levels presented in the table are considered to be conservative estimates of power station operational sound levels. Efforts will be made during the plant design phase to utilize low-noise equipment or components. The station is scheduled to operate 24 hours, seven days per week.

Cooling tower sound levels, measured 150 meters (m) or 500 feet from an installation of natural draft units, were used for the calculations. The A-weighted sound level at 150 m for a typical cooling tower is 50 decibels (dB).

The following conceptual coal handling system was assumed for sound level calculations: a covered active storage with a traveling tripper for stocking out coal and a below-grade rotary plow feeder for reclaiming coal. This assumption is considered conservative with respect to estimating noise impacts. Typically, this type of system would have the following noise characteristics. An intermittent and high level noise source associated with coal handling as the coal car dump is operated. The coal cars are clamped, producing about 80 dB at 20 meters (70 feet) for 0.5 second followed by three seconds of a 70 dB sound level due to car rotation, and 25 seconds at 65 dB due to emptying of the car. A sound level of 70 dB due to the return of the car to the upright position for three seconds is followed by approximately 30 seconds of background ambient sound level. The total cycle time is approximately one minute. The equivalent sound level for this operation is 64.8 dB at 20 meters (70 feet).

Adding the acoustic energy for all coal handling operations provides an equivalent sound level, L_{eq} , of 44 dB at 300 m when the coal car emptying is in progress or an equivalent sound level, L_{eq} , of 39 dB at 320 m when the coal car dumping does not take place. Section 3.1.3.1 described the coal transportation system. It is assumed that the dumping of 70 to 90 coal cars takes approximately four hours.

Operation of the station will increase train traffic on the Seaboard Coast Line Railroad by one or two trains per day. As a typical freight train passes by, the equivalent sound level (L_{eq}) emitted to a receiver 30 meters from the track is estimated to be 84 dB for a duration of 100 seconds (Dames & Moore files). When passing through more populated areas where the train speed is regulated, sound levels might be lower but they will exist for longer duration.

When coal is removed from the coal storage pile, one or two loaders will be used to move the coal to the reclaim automatic feeder areas. The estimated equivalent sound level for two loaders operating together is 53 dB at 300 meters (1000 feet).

5.6.2 Operation Noise Impact

The day/night sound levels, L_{dn} , during operation of the plant are computed by adding, on an energy basis, the sound level contributions of each individual source discussed above and presented in Table 5.6-1. These computations include coal handling at the coal storage pile in order to present the most conservative case. The plant operation sound levels are extrapolated to noise sensitive areas represented by the baseline measurement locations (Figure 2.6-1). The 100 meters (300 feet) of dense woods are considered in these calculations. The results are presented in Table 5.6-2. No change in ambient day/night sound levels is anticipated except at Location 3 where a change of 1 dB is indicated.

No significant change in day/night sound levels, L_{dn} , are indicated at noise sensitive land use locations represented by the baseline measurement locations. Hence, no adverse noise impact is anticipated from the operation of the station.

Table 5.6-1

Plant Operation Source Equivalent Sound Levels
at 300 Meters (1000 feet) from Plant*

Outdoor Power Block Sources	Outdoor L _{eq} (dB)**	Duration of Operation	
		Daytime (hr)	Nighttime (hr)
Main Transformer	41		
F.D. Fan	40		
F.D. Fan Motor	41		
Total L _{eq}	41.5	15	9
<u>Coal Handling</u>			
Active Pile with Coal Car Dump	44	4	
Active Pile without Coal Car Dump	39	7	9
Inactive Storage Area	53	Intermittently	Intermittently
Cooling Towers (natural draft)	47	15	9

*Due to attenuation of plant walls, sound levels of indoor sources are negligible (<15 dB).

**Power Block sound levels are taken from a study for a similar station of 2 units of 600 megawatts generating capacity (R.G.&E, Reference 1). Coal handling sound levels from a previous Environmental Impact Study for PSCC (Reference 2).

Table 5.6-2

Operation Ambient Sound Levels at Baseline Measurement Locations

Location	Background Ambient Sound Levels, dB			Contribution ^{a,b} to Ambient Sound Levels, dB	Operation Ambient Sound Levels, dB			Change in Ambient Sound Levels, dB		
	L _d	L _n	L _{dn}		L _d	L _n	L _{dn}	L _d	L _n	L _{dn}
1. Warner Point	43	40	47	25	43	40	47	0	0	0
2. Degeyter Motel	52	51	57	18	52	51	57	0	0	0
3. Wild Waters Trailer Park	47	39	48	30	47	40	49	0	1	1
4. On Site	43	36	44	--	On Site			On Site		
5. Mulberry and Tillman Rds.	47	35	46	24	47	35	46	0	0	0
6. Route 17	57	49	58	32	57	49	58	0	0	0

^a Sound level includes 10 dB attenuation due to 90 meters (300 feet) of dense woods onsite surrounding the plant.

^b Since this analysis was completed in August 1978, several design decisions have been made by SECI that have resulted in the selection of equipment with lower operating sound levels than that assumed in the analysis. Thus, the calculated sound levels are conservative.

5.7 OTHER IMPACTS

5.7.1 Transportation

Plant operations will increase traffic levels in the plant vicinity. After construction is completed in 1983, the total workforce of the plant will be approximately 140 persons. The arrival of plant employees will increase traffic levels along State Route S209 (locally known as "West River Road" and "County Road C209"). Although Average Daily Traffic (ADT) along this highway is below capacity levels, peak hour traffic during morning rush hours may induce stacking problems at the intersection of U.S. Route 17 and State Route S209. This congestion may be relieved somewhat since inbound plant traffic along State Route S209 will be eastbound while commuter traffic from residential areas will be westbound toward U.S. Route 17. The addition of a traffic signal at the plant entrance on State Route S209 would help to alleviate any congestion caused by plant traffic crossing the westbound lane of State Route S209. This signal would also serve to alleviate stacking of vehicles at the intersection of U.S. Route 17 and State Route S209, since the delay to westbound traffic would give the intersection time to clear between traffic flows.

If conditions warrant, a signalized intersection at U.S. 17/SR209 may become necessary. The addition of turn lanes on U.S. Route 17 would also decrease congestion at the intersection. Normal service deliveries to the plant should have a minimal effect on traffic flows in the area since the delivery will generally occur during periods of minimal traffic flow, not during peak hours.

5.7.2 Land Use

Loss of Productivity & Alternative Uses

The plant is expected to be in operation for 35 years. During this time the uses of this land will be restricted to power generation. About 60 percent of the site will be developed while the rest of the site area will continue in its natural state.

Since 46 percent of the site is considered "developable" by the Coastal Zone Management Program, it is conceivable that within the next 35 years it would have been developed for either residential, commercial, or heavy industrial uses. Putnam County is not expected to have excessive residential or commercial development occurring in the foreseeable future (Section 2.8.3). Therefore, the pressure to use the site tract for either type of development is uncertain. Criteria for heavy industrial siting may eliminate many areas in Putnam County. Since the Putnam Site possesses favorable characteristics for heavy industrial development such as access to transportation and water and non-conflicting land uses, its development for industry seems favorable. Therefore, there is a high probability that the Putnam Site would have been used for some type of industrial development had it not been selected for electric power development.

A majority of the site lies within an area classified as only fair to poor for food crop, pasture, and woodland uses (Figure 2.8-1). The rest of the site is rated as good for pasture and woodland uses; however, the county in general has ample area for such uses (Section 2.8.1.2), so preemption of these uses does not appear a significant factor. The soils on the site area are also rated as unsuited to recreational uses normally associated with outdoor activity. In addition, many other areas are available for recreational activity in Putnam County.

Conflicting Land Uses

There does not appear to be any conflicting land uses with the immediate site vicinity. Land uses such as residential, commercial, and institutional are considered to be incompatible with heavy industrial uses such as a power station. In general, most of the residential land uses in the site vicinity are far enough removed from the site to avoid any adverse affects which might create conflicts. The nearest residential land uses in the site vicinity are far enough removed from the site to avoid any adverse affects which might create conflicts. The nearest residential land uses to the site are located along U.S. Route 17, and State Route S209 near the St. Johns River (Figure 2.8-2). The nearest

residential areas along the St. Johns River will be separated from the main plant structures by approximately 5,000 feet. Of this distance, approximately 3000 feet will remain heavily wooded and should provide a sufficient buffer zone between the plant and the residences.

5.7.3 Historic, Scenic, Cultural, and Natural Landmarks

The operation of the Seminole station should have no effect on the public lands discussed in Section 2.8.4. The operation of the plant will not interfere with any identified historic, scenic, cultural, or natural landmarks. The most noticeable impact of the plant will be the stacks and cooling tower visibility from the Hudson Wildlife Management Area Lands. Although this will intrude on the rural setting for persons hunting and hiking in the area, tree cover will serve to screen most of the facilities from view. The stack and cooling towers will be visible to boating ramps on the St. Johns River.

A detailed report of the archeological survey of the site is found in Appendix J. None of the sites discovered during the survey were deemed to be of significance and are not slated for preservation or excavation.

5.7.4 Aesthetics

Figure 3.1.2 is a view of the plant's eastern profile. An artist rendering is given as the frontispiece to Volume I. The tallest structures of the facility is the 675 foot stack. Other major components of the plant such as the boiler building, ash silos and natural draft cooling towers vary from 75 to 450 feet tall.

Screening of the plant facilities is to be accomplished by a buffer zone around the plant's perimeter (Figure 3.1-3). The buffer zone is to be composed mainly of natural vegetation supplemented by plantings where necessary. The buffer zone, in conjunction with other undisturbed areas on the site is expected to provide adequate screening of all the plant facilities except the stack and cooling towers.

In general, the power plant facilities will not be visible from the highways in the area if the roadside has screening of 40 to 50 foot trees along side it. In areas where there are no trees of this height within 50 feet of a view, the stack and cooling towers may be visible. The further from the facilities the viewer is, the less the tree height needs to be for effective screening. The stack and cooling towers will be visible from many of the residences along both sides of the St. Johns River, especially those with long unbroken vistas in the plant's direction. The facilities are also likely to be visible from the Community of Bostwick and may also be visible from some areas in Palatka.

5.7.5 Aviation

The plant's main source of possible impacts on aviation in the area is the 675-foot stack. To reduce the possibility of the stack infringing on take-off and landing operation at Key Larking Field, 5.7 miles southwest of the site, the Federal Aviation Administration (FAA) investigated the plant's location for features hazardous to aircraft. A permit to construct a stack up to 800 feet in height was granted on May 1, 1978 by the FAA.

Although the stack is a possible obstruction to light aircraft, the safety markings and warning lights, as required by the FAA, should minimize the hazard. It is possible that the visibility of the stack may prove valuable as a navigational aid to pilots.

5.7.6 Bird Mortality Caused by Collision with Structures

Bird mortality caused by collision with towers and other man-made structures has been well documented (Jackson and others, 1974; Stoddard and Norris, 1967; Stout, 1967; and Tordoff and Mengel, 1956). Mortality is highest during periods of migration when birds move south in the fall and back north in the spring. A considerable portion of all southward migration in eastern North America passes through Florida during the fall as Florida is located near the base of the massive Atlantic Flyway.

Studies have shown that mortality is as much as ten times greater during the fall than the spring (Brewer and Ellis, 1958). Generally,

migratory birds move with weather fronts in the fall, and these fronts are frequently associated with bad weather. In general, migratory birds fly at altitudes well above man-made structures. It is during times of poor visibility, low cloud ceiling, and rain that most mortality occurs. Migrants are then forced to fly at low altitudes and, as many birds fly primarily at night, the chances of collision are greatly increased.

A majority of bird collision studies were conducted at television and radio towers, which present a different type of hazard from solid towers as the radio-type towers are equipped with guy wires. The nearly invisible guy wires greatly expand the hazard area around these towers. Frequently, birds are attracted to the warning lights on towers, and many collide with the guy wires as they fly around the tower in confusion (Mayfield, 1967; Graber, 1968). Larger birds that have been observed avoiding solid towers (Rybak and others, 1973) are not so successful when they encounter guy wires. The majority of birds found striking towers of any type are smaller, less agile songbirds. Few studies list waterfowl and shorebirds among the casualties (Graber, 1968). Waterfowl may travel by day or night, while many songbirds fly only at night when visibility is low.

It is difficult to estimate mortality due to collision with towers. Mayfield (1967) estimates that one million birds are killed annually by television towers, and that this mortality amounts to "one in about 6,000 of the year's bird casualties in the United States. Proportionately, 16/1,000ths of one percent is not a significant number of deaths from a single cause." There are many more television towers in the United States than cooling towers, leading to the conclusion that mortality from the towers on the Putnam Site would be insignificant to avian populations.

Transmission lines pose a different sort of hazard to birds. They are constructed parallel to the earth's surface and may seem to present a barrier to bird movement for long distances. However, this is not the case. Resident birds learn quickly where the lines are and commonly use them as perches for resting or hunting. Transmission towers are

frequently used as nesting sites as well. Several studies indicate that most birds that collide with transmission lines or towers are migrants unfamiliar with the area (Hochbaum, 1955).

While isolated cases of bird mortality may appear to be alarmingly high - up to 2500 a year at one television tower near Tallahassee (Stoddard and Norris, 1967) - most ornithologists consider bird mortality through collision with towers to be "trivial and unimportant" when compared to other causes of death (Stout, 1967; Mayfield, 1967).

5.8 MITIGATING MEASURES

Emission Control System

The proposed station will be equipped with an emission control system to control discharges of suspended particles, sulfur dioxide, and oxides of nitrogen. This system will be designed to meet New Source Performance Standards that will be promulgated by the EPA under the Clean Air Act.

Cooling Towers

The proposed station will utilize natural-draft cooling towers that will accomplish two mitigation actions. First, use of the towers will reduce thermal discharges to the St. Johns River to negligible amounts. Second, use of cooling towers with an associated closed-cycle cooling system, will reduce water intake volumes from about 1,900 cfs needed for a once-through cooling system to about 25 cfs, a reduction of 98 percent. Entrainment and impingement potential will be reduced a like amount compared to a once-through system.

The cooling towers will be operated to accomplish two additional mitigating affects. First, drift eliminators will be used to reduce drift losses, and attendant potential impacts, to the lowest practicable amount. Second, during cooling water chlorination treatment, blowdown valves will be closed to reduce to minimum amounts the discharge of free available chlorine.

Water Well System

Two Floridan Aquifer wells will be utilized, instead of one, to reduce localized lowering of the Floridan Aquifer. This will prevent potentiometric elevations from being lowered to below mean sea level, and will eliminate the potential for increases in salt-water encroachment.

Central Wastewater Treatment System

A central Wastewater Treatment System will be provided to treat miscellaneous plant wastewater streams to meet effluent quality standards

specified by State and Federal regulations. This will reduce the potential for impacts to the aquatic ecosystem of the receiving stream.

Fugitive Dust Control

Control of nuisance dust will be accomplished by the application of water and/or dust-suppression chemicals when needed.

Sanitary Wastewater Treatment System

A sanitary wastewater treatment system will be provided to meet state regulations.

Intake Structure Design and Siting

The preferred location for the intake structure has been identified based on the consideration of least environmental impacts with respect to land use, river navigation, terrestrial habitat, and aquatic ecological resources. The design of the intake structure will be predicated upon the best available technology with respect to minimizing entrainment and impingement potential.

Site Layout and Landscaping Plan

Clearing of the natural vegetation onsite will be kept to a minimum to reduce impacts to terrestrial communities. This will have two other mitigation effects. First, maintaining a maximum peripheral zone of native vegetation will help to attenuate noise created by the operation of onsite equipment. Second, the vegetated zone will serve as a visual barrier to improve the aesthetic characteristics of the site.

5.9 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Listed below is a brief summary of the adverse environmental impacts expected during operation of Seminole Plant Units No. 1 and No. 2 that cannot be avoided by any practical means. Except as noted, these impacts are considered to be minor or negligible.

1. Air emissions from the plant will use up a portion of available PSD increments, but will not prevent other emission sources from locating in the area. Plant emissions will also raise prevailing ambient concentrations of some pollutants, but not to the harmful levels defined by ambient air quality standards.
2. Escape of fugitive dust from onsite activity.
3. Slight impacts to the aquatic environment from discharge of plant effluent.
4. Minimal impacts are expected to the aquatic environment from impingement and entrainment effects.
5. Minimal lowering of the potentiometric surface of the Floridan Aquifer.
6. Regulated discharge of treated plant wastewaters to the St. Johns River.
7. Consumption of land for station structures and for onsite storage of waste materials.
8. A slight increase in traffic levels on local roads and highways. Some disruption and noise impacts associated with increased rail traffic bringing fuel to the site.
9. Aesthetic impacts from tall structures and possibly the cooling tower plumes.
10. A slight increase in bird mortality caused by collision with station structures.

These unavoidable impacts are discussed in detail in Section 5.1 through 5.7, and proposed mitigating measures to reduce them are discussed in each section with a summary in Section 5.8.

5.10 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Consumption of Fuel

The commitment of coal, and relatively minor amounts of fuel oil, represents an irretrievable commitment of fossil fuel to the project. Coal is an abundant but non-renewable resource. Based on estimated average annual coal consumption, Seminole Plant Units No. 1 and No. 2 are expected to require about 114 million tons of coal in the 35-year life of the plant. The consumption of fuel oil for the purpose of initial light-off and low-load flame stabilization is expected to be 13.5 million gallons over the life of the plant.

Consumptive Use of Water

During plant operation, water is evaporated in the cooling process and from the ash and sludge handling system. The evaporated water remains in the hydrologic system in vapor form until it returns to the earth as precipitation. For the purpose of this discussion, this evaporation loss is defined as the consumptive use of water which is derived from the St. Johns River and the Floridan Aquifer. Average consumptive use, based on a 0.7 load factor, is estimated at about 10,000 gallons per minute. This is equivalent to a total of 184 billion gallons over the life of the plant.

Other Resource Commitments

The proposed station will depend upon air resources for dispersion of heat, particulates, sulfur oxides, nitrogen oxides, and other air pollutants. The station will also depend upon the St. Johns River as the water source and for dispersion of plant effluents. The station will require land area for the main structures and for the disposal of ash and scrubber sludge waste materials. Other resources include land and vegetative and wildlife resources associated with the clearing operations for main plant structures and the waste disposal area.

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6.0

**ECONOMIC AND SOCIAL
EFFECTS OF PLANT OPERATION**

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ECONOMIC AND SOCIAL EFFECTS OF PLANT CONSTRUCTION AND OPERATION

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6.0 ECONOMIC AND SOCIAL EFFECTS OF PLANT CONSTRUCTION AND OPERATION

Construction and operation of the Seminole Plant Units No. 1 and No. 2 will have a variety of effects on residents of the area surrounding the proposed site as well as on people in other parts of the state and region. The purpose of this chapter is to identify to the extent possible the recipients of these effects, and to quantify the project benefits or costs to the groups affected.

Socioeconomic effects are often classified into "direct" and "indirect" effects. Synonymous descriptors are "internal" and "external" effects. Direct, or internal effects are those affecting primarily the owners, operators, and users of the facility; the costs of constructing and operating a generating plant are borne by these groups, and the users are charged a price for the electrical energy they consume. Indirect or external costs and benefits impact on people and interests in the vicinity of the project who, because of their proximity to the site and its activity, experience changes in their local environment -- such as traffic congestion, temporary population increases, increased spending by project personnel, and the like. Many of these effects are difficult to measure, and qualitative judgments often must be made as to the relative values of costs and benefits.

The section is divided into two parts. Section 6.1 deals with direct or internal effects, and consists of an analysis of the monetary values of the power generated and sold. Section 6.2 addresses indirect or external effects, and describes estimated changes in employment, population, income, and the use of private and public services in the site area. Baseline data are drawn from Section 2.10.

For the purpose of the economic analysis, a 30-year operating life for each generating unit was assumed. However, it is recognized that the actual operating life may be longer.

6.1 DIRECT (INTERNAL) ECONOMIC EFFECTS

6.1.1 Direct Benefits: Energy Sales

The principal direct benefits of the Seminole Plant will be those inherent in the uses of the electrical energy by consumers of the several distribution cooperatives purchasing power from Seminole Electric Cooperative, Inc (SECI). As a not-for-profit producer of power, SECI charges rates just sufficient to cover total costs of generation and transmission. It is not possible to measure in dollar terms exactly how much the power (SECI) produces is worth to its consumers. Measurement of value is complicated by the fact that electrical energy per se is of little use to the typical user; it is what the energy does -- to illuminate, create mechanical power, and heat or cool enclosed space, and so forth -- that is useful, and the factors governing the demand for such services depend on a number of things besides the cost of electricity. However, it can be said that a reliable, relatively low-cost source of electrical energy for homes, businesses, industry, and institutional uses is essential to our social and economic welfare in an advanced industrial economy and society.

It is well recognized, moreover, that shortfalls or curtailments in the supply of electric power are the cause of economic and social disruptions, which can range from being mildly annoying or inconveniencing to chaotic. Accordingly, the primary criteria for judging the merits of a proposed steam-electric generating facility are whether reliable alternatives exist and whether the proposed facility is the most economical means of ensuring the additional generating capability.

The arguments for SECI's development of wholly-owned generating capability with the station are presented in Section 1. Most important among these are the greater reliability of supply for the SECI member cooperatives, in the face of increasing siting problems for neighboring utilities with rapidly expanding service requirements of their own

(thereby constraining the future availability to SECI of purchased power), and the economies of SECI's tax-exempt status and accessibility to low-cost capital.

On the basis of past and projected trends in energy demand and sales, SECI is projecting that its members' kilowatt-hour (kwh) requirements will expand between 1976 and 1986 at rate of between 10 and 11 percent per year. Energy consumption by the 11 system members are expected to rise from 3.10 billion kwh in 1976 to 8.46 billion kwh in 1986. Peak system load over the same period is estimated to rise from 802.3 megawatts (MW; 1,000 kilowatts equals one MW) to 2,234.8 MW. All but 14 MW of the 1976 load was borne by neighboring utilities (mainly Florida Power Corporation (FPC) and Florida Power & Light Company (FPL)). In 1975, SECI purchased as tenants in common 14 MW of the 825 MW Crystal River Unit 3, a nuclear unit owned 90 percent by FPC.

With the proposed two 600-MW units in operation by 1986, SECI will be able to carry slightly more than one-half its estimated 1986 system peak load and, assuming a 68 percent capacity factor, supply about 85 percent of its members' energy requirements in that year (7.15 billion kwh out of a total requirement of 8.46 billion kwh), assuming no sales of unit power to other utilities.

6.1.2 Direct Costs

~~Seminole~~ Plant Units No. 1 and No. 2 will involve the expenditure of over \$925 million in capital investment by mid-1985, when Unit No. 2 is planned to commence full commercial operation. Annual operating costs with both units on line will exceed \$300 million, of which fuel costs alone will account for \$180 million, or 60 percent (1986 prices). Capital investment and operating costs include a substantial pollution control component, most of which are incurred by sulfur dioxide (SO₂) and fly ash control systems that remove those substances from the flue gas. Total costs of investment and operation are borne by the owner-cooperatives that comprise SECI. Ultimately, the costs are borne by the purchasers of the power generated, and the prices they pay include the costs of environmental protection measures built into the plant's operation.

Capital Investment Costs

Construction costs for the plant, including land, labor, and equipment, have been projected to total over \$925 million* as follows:

Unit No. 1	\$ 460,000,000 (1983 dollars)
Unit No. 2	<u>465,170,140</u> (1985 dollars)
Total	\$ 925,170,140

*Source: SECI, May 1978

At nominal (nameplate) power ratings of 600,000 kilowatts (KW) per unit, the capital cost of the completed plant is \$771 per KW of generating capability. Pollution control systems are estimated to account for approximately one-fifth of this figure.

Capital cost estimates are based on current (1978) costs of construction and equipment and have been escalated at a six percent annual rate to yield the above total values for each unit. Labor costs of construction will total an estimated \$110 million (Autumn 1979 through Spring 1985, including escalation and fringe benefits).

Fuel Supply Costs

Illinois Basin bituminous coal will fuel the Seminole Plant. Each 600-MW unit will consume approximately 1.5 million tons annually. In 1986, with both units in regular operation (assuming a 68 percent average annual capacity factor) the fuel burn cost is projected at about \$178.6 million (SECI, May 1978). Transportation of the coal will account for at least one-third of the delivered cost of the fuel.

Coal costs are predicted on a 1978 average cost of \$1.60 per million Btu of coal with a heat value of 11,000-12,500 Btu per pound and a plant heat rate of approximately 10,000 Btu per kilowatt-hour generated. Coal prices are projected to escalate six percent annually (SECI, May 1978).

A 75-day average reserve stockpile of coal, or approximately 310,000 tons for each unit, will be maintained, but a storage area capable of 90 days supply is planned. The suppliers of the coal and the details of transporting it to the plant had not yet been determined at the time this report was prepared.

An oil-fueled power plant of equivalent size (1,200 MW) burning residual fuel oil would consume over 11 million barrels of oil per year at a cost of about \$150 million (assuming a cost of \$13 per barrel of oil). Natural gas is not available for new power plants, so no comparison of fuel costs is possible. Initial fuel cycle costs for a 1,200 MW nuclear power plant's first year of full operation would amount to about \$20 to 25 million (including plutonium credit and shipping charges, but excluding waste disposal).

Operating and Maintenance (O&M) Costs

Labor and materials to operate the Seminole Plant (exclusive of fuel and fixed charges) are projected to cost \$16.4 million in 1984, when Unit No. 1 is in full operation, and will rise to \$34.2 million in 1986 with both units in operation. The plant's regular payroll is estimated to number 99 employees in 1983 and 1984, with a total annual wage and salary cost averaging \$2.58 million (1983-84 rates). Unit No. 2 will require an additional 41 employees commencing in 1985, raising the annual labor cost to about \$4.0 million for 140 persons. Wages and salaries are projected to escalate at a five-percent annual rate and are based on current (1978) levels and trends in generating station personnel costs. Labor costs include fringe benefits and employer's contributions, which typically comprise about 30 percent of total labor costs.

Materials and services utilized in operating and maintaining (O&M) the plant comprise about seven-eighths of total O&M costs, with plant labor accounting for the balance. In 1986, with both units in operation, total O&M costs (including labor) are projected at \$34.2 million. Costs are based on current (1978) levels and trends of coal-fired steam generating plant operating costs, and assume a six percent annual rate of escalation.

Other Direct Costs

Other direct costs, which partly are a function of the level of operation of the plant, but also relate to fixed cost elements, include working capital expense, taxes, and insurance. Working capital is

required primarily to maintain the 75-day fuel inventory. During 1984, working capital requirements are estimated at \$2.2 million, rising to \$5.0 million in 1986.

The Seminole Plant will be subject to property taxes on land, structures, equipment, and coal stockpile, and to a gross receipts tax. The basis for assessment of ad valorem property taxes has not been determined and therefore only gross estimates can be made of the additional revenues Putnam County jurisdictions containing the plant site would receive.

A more detailed analysis of potential tax liabilities is presented in Section 6.2.3. From that section, which is based on data from SECI, the Putnam County Appraiser's Office, and State of Florida sources, the following estimates of annual taxes are taken (data are for 1986, the first full year of operation with both units on line):

Estimated Taxes on Seminole Plant, 1986

(in millions of dollars)

Property Taxes, Putnam County	\$ 9.21 million
State Gross Receipts Tax	<u>5.90 million</u>
Total	\$15.11 million

Source: Section 6.2.3

As noted earlier, the tax estimates are not based on actual property valuations, and assume that current assessment ratios and tax ratios will remain constant. In fact, these parameters are likely to vary significantly over time.

Insurance costs are estimated on the basis of capital invested in the plant. A fixed charge rate of between 0.25 percent and 0.35 percent has been projected, which would yield a premium of between \$2.31 and \$3.24 million per year.

Present Value of Direct Costs

The projected total cost of the resources that would be employed in the construction and operation of the Seminole Plant is approximately \$20 billion. This figure is based on present estimates of the costs of labor, fuel, materials, equipment, and capital, all of which could vary significantly. The \$20 billion value is the sum of costs over the period 1979-2015, assuming a six percent average annual rate of cost escalation.

The present value of total capital and operating costs is estimated at \$4.9 billion in 1983 dollars (the year Unit No. 1 is scheduled to commence regular commercial operation). The present worth of projected capital and operating costs was computed using SECI's estimated cost of capital, 8.5 percent.

6.2 INDIRECT (EXTERNAL) SOCIOECONOMIC EFFECTS

Throughout this socioeconomic analysis, the primary impact area of Putnam County will be the major focus. Although there may also be various types of impacts occurring in the secondary impact area consisting of Alachua, Bradford, Clay, Duval, Flagler, Marion, St. Johns, and Volusia counties, the impacts in this secondary impact area are not expected to be nearly as noticeable, if at all, as the impacts occurring in Putnam County. Therefore, unless stated otherwise further discussions of potential impacts will refer to the primary impact area of Putnam County.

6.2.1 Demographic Impacts

The population of Putnam County is expected to experience a slight increase in growth above the medium scenario baseline case of Table 2.9-4 due to the construction and operation activities that are a part of the Seminole project. These population changes will result from two factors. First, construction-phase labor requirements are expected to bring new families into the Putnam County area. Second, operation-phase labor requirements are also expected to attract new families to Putnam County.

Construction-Phase Labor Requirements and Costs

Construction of the Seminole project will require hundreds of workers over a multi-year time period. Table 6.2-1, gives estimates of manpower requirements and a tentative construction schedule. Labor requirements can be disaggregated into two major categories - manual and supervisory. Construction activities are expected to commence in the fourth quarter of 1979, and end by the middle of 1985. From Table 6.2-1, it can be seen that manual labor requirements are expected to reach a peak of 903 workers on an average day during the third quarter of 1982. Supervisory labor requirements are expected to reach a peak of 111 workers on an average day during the second quarter of 1982. Total labor requirements should also peak during the second quarter of 1982, with approximately 1,013 individuals working at the Putnam Site on an average day.

It is not expected that Putnam County will be able to supply all the labor demanded by Seminole construction activities. Therefore, it is expected that some workers will migrate from outside Putnam County and become new County residents. However, it is anticipated that most of the construction workers will commute from the Jacksonville area, which has labor union jurisdiction over the Putnam Site on the west bank of the St. Johns River. It is also possible, however, that some workers may commute from the Gainesville or Daytona Beach areas, which are also sources of skilled labor within 60 miles of the site.

Commuters will not cause any direct increase in the permanent population of the primary impact area of Putnam County. They will, however, have an impact on the daytime population of the area in the vicinity of the site. The permanent population of Putnam County will be affected by relocaters, however, who will be the primary source of population increase in Putnam County during the construction phase activities. Table 6.2-2 presents data for the estimated distribution of manual and supervisory construction phase personnel among commuters, relocaters, and local residents. The data in this table are a key input to the socioeconomic projections presented in this report. It must be stressed that the data presented in Table 6.2-2 represent rough estimates of expected future events, and that no special significance should be attached to any of the point estimates presented in Table 6.2-2. Appendix H-3 discusses the derivation of these data in greater detail.

From Table 6.2-2, Column 12, it can be seen that approximately 65 construction workers are expected to move into Putnam County during 1982, the peak year of construction activity. This figure is relatively small, however, when compared to the anticipated 818 workers who are expected to commute to the Putnam Site on a daily basis.

Population increase in Putnam County due to construction phase activities will not be confined to the migration of construction workers and their families into the county. As these construction workers spend their income, demand for goods and services within Putnam County will

increase. As aggregate demand increases, additional employment will be induced in order to supply the incremental goods and services demanded. It is likely that some of the induced employment increases will result in induced population increases, beyond the direct population increases attributable to the demand for construction manpower. Table 6.2-3 gives an indication of the magnitude of construction phase labor costs. In Section 6.2.2, the data in Table 6.2-3 will become a key element in the formulation of Seminole project income projections. For now, however, it is sufficient to state that there will be both a direct and induced component to population changes during the construction phase.

Operation Phase Labor Requirements and Costs

The first unit of the Seminole project is expected to come on line during the middle of 1983. Table 6.2-4 presents estimates of the number of employees required annually.

As in the case of the construction phase, it is not expected that Putnam County will be able to supply all the labor demanded for operation phase activities. When Seminole Plant Unit No. 1 comes on line in mid-1983, jobs for approximately 99 employees will be created. In mid-1985, when Unit No. 2 comes on line, an additional 41 jobs will be created. It is anticipated that a significant proportion of the operating phase employees hired by SECI will migrate into Putnam County along with their families, leading to a population increase.

Total labor cost for the operation phase is also presented in Table 6.2-4. As operation phase employees spend this income, they will induce more employment in Putnam County. Hence, as in the construction phase, operation phase population increases should induce additional population increases as people move into Putnam County to help supply the additional goods and services demanded by the new operation phase employees and their families.

Population Impacts

Baseline population projections (without consideration of the proposed plant) for Putnam County have been presented in Table 2.9-4. Three scenarios are presented in this table, each reflecting different assumptions concerning the degree of migration into a given county. For Putnam County in the year 1985, the medium scenario baseline population projection is 48,500 people. The low scenario projection is 44,900 people, 8.0 percent below the medium scenario projection. The high scenario projection is 52,200 people, 7.6 percent above the medium scenario. Thus, the baseline population projection for Putnam County in 1985 can be restated as 48,500 plus or minus 8 percent depending upon one's assumptions regarding migration. The "plus or minus 8 percent" represents a range of values in which the actual 1985 population is estimated to fall.

It can be seen from Table 6.2-5, Column 5, that the Putnam County population projection for 1985 is 49,146. This projection reflects the situation expected to occur with the Seminole project. This estimate for 1985 is only 1.3 percent above the baseline medium scenario projection of 48,500, and easily falls within the confidence interval of plus or minus 8 percent for Putnam County in 1985. The implication of this analysis is that the population increase induced by the Seminole project will not be great enough to fall outside the confidence interval for the baseline case.

It can also be seen from Table 6.2-5 that the greatest demographic impact is expected to occur in 1983 when the population of Putnam County with the project is projected to be 48,251, or 1.6 percent above the baseline projection. Considering that the range of values for 1983 baseline projections is on the order of plus or minus 8 percent, it becomes apparent that even in the year of peak demographic impact, the population in Putnam County as a result of the Seminole project will not be significantly different from the population projected for the baseline

case. After construction is completed and both units are in regular operation, the permanent change in the county's population over baseline projections would be 526 persons, or a maximum of one percent of the total county population. Appendix H.4 discusses the methodology used in assessing demographic impacts.

6.2.2 Economic Impacts

Employment Impacts

Putnam County employment will increase due to the Seminole project for two reasons. First, there will be a direct employment increase of workers during construction and operation of the Seminole project. Second, there will be induced employment from increased demand for goods and services in Putnam County.

In Table 2.10-6, employment projections for ten industrial sectors are presented for the years 1980 to 2000. In these baseline employment projections, the finance, insurance, and real estate sector; the transportation, communication, and public utility sector; the government sector, and the construction sector are projected to experience the most rapid rates of employment growth through the year 2000. These same four sectors will probably experience the most significant employment impacts due to the Seminole project. The construction sector will grow due to the direct demand for construction labor during the construction phase. The transportation, communication, and public utility sector will grow due to the direct demand for operating personnel once the Seminole units come on line. The finance, insurance, and real estate sector will grow due to the demand for banking services, insurance, and housing by the relocaters to Putnam County. Finally, depending on the way in which the Putnam County authorities handle the potentially large property tax revenues from the Seminole plant, the government sector could experience significant increases in employment as public services expand due to increased revenue.

Employment increases resulting from Seminole construction and operation phase activities are presented in Table 6.2-6. The peak year of employment impact is expected to be in 1983 when total Putnam County employment is expected to be 3.3 percent above the baseline employment of 16,378. Over the life of the plant, Seminole operation phase activities can be expected to cause an increase in employment of about 2.0 percent above the baseline employment projections. For a detailed discussion of employment projection methodology, refer to Appendix H.5.

Income Impacts

Putnam County income is expected to increase due to the Seminole project for two reasons. First, there will be a direct income increase resulting from the wages paid directly to labor during the construction and operation phases of the Seminole project. Second, there will be an induced component to the income increases. As the Seminole construction and operation phase employees and their dependents spend that income in Putnam County, the demand for goods and services will increase.

Putnam County personal income impacts are presented in Table 6.2-7. Direct and induced personal income impacts due to construction phase activities are presented in Column 3 of this table. Income generated due to construction activities is expected to peak in 1982 at a level of \$9.2 million.

Direct and induced income generated due to operation-phase activities will first appear in 1983 when the first unit begins operation. In 1985, direct and induced operation-phase income will rise to \$4.0 million as the second unit begins operation.

Income impacts are projected to peak in 1982 when the change from the baseline case is expected to be around 2.5 percent. Thereafter, total personal income impact as a percentage of the baseline income projection will decline steadily. By 1987, the income impact due to the Seminole project will have declined to only 0.1 percent of the baseline income projection. For a more detailed discussion of income impact projection methodology, refer to Appendix H.6.

There is another scenario that must be presented in this discussion of income impacts of the Seminole project. Due to uncertainty regarding the way in which Putnam County will handle the increases of property tax revenues, property tax impacts have not been considered in the formulation of demographic, employment, or income impact projections. Up to this point, this analysis has made the implicit assumption that property tax millage rates would be adjusted so that property tax revenues remain essentially constant, in real dollars, after the Seminole project is in the operation phase (implying a large measure of property tax relief to existing property holders).

One could assume, however, that property tax millages will not be changed from the current 1978 levels, and that Putnam County could experience a significant increase in property tax revenue as a result of the Seminole project. (See Section 6.2.3 for a more detailed discussion of property tax impacts.)

Assuming that the 1978 rate of 16.326 mills remains unchanged, approximately \$11.7 million in property taxes would be paid by SECI to Putnam County in 1985. Assuming that the taxing jurisdictions spend this additional tax revenue locally, approximately \$33.1 million in additional income would be generated in Putnam County's economy in 1985 alone, after all induced and multiplier effects are considered. Thus, assuming no change in the tax rate, the total income impact of the project in 1985 would be \$38.2 million as opposed to \$5.1 million as shown in Column 5 of Table 6.2-7. When property taxes are considered, the income impacts of local consumption by construction and operation phase personnel become small in comparison. Whereas the change from the baseline case is about 1.0 percent for 1985 when property taxes are not considered (Column 7 of Table 6.2-7), the change from the baseline income for 1985 becomes 6.4 percent when property taxes are considered.

Thus, it becomes evident that property tax is the key variable in the determination of income impacts resulting from the Seminole project. Since income changes influence employment changes, demographic changes, and the demand for public services, it becomes evident that a wide range of impacts is possible, all depending on how Putnam County handles the property tax issue.

For the remainder of this impact analysis, it will be assumed that property tax revenues and county expenditures will remain relatively constant in real per capita dollars throughout the duration of the Seminole project.

6.2.3 Public Finance Impacts

Construction and operation of the Seminole Plant will generate new tax revenues for several jurisdictions in Putnam County and for the State of Florida. Ad valorem taxes on the land, structures, equipment, and coal stockpile of the plant in the form of real and personal property taxes will be the source of additional revenues for local governments in the County, while the gross receipts tax will be the main source of new state level taxes. As a cooperative, SECI is exempt from state and federal income taxes, but it does pay property and gross receipt taxes. Moreover, the SECI distribution cooperatives pay sales tax on the power sold to ultimate consumers.

No official estimates of the taxes that will be paid by the Seminole Plant are available. The reasons are: (1) the bases for assessing the value of the land, improvements, and fuel supply at the proposed site have not been established by the Putnam County Assessor; (2) the price of the electrical energy to be sold to the member cooperatives has not been firmly estimated; and (3) tax rates for future years cannot be precisely predicted. Accordingly, it is only possible to estimate the general order of magnitude of various tax revenues, which in no way represent forecasts of tax rules and rates that may be in effect in the future.

Property Tax Impacts

It is uncertain how much of the expected capital cost (or other basis) of the Seminole Plant will be assessed for real and personal property taxes in Putnam County, and how much of the assessed valuation will be exempt. Also, the coal stockpile that will be maintained at the plant (a 75-day supply on the average) will be subject to property taxes. If it is assumed that 100 percent of the capital investment cost of the plant is the assessed valuation of the facility and that pollution control facilities are exempt, (such facilities will account for about 20 percent of the total capital cost), then the gross taxable value of the Seminole Plant would be on the order of \$740 million. The net taxable value of the plant would average approximately one-half that figure, since the assessment would have to be on the undepreciated portion of the original capital cost of the plant. Thus, over the 30-year operating lives of each unit (No. 1, 1983 to 2012; No. 2, 1985 to 2014), property taxes on the plant would decrease each year, ceasing in the year 2015. The coal stockpile is also subject to a property tax, but it is assessed for tax purposes at a lower ratio (10 percent) than the plant. (Subsequent to completion of research, it was learned that the assessment ratio for the coal stockpile was reduced to one percent of full value.) In contrast to the plant's assessable value, the coal stockpile's taxable value will rise through the years, assuming cost escalation continues. Thus, the annual property tax on the coal inventory will rise through time until the plant approaches retirement and the fuel reserve is used up.

Table 6.2-8 summarizes the above discussion and supplies estimated values for property tax revenues under the stipulated assumptions. Changes in investment and fuel costs, assessment ratios and millage rates would, of course, materially affect the estimates. The table shows estimated taxable values and taxes at several points in time to illustrate the effects of depreciation (on plant taxes) and fuel price

escalation on tax revenues. Assessment ratios and the millage rate are held constant, which implies that tax authorities in Putnam County would take full advantage of the increase in the county's assessed value resulting from the Seminole project. There is no basis in fact, it is emphasized, to assume that the jurisdictions would necessarily follow this policy. The two units are assumed to enter the tax rolls on January 1, 1983 and 1985, respectively, being exempt from property taxes until the year of their commissioning. Reviewing Table 6.2-8, property tax revenues on the plant would be at a maximum in 1985, amounting to approximately \$11.7 million. Thereafter, they would decline. The values for 1999, the mid-point in time for the plant, represent a rough average. In 2012, Unit No. 1 is completing its final year of operation, Unit No. 2 has two more years, and the coal stockpile has reached its highest value. In 2013 and 2014 the stockpile is needed for only one unit, and will be used up in the final year. On the basis of the above assumptions, total real and personal property taxes that would accrue to Putnam County jurisdiction from the Seminole Plant would aggregate to \$191.4 million over the 32-year period of 1983-2014.

Referring to the Baseline Section of the report that deals with Public Financing (specifically, subsection "Property Taxes"), it was noted that the assessed value of non-exempt real and personal property in Putnam County in 1976 amounted to \$350.9 million (Table 2.10-17). Over the period 1972-1976, non-exempt assessed values had nearly doubled, with year-to-year changes on the order of 15 to 20 percent. If these rates of increase continue for the decade 1976-1985, non-exempt assessed values could be on the order of \$1.4 billion to \$2.2 billion by the mid-1980's. If it is assumed that the Seminole Plant is incremental to this trend, then its inclusion on the property tax bases would expand the rolls in, say, 1985 by one-third to one-half, a very substantial increase. To the extent that trends in assessed values were lower or

higher than hypothesized above, the contribution of the Seminole Plant to the county's tax base would vary inversely. But the increment would still be very significant in real terms, and likely to offset by several times whatever increases in costs of public services that had occurred as a result of project-induced increases in local population.

According to information from the Putnam County Property Appraiser, the tax rate on the Seminole Plant site land in 1977 was 16.458 mills:

<u>Jurisdiction</u>	<u>Amount</u>	<u>Percent</u>
County	8.250 mills	50.1%
School District	8.070 mills	49.0%
St. Johns River Water Management District	<u>0.138 mills</u>	<u>0.9%</u>
	16.458 mills	100.0%

Source: Putnam County Property Appraiser, 1977.

The Putnam County School District's share, 49 percent, produced revenues projected at \$3.3 million (Section 2.10, Table 2.10-21), which amounted to 26 percent of the District's total revenues. Assuming that in 1985 the District has the same share of the total property tax levy (assumed to be the same as in 1978: 16.326 mills), the Seminole plant's property taxes would yield about \$5.7 million to the school system. The balance of \$6.0 million (Table 6.2-8) would go to the County, with a small proportion accruing to the St. Johns River Water Management District.

Population impacts of the construction and operating phases of the Seminole project have been estimated in Section 6.2.1. The numbers of school-age dependents of immigrating personnel will reach a maximum of 250 in 1983, and decline to a long-term increment of 175 by 1986 (Section 6.2.4). As is evident, their numbers are relatively small in comparison to the potential increase in the school district's financial resources and thus its ability to provide for their classroom and instructional requirements.

It should be noted that the project-induced increases in demand for various public services during the construction phase precede the placement on the tax rolls of the assessed value of the plant. As a result, a cash flow problem of a short-term nature may develop for agencies dealing with transient and relocated personnel and traffic. Ultimately, their budgets will reflect the increase in the county's tax base, but in the interim, advance planning will be necessary to anticipate changes in service level requirements. Planners will benefit from a continuing dialogue with Seminole project management with respect to the timing and magnitude of construction activities. Impacts of the project on local government service loads are likely to be small and localized, as will be discussed in some greater detail in Section 6.2.4 and 6.2.5.

Other Tax Impacts

The principal "other" tax that the Seminole Plant will generate is a gross receipts tax, paid to the State. This tax is a 1.5 percent levy on the gross revenues from sales of SECI-generated power to member cooperatives and other utilities. Estimates of this tax's yield are uncertain due to the preliminary nature of generating cost estimates and the possibility that the tax rate might change. Seminole estimates that it would charge 46.2 mills per kilowatt-hour in 1983 for power sold from Unit No. 1. The units are planned to operate at a 68 percent capacity factor, which translated into a gross output per year for each 600-MW unit of 3,574.08 million kilowatt-hours. At 46.2 mills per kwh, the two units combined would produce 7,148.16 million kwh per year worth \$330.24 million. The gross receipts tax, at 1.5 percent, would yield \$4.95 million.

SECI has projected that costs of power generation will escalate at a six percent average annual rate. Assuming the rates charged for power rise at the same rate, over the 32 years the two units are in operation a total of \$28.42 billion in gross revenues would accrue to SECI, upon which the 1.5 percent gross receipts tax would yield \$426.3

million. The state charges a sales tax on sales of electric power. SECI is not liable to this sales tax, however, because it sells all of its power at wholesale to other cooperatives and utilities. Those latter entities, selling to ultimate users, will include a retail sales tax levy. The yield of that tax cannot be estimated, as the rates charged for power vary from utility to utility with respect to different customer groups.

Indirectly, the state will derive tax revenues from the Seminole project. The multiplier effect on local incomes of purchases made by project personnel during construction and operation will have a retail trade component also, which will generate sales and gasoline taxes on local spending. The amounts of these taxes arising indirectly cannot be estimated with precision. But if it is assumed that 50 percent of local consumption expenditures made in Putnam County are for taxable goods and services, then the income arising from the Seminole project would generate in its peak construction year, 1983, about \$5 million in taxable sales (Table 6.2-7, Column 5, multiplied by 0.5), upon which the State 4 percent sales tax would yield \$0.2 million. This may be compared to the \$5.2 million in sales taxes collected in Putnam County in 1976.

The State gasoline tax of 8 cents per gallon yielded \$1.9 million on sales in Putnam County in 1976 (Section 2.10.6). During construction (1979-1985) commuting workers from outside Putnam County -- who comprise the majority of the work force -- will purchase some of their fuel requirements within the County. From the projections of employment impacts (Section 6.2.2) and traffic impacts (Section 4.6.1), the estimate of 330 cars per day carrying commuting workers to and from the site during the peak commuting year of 1982 (assuming three workers per car) has been developed. Assuming each car uses 20 gallons of gasoline per week on the average, the 8 cent tax would yield \$83.20 per car per year. With an average of 330 cars used for commuting in the peak years, total gasoline usage would amount to 351,000 gallons per year, yielding a gasoline tax revenue of \$28 thousand. One-half of that amount probably would accrue to Putnam County.

6.2.4 Public Service Impacts

Housing

As construction and operation phase personnel relocate to Putnam County the demand for housing, both direct and induced, will increase. From Table 6.2-5, during 1983, the peak year of demographic impact, approximately 751 people will relocate to Putnam County. Assuming an average size of 3 persons per household, approximately 250 additional dwelling units will be required in Putnam County due to the Seminole project.

In Section 2.10.3, in 1976, there were approximately 1,567 standard dwelling units available for occupancy in Putnam County. Assuming that this figure would remain relatively constant in the baseline case, it does not appear that the Seminole project will cause any severe pressure on availability of housing in Putnam County. Increased upward pressure on real estate values, however, is a possibility.

Education

In Section 6.2.4, it was estimated that approximately 250 new households will migrate to Putnam County during 1983, the peak year of demographic impact. Assuming one school-age individual for each household, approximately 250 additional students can be expected to enroll in the entire Putnam County School District during 1983, the peak year of demographic impact.

From Table 2.10-14, the total student capacity in the Putnam County School District during the academic year 1977-1978 was 11,952. From Table 2.10-15, it can be seen that the projected total enrollment in the Putnam County School District for the academic year 1981-1982 is 10,333 students. Assuming this enrollment is a reasonable estimate of the baseline situation in 1983, it follows that the estimated enrollment with the addition of students from Seminole families would be around 10,583 students for 1983. This enrollment is substantially lower than the capacity of 11,952 students; thus it does not appear that the Seminole project will place any undue burden on the Putnam County School District.

Medical Facilities

In Section 2.10.4, a major new medical facility, the Putnam Community Hospital, began receiving patients on September 1, 1975. This section also indicates that the 1977 occupancy rate at Putnam Community Hospital was 80 percent. Given that the population in Putnam County is only expected to increase by 1.6 percent over baseline during 1983, the peak year of demographic impact, it does not appear the Seminole project will have any major adverse impact on the quality or quantity of medical services offered in Putnam County.

Fire Fighting Facilities

In Section 2.10.4, Putnam County had 327 firefighters in 1976, or 7.5 firefighters per 1000 population. Assuming no change in the number of firemen, inclusion of the project-induced population changes would reduce the ratio of firemen to 7.3 per 1000 population by 1983. This ratio still compares favorably with the general minimum standards of 2.4 firefighters per 1000 of population. Thus, it appears that the Seminole project will have no major adverse impact on the demand for firefighting services in Putnam County.

Additionally, SECI plans to contact the Palatka Fire Department to insure that communication channels can be established to provide prompt response to any fires that may occur during construction activities, and to insure that adequate equipment and personnel are available to fight major fires.

SECI also plans to locate hand fire extinguishers throughout the construction site to provide an immediate response to incipient fires. A fire brigade will be formed and trained in the use of the equipment located on the site (Section 3.9).

For fire protection during the operation phase of the Seminole project, one 300,000 gallon storage tank will be installed at the site. This tank will supply approximately three hours of water supply

for fire fighting purposes. Additionally, one diesel-powered fire pump will be installed near the storage tank. This pump will have its own fuel oil storage tank and battery-powered electric starting system. Finally, an underground fire loop will be installed with about four fire hydrants located throughout the site.

Police Protection

Section 2.10.4 reported that Putnam County had 129 law enforcement officers in 1975, giving a ratio of 2.95 police officers per 1000 population. Assuming no change in the number of policemen, this ratio will change to 2.67 policemen per 1000 of population by 1983. This ratio compares favorably with recognized law enforcement standards which indicate that 1.75 to 2.00 officers are generally required per 1000 persons living within the area to be served. Therefore, it appears that the Seminole project will have no major adverse impact on the demand for police services in Putnam County.

Recreation

There is an abundance of recreational opportunities in Putnam County due to its close proximity to rivers, lakes, national forests, and the ocean. Given that population in Putnam County is expected to increase by only 1.6 percent above baseline in 1983, it is estimated that the demand for recreational activities will increase by a similar 1.6 percent. Thus, no major adverse impact on the supply of recreational opportunities is expected to occur as a result of the Seminole project.

6.2.5 Public Utility Impacts

Electricity

Putnam County receives electric power from the Clay Electric Cooperative, a member of SECI, and from FP&L. In view of the fact that SECI plans to install 1,200 megawatts of generating capacity in Putnam County by 1985, and that FP&L has recently installed 500 megawatts of generating capacity in East Palatka, it does not appear that Putnam County will experience any shortages of electricity as a result of the Seminole project.

Natural Gas

Although the City of Palatka receives natural gas from the Palatka Gas Authority, the rural areas of Putnam County are not served by any natural gas pipelines. The demand for natural gas in the City of Palatka as a result of the Seminole project is not expected to be measureable.

Water Supply

Section 2.10.5, reported that Putnam County does not presently provide water supply services within the county. Various incorporated municipalities, however, do supply water within their jurisdictions. Many residents of Putnam County, therefore, must rely on wells for water. The Seminole project will not cause a great increase in the household demand for water in Putnam County.

Sewage Treatment

Section 2.10.5 stated that Putnam County does not presently provide sewer services to county residents. The City of Palatka does, however, have a sewer system, which in 1976 had an 85.7 percent utilization rate. Population growth in Palatka due to the Seminole project can be expected to increase the utilization of the Palatka sewer system by one or two percent. Therefore, the Seminole project is not expected to have any major adverse impact on the Palatka sewer system.

Solid Waste Disposal

Section 2.10.5 stated that Putnam County provides no door-to-door collection services for solid waste. As a result of the lack of an extensive collection system, widespread roadside dumping has been a problem. Population increase due to the Seminole project could exacerbate this dumping problem.

Table 6.2-1

Seminole Construction-Phase Labor Requirements
(Average monthly employment per quarter)

<u>Quarter/Year</u>	<u>Manual Labor</u>	<u>Supervisory Labor</u>	<u>Total Labor Force</u>
4-1979	55	8	63
1-1980	165	24	189
2-1980	211	31	242
3-1980	261	39	300
4-1980	288	50	338
1-1981	365	53	409
2-1981	496	68	564
3-1981	666	81	747
4-1981	766	91	857
1-1982	901	107	1,008
2-1982	902	111	1,013
3-1982	903	100	1,003
4-1982	776	98	874
1-1983	558	81	639
2-1983	670	91	761
3-1983	677	85	762
4-1983	744	88	832
1-1984	739	92	831
2-1984	723	92	815
3-1984	630	75	705
4-1984	462	70	532
1-1985	161	46	207
2-1985	154	33	187
Total Man-Months	36,792	4,842	41,634

Source: Burns and Roe, Inc., April 24, 1978.

Notes:

Average monthly employment per quarter represents the average number of employees employed each month during any given quarter. A quarter consists of three months.

Manual labor includes all union craft labor.

Supervisory labor includes contractor supervisory and administrative personnel and construction management personnel.

Total man-months is calculated by multiplying average monthly employment per quarter times three months per quarter.

This table assumes that each laborer works a full man-month each month.

A man-month is equivalent to one laborer working 173.3 hours per month.

Table 6.2-2

Commuter Composition of Seminole Construction Labor Force
(Number of Laborers)

Year (1)	MANUAL LABOR				SUPERVISORY LABOR				ALL LABOR			
	Average Monthly Employment (2)	Commuters (3)	Relocaters (4)	Local Residents (5)	Average Monthly Employment (6)	Commuters (7)	Relocaters (8)	Local Residents (9)	Average Monthly Employment (10)	Commuters (11)	Relocaters (12)	Local Residents (13)
1979	55	47	3	5	8	6	2	0	63	53	5	5
1980	231	196	12	23	36	27	7	2	267	223	19	25
1981	571	485	29	57	73	55	14	4	644	540	43	61
1982	871	740	44	87	104	78	21	5	975	818	65	92
1983	662	563	33	66	86	65	17	4	748	628	50	70
1984	639	543	32	64	82	62	16	4	721	605	48	68
1985	157	134	8	15	40	30	8	2	197	164	16	17

Source: Burns and Roe, Inc., April 24, 1978, and Dames & Moore, June 1978.

Notes:

All figures on this table are estimates that represent one possible scenario for the commuter composition of the Seminole construction labor force. No special significant should be assigned to any of the individual point estimates.

A commuter is a worker who commutes daily from outside Putnam County to the site inside Putnam County. A weekly commuter is considered to be a relocater. In this table, the "commuter" column gives the average number of commuting employees who are commuters each month. thus, the sum of commuters, relocaters, and local residents for manual labor equals the average monthly employment in any given year.

A relocater is a worker who has moved into Putnam County from outside Putnam County, or who is a weekly commuter. The "local resident" column gives the average number of these employed each month.

A local resident is a worker who has a permanent domicile in Putnam County for the duration of the Seminole project. The "local resident" column gives the average number of local residents employed each month.

See Appendix H.3 for a discussion of the assumptions used in the preparation of this table.

Table 6.2-3

Seminole Construction-Phase Labor Costs
(Thousands of Dollars)

<u>Quarter</u>	<u>Manual Labor</u>	<u>Supervisory Labor</u>	<u>Total Labor Cost</u>
4-1979	\$ 271.9	\$ 49.8	\$ 321.7
1-1980	829.8	149.5	979.3
2-1980	1,226.7	209.1	1,435.8
3-1980	1,573.3	263.1	1,836.4
4-1980	1,825.4	337.4	2,162.8
1-1981	2,366.8	357.6	2,724.4
2-1981	3,707.4	494.0	4,201.4
3-1981	5,031.7	588.5	5,620.2
4-1981	5,713.5	661.2	6,374.7
1-1982	6,627.5	777.5	7,405.0
2-1982	7,093.5	864.1	7,957.6
3-1982	7,096.8	778.5	7,875.3
4-1982	6,218.6	762.9	6,981.5
1-1983	4,273.3	630.6	4,903.9
2-1983	5,557.3	755.6	6,312.9
3-1983	5,769.4	705.8	6,475.2
4-1983	6,306.5	730.7	7,037.2
1-1984	6,384.9	764.0	7,148.9
2-1984	6,656.3	811.7	7,468.0
3-1984	5,826.3	661.7	6,488.0
4-1984	4,293.9	617.6	4,911.5
1-1985	1,392.2	405.9	1,798.1
2-1985	1,330.4	291.1	1,621.5
Total	\$97,373.4	\$12,667.9	\$110,041.3

Source: Burns and Roe, Inc., April 24, 1978.

Notes:

Construction labor costs represent total wage package rates, including union fringe benefits and travel allowances for manual labor, and complete payroll wage rates, excluding non-payroll mark-ups, for supervisory labor.

Labor costs are escalated to the period designated through the use of past and present union wage agreements for manual labor, and historical data for supervisory labor.

Table 6.2-4

Seminole Operation Phase
Labor Requirements and Costs

<u>Year</u> (1)	<u>Number of Employees</u> (2)	<u>Labor Cost</u> <u>(Million Dollars)</u> (3)
1983	99	2.52
1984	99	2.64
1985	140	3.93
1986	140	4.13
1987	140	4.33
1988	140	4.55
1989	140	4.78
1990	140	5.02
1991	140	5.27
1992	140	5.53
1993	140	5.81
1994	140	6.10
1995	140	6.40
1996	140	6.72
1997	140	7.06
1998	140	7.41
1999	140	7.78
2000	140	8.17
2001	140	8.57
2002	140	9.00
2003	140	9.46
2004	140	9.93
2005	140	10.42
2006	140	10.95
2007	140	11.50
2008	140	12.07
2009	140	12.67
2010	140	13.31
2011	140	13.97
2012	140	14.67

Source: Seminole Electric Cooperative, Inc.,
May 2, 1978, and Dames & Moore, June 1978.

Notes:

Labor costs have been escalated at 5 percent per year.

Unit No. 1 will begin commercial operation in June 1983.

Unit No. 2 will begin commercial operation in June 1985.

Table 6.2-5

Seminole Construction and Operation Phase Demographic Impacts

Year (1)	Putnam County Baseline Population Projections (Medium Scenario) (2)	Incremental Population Change Due to Seminole Project (3)	Aggregate Population Change Due to Seminole Project (4)	Putnam County Seminole Project Population Projections (Medium Scenario) (5)	Percent Increase From Baseline Case (6)
1978	44,400	0	0	44,400	0.0
1979	45,200	38	38	45,238	0.1
1980	46,000	105	143	46,143	0.3
1981	46,500	180	323	46,823	0.7
1982	47,000	165	488	47,488	1.0
1983	47,500	263	751	48,251	1.6
1984	48,000	-15	736	48,736	1.5
1985	48,500	-90	646	49,146	1.3
1986	49,600	-120	526	50,126	1.1
1987	50,700	0	526	51,226	1.0
1988	51,800	0	526	52,236	1.0
1989	52,900	0	526	53,426	1.0
1990	54,000	0	526	54,526	1.0
1995	58,200	0	526	58,726	0.9
2000	62,500	0	526	63,026	0.8
2005	66,400	0	526	66,926	0.8
2010	70,300	0	526	70,826	0.7
2015	74,250	0	526	74,776	0.7

Source: University of Florida, Bureau of Economic and Business Research, July 1977, 1978-2020 Projections of Population by County, and Dames & Moore, June 1978.

Notes:

The Putnam County Baseline Population Projections (Medium Scenario) in this table are identical to the medium scenario projections of Table 2.1.9-4. Baseline Population Projections. Interpolation was used to calculate figures for years not ending in a zero or a five.

The incremental population change due to the Seminole project (Column 3) represents the number of people expected to move into or out of Putnam County each year due to the Seminole project.

Aggregate population change due to the Seminole project (Column 4) represents the sum of all incremental population changes due to the Seminole project from 1978 to the given year.

The Putnam County Seminole Project Population Projection (Column 5) represents the sum of the baseline projection and the aggregate population change due to the Seminole project for any given year.

For a more detailed discussion of the demographic impact methodology utilized, refer to Appendix H.6.

Table 6.2-6

Seminole Construction and Operation Phase Employment Impacts

Year (1)	Putnam County Baseline Employment Projections (2)	Incremental Employment Change Due to Seminole Project (3)	Aggregate Employment Change Due to Seminole Project (4)	Putnam County Seminole Project Employment Projections (5)	Percent Increase From Baseline Case (6)
1978	14,958	0	0	14,958	0.0
1979	15,284	26	26	15,310	0.2
1980	15,610	89	115	15,725	0.7
1981	15,866	157	272	16,138	1.7
1982	16,122	139	411	16,533	2.5
1983	16,378	132	543	16,921	3.3
1984	16,634	-11	532	17,166	3.2
1985	16,890	-122	410	17,300	2.4
1986	17,082	0	410	17,492	2.4
1987	17,274	0	410	17,684	2.4
1988	17,465	0	410	17,875	2.4
1989	17,657	0	410	18,067	2.3
1990	17,849	0	410	18,259	2.3
1995	19,081	0	410	19,491	2.2
2000	20,347	0	410	20,757	2.0

Source: Jacksonville Area Planning Board, June 1976B, Regional Employment Study; Bureau of the Census, 1970, U. S. Census of Population; Burns and Roe, Inc., April 24, 1978; Seminole Electric Cooperative, Inc. May 2, 1978; U. S. Water Resources Council, January 1977, Guideline 5, Regional Multipliers; and Dames & Moore, June 1978.

Notes:

The Putnam County Baseline Employment Projections of Column 2 come from Table 2.1.10-6. Interpolation was used to formulate baseline projections for years not ending in a zero or five.

The incremental employment change due to the Seminole project, and the aggregate employment change due to the Seminole project refer to direct and induced employment changes. For a discussion of derivation of the data in Columns 3 and 4 of Table 6.2-6, refer to Appendix H.5.

Putnam County Seminole Project Employment Projections of Column 5 in Table 6.2-6 were calculated by summing the baseline projections of Column 2 and the aggregate employment changes of Column 4.

Table 6.2-7

Seminole Construction and Operation Phase Income Impacts
(in millions of nominal dollars)

Year (1)	Putnam County Baseline Personal Income Projection (2)	Personal Income Impact due to Construction Phase (3)	Personal Income Impact due to Operation Phase (4)	Total Personal Income Impact (5)	Putnam County Seminole Project Personal Income Projection (6)	Percent Change from Baseline Case (7)
1978	247.2	0.0		0.0	247.2	0.0
1979	275.9	0.1		0.1	276.0	0.0
1980	308.3	2.0		2.0	310.3	0.1
1981	339.3	5.8		5.8	345.1	1.7
1982	373.8	9.2		9.2	383.0	2.5
1983	412.0	7.6	2.6	10.2	422.2	2.5
1984	453.6	7.9	2.7	10.6	464.2	2.3
1985	499.6	1.1	4.0	5.1	504.7	1.0
1986	550.0		4.2	4.2	554.2	0.8
1987	605.8		4.4	4.4	610.2	0.1
1988	667.3		4.6	4.6	671.9	0.1
1989	734.8		4.9	4.9	739.7	0.1
1990	809.4		5.1	5.1	814.5	0.1
1995	1,298.9		6.5	6.5	1,305.4	0.1
2000	2,084.1		8.3	8.3	2,092.4	0.0
2005	3,296.5		10.6	10.6	3,307.1	0.0
2010	5,213.5		13.6	13.6	5,227.1	0.0

Source: Burns and Roe, Inc., April 24, 1978; Council of Economic Advisors, May 1978, Economic Indicators, Washington, D.C.; Florida Dept. of Commerce, April 1977, Putnam County Economic Data; Jim Roach, June 2, 1978, Florida Power & Light Co., personal communication; Seminole Electric Cooperative, Inc., May 2, 1978; U. S. Corps of Engineers, December 1975, Projections of Economic Activity in Florida, Series E Population; U. S. Water Resources Council, January 1977, Guideline 5, Regional Multipliers, Washington, D.C.; and Dames & Moore, June 1978.

Notes:

The personal income impacts of Columns 3, 4, and 5 include direct and induced income changes.

For a more detailed explanation of the methodology used, refer to Appendix H.6.

Table 6.2-8

Hypothetical Putnam County Property Taxes from Seminole Plant
(in millions of dollars)

	<u>1983</u>	<u>1985</u>	<u>1999</u>	<u>2012</u>
Unit 1 -- Net Assessed Value ¹	\$368.0	\$368.0	\$368.0	\$368.0
less accumulated depreciation ²	0.0	24.5	196.3	355.7
Net taxable value	<u>\$368.0</u>	<u>\$343.5</u>	<u>\$171.7</u>	<u>\$ 12.3</u>
Unit 2 -- Net Assessed Value ³	\$ 0.0	\$372.1	\$372.1	\$372.1
less accumulated depreciation ²	0.0	0.0	173.6	334.9
Net taxable value	<u>\$ 0.0</u>	<u>\$372.1</u>	<u>\$198.5</u>	<u>\$ 37.2</u>
Coal Stockpile (@10%) ⁴	<u>\$ 1.5</u>	<u>\$ 3.4</u>	<u>\$ 7.7</u>	<u>\$ 16.4</u>
Total Taxable Value	\$369.5	\$719.0	\$377.9	\$ 65.9
Total Putnam County Tax (@16.326 mills) ⁵	\$ 6.0	\$ 11.7	\$ 6.2	\$ 1.1
Total Taxes, 1983-2014	\$191.4			

¹\$460,000,000 less 20% for exempt pollution control facilities. Assumes property enters tax rolls January 1, 1983.

²Straightline over 30 years. Unit 1 AV declines at \$12.3 million per year, Unit 2 @\$12.4 million per year.

³\$465,170,400 less 20%, commencing January 1, 1985.

⁴Stockpile valuation based on estimated cost of coal (delivered) of \$1.60 per million BTU (1978) for 75-day inventory with each unit burning 1.5 million tons per year of 12,000 BTU/lb. coal. Coal costs escalated to 1986 at 5.3% annually and 6.0% thereafter.

⁵1978 millage rate, real and personal property.

Source: Appendix H, Table H-7.

7.0

**RELATIONSHIP BETWEEN
LOCAL SHORT-TERM USES
OF MAN'S ENVIRONMENT AND
THE MAINTENANCE AND
ENHANCEMENT OF LONG-TERM
PRODUCTIVITY**

SAJOD-RP
Mr. David L. Lester

22 June 1978

If you have any questions regarding the content of this letter, please do not hesitate to contact us.

Sincerely yours,

Gail G. Gren

GAIL G. GREN
Chief, Operations Division

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RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

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7.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.1 LAND USE

7.1.1 Long-Term Pre-Emptive Use of Land

Seminole Plant Units No. 1 and No. 2 will be constructed on a site comprising about 2,000 acres in Putnam County, Florida. Although about 65 percent of this area will be left in its present state, the site in its entirety will be unavailable for other uses during both the construction and operating phases of the plant's life, or for approximately 40 years. Upon retirement, only the area of the sludge and ash disposal, or about 270 acres (Figure 3.1-1) might not be suitable for any useful purpose depending on the ultimate characteristics of the waste material.

Therefore, the proposed project would, at worst, place some long-term restrictions on development of approximately 270 acres of land. The balance of the land could be reclaimed for other uses after retirement.

7.1.2 Regional Significance of Pre-Empted Land

The 2,000-acre site required by Seminole Plant Units No. 1 and No. 2 represent approximately 0.008 percent of SECI's service territory and 0.4 percent of the land area of Putnam County. Nearly 65 percent of Putnam County is forested, and 5 percent is urban. Therefore, developed pre-emptive land use by the plant is not expected to have any measurable effect on land availability or use in Putnam County.

7.2 WATER USE

7.2.1 Use of Ground Water

During construction of Seminole Plant Units No. 1 and No. 2 an average of 0.034 million gallons per day (mgd) will be drawn from the Floridan Aquifer. When both units are operating at full capacity, approximately 0.6 mgd will be drawn from the same aquifer. This represents a 2.1 percent increase in ground water use in Putnam County based on 1970 estimates of withdrawal (Section 2.11.2).

Ground water use by the plant is estimated to have only a slight effect on nearby wells (a maximum 2.5-foot drawdown at the nearest well; Well D-1, a residential well; Appendix D.6) tapping the same aquifer. This effect is estimated to be felt only during the life of the station, and no permanent change in the aquifer is expected.

7.2.2 Use of Surface Water

Operating at full capacity, Seminole Plant Units No. 1 and No. 2 will withdraw about 15.8 mgd from the St. Johns River. Of this, about 13.4 mgd will be consumed by the cooling process (evaporation and drift) and other plant losses, and about 2.4 mgd will be returned to the St. Johns River.

The maximum consumptive loss of surface water, depending on the final station process selection and design, assuming the station operates at full capacity, will be about 21.0 mgd or 32 cubic feet per second (cfs). This compares to a calculated mean discharge of the St. Johns River of 7,613 cfs. Therefore, the consumptive losses will, at most, be less than one-half of one percent of the river flow. This use will extend over the operating life of the station, and no permanent effects of such use are expected.

7.3 AIR USE

7.3.1 Air Quality Performance of the Proposed Plant

As discussed in Section 5.1.2.2, computer modeling indicates that plant operation will result in an impact on air quality in the site area. For example, at full operating capacity, up to 85 percent of the allowable 3-hour Class II Prevention of Significant Deterioration (PSD) increment for SO_2 may be used up. However, this percentage consumption would apply only to a small geographical area. At other points and for other averaging times, a much lower percentage of Class II increments should be consumed based on modeling results. Modeling results also indicate that no ambient air quality standards should be threatened as a result of plant operation.

7.3.2 Regional Significance of Air Use

The plant's pre-empting a percentage of PSD Class II increments could have some effect on future industrial growth in the region. However, it is not expected that Seminole would consume a major portion of any increment (more than 50 percent) except within a small area less than 2 km from the Putnam Site for short-term concentrations of SO_2 alone. Therefore, the only industrial emission sources which could be significantly affected are those which would emit SO_2 and which would be located at points where they could interact with Seminole during the specific meteorological conditions which produce highest ground-level SO_2 concentrations attributable to Seminole.

Also of regional significance are impacts on nearest nonattainment and PSD Class I areas. Modeling results indicate that Seminole should have an insignificant effect (using EPA definitions of significance) on the Jacksonville particulate matter nonattainment area and on the Okefenokee National Wilderness PSD Class I area.

7.4 ENERGY USE

7.4.1 Coal Consumption

At average operation, Seminole Plant Units No. 1 and No. 2 will consume above 8,940 tons of coal per day, or about 114 million tons of coal over the 35-year operating life of the station.

7.4.2 Regional Significance of Coal Consumed

Completion of the proposed station will make 1,200 MW of electric power available to the citizens of Florida. SECI will have at its disposal a significant amount of independent generating capacity, and may at times have the option of providing power to other utilities, thus improving its own economic position and enabling it to provide electric service to its consumers at lower rates.

7.5 CONCLUSION

In summary, the construction and operation of Seminole Plant Units No. 1 and No. 2 are expected to:

1. Temporarily pre-empt a very small portion of the available land in the region;
2. Have very little temporary effect on ground water and surface water use in the site area;
3. Have an effect on regional air quality, but within statutory limits;
4. Consume about 114 million tons of coal over the operating life of the station; and
5. Produce about 250 billion kilowatt-hours of electrical energy over the operating life of the plant.

In view of the developing nature of the area, even at the lowest of SECI's load-growth projections, the project's relatively sparing use of water and air resources and the fact that the fuel use estimates are based on both lower-quality coal and base-load operation, the project appears defensible.

Further, the area is in need of additional electrical energy to support its continuing growth. Since the additional generating capacity under consideration is conservative (smaller than the load-growth estimates), the project appears to demonstrate a positive relationship between short-term use of environment and resources and maintenance and enhancement of long-term productivity.

8.0

**REGULATORY COMPLIANCE
MONITORING PROGRAM**

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REGULATORY COMPLIANCE MONITORING PROGRAM

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8.0 REGULATORY COMPLIANCE MONITORING PROGRAM

The purpose of an environmental monitoring program is to ensure compliance with applicable State and Federal regulations during the construction and operation of the project. Plans for the program have not yet been developed in detail. The scope of the monitoring program will be coordinated with regulatory agencies and will reflect regulatory requirements at the time the permits are issued. Compliance monitoring requirements will be included as conditions of the permits.

This section identifies expected requirements and describes a general monitoring approach that will eventually be shaped into a specific monitoring plan. This section includes (1) monitoring during construction, (2) monitoring during station operation, and (3) a management plan to assure compliance activities are carried out responsibly.

8.1 CONSTRUCTION MONITORING

This phase of the environmental monitoring program is directed to regulatory compliance measures relative to construction activities.

8.1.1 Dredging

As discussed in Section 4.4, impacts to the aquatic ecosystem from dredging activities should be minimal. Because of the short one to two week dredging period, upland disposal of spoil, and techniques available to control suspended sediments, monitoring should be limited to site surveillance to assure controls are being applied as required.

8.1.2 Construction Runoff

As explained in Section 3.1.2, a system of drainage ditches or swales will be provided throughout the cleared area for the main station structures. These ditches will be designed to carry off excess water from large precipitation events. As shown in Figure 3.1-4, water carried by the drainage system will enter onsite lowlands and will not discharge offsite. Therefore, no monitoring will be required.

8.1.3 Ground Water

The ground water monitoring program begun in November 1977 will be continued during construction to document changes in ground water quality caused by construction to enhance the data base from which operational effects will be measured. Monitor wells described in Appendix D (Figure D-1) will be used during the construction and operational periods unless construction activities destroy one or more of them. If this occurs, new wells will be constructed in appropriate locations.

On a quarterly schedule, water levels, specific conductance, temperature, and pH will be measured. After construction begins, on a semi-annual basis, a complete chemical analyses will be made on samples from each well. The parameters to be included should be similar to that of the sampling program carried out from November 1977 through April 1978 (Appendix D.5).

8.2 OPERATIONAL MONITORING

8.2.1 Air Quality Monitoring

Operational monitoring activities will take into consideration the latest monitoring guidelines and the existence of other monitoring stations in the area of the Putnam Site. This section contains conceptual monitoring description divided into two sections; stack monitoring and ambient air quality monitoring. The stack monitoring section is more detailed than the ambient monitoring section since stack monitoring requirements and procedures are standardized.

Stack Monitoring

Federal New Source Performance Standards for fossil fuel-fired steam generators (40 CFR 60.45) prescribe stack monitoring requirements. For coal-fired generators, continuous sulfur dioxide (SO_2) monitoring is necessary if a flue gas desulfurization system is used to meet emission standards. A system of continuous nitrogen oxides (NO_x) monitoring is required if initial performance tests show that NO_x emissions are greater than 70 percent of the emission standard. Finally, if either continuous SO_2 or NO_x monitoring is necessary, then either continuous carbon dioxide (CO_2) or oxygen (O_2) measurements are also necessary.

In-stack opacity monitoring is also normally required for coal-fired generators. In the case of the Seminole Station, however, the exhaust gases will be saturated after leaving the flue gas desulfurization system. Since no re-heat will be applied, water vapor condensation is likely to occur within the stack or before. Opacity measurements would then have no value. If opacity monitoring is determined to be meaningful, a continuous opacity monitoring instrument meeting requirements specified in federal regulations will be provided. In addition to meeting these basic requirements, the instrument will include means for automatic zero calibration and correction, and span calibration checks. Provision will be included for on-stack readout of measurement signals, zero and span calibration signals, and optical alignment. The instrument will provide linear outputs corresponding to

optical density and opacity corrected for stack exit conditions, and will incorporate multiple switch selectable measurement ranges for each output, extending from 10 to 100 percent opacity or equivalent. A remote control unit will be provided. It will contain a measurement indicator, means for manual remote calibration, and dual independently adjustable alarms. It will also contain fault monitors to indicate the status of normal maintenance items including air purge filters, transmissometer windows, shutters, and on-stack electro optics.

A continuous SO_2 and NO_x measurement monitor, that also satisfies minimum regulatory requirements, will be installed. In addition to meeting these basic requirements, the instrument will incorporate an in situ measurement technique providing a linear response with pollutant gas concentration. If the instrument measurement is affected by stack gas temperature, the output will be automatically corrected for temperature effects including ideal gas-law volumetric considerations and spectral absorption variations. The instrument will also include a means for automatic and manual on-stack zero and span calibration checks - free from the interference effects of the flue gas - and will not require external calibration gases or light sources. Measurement ranges of 500, 1000, and 1500 parts per million, selectable from the control room, will be provided. A remote control unit with measurements indicator, manual calibration, alarm level detectors for each gas, and status indicators for all major maintenance/operational conditions will be included.

As required with continuous SO_2 and NO_x analyzers, either a continuous CO_2 or O_2 monitor is also required. An O_2 monitor is planned for installation on each of the Seminole Stations stacks. In addition to other features, the instrument will not require any sample extraction or conditioning. The oxygen sensor will be totally specific to the measurement of oxygen and will have no potential interferences. The instrument will incorporate means for unattended zero and span calibration checks which can be activated either automatically or manually. The output will be linear with percent oxygen and will

include switch selectable measurement ranges of 0-2.5 percent, 0-10 percent, and 0-25 percent oxygen.

All necessary sampling ports, platforms, ladders, etc. will be provided in accordance with the latest revision of DER's "Standard Sampling Techniques and Methods of Analysis for the Determination of Air Pollutants from Point Sources."

Ambient Air Quality/Meteorology Monitoring

Ambient air quality monitoring will probably commence prior to plant operation, and will continue during the operational phase of each unit. Pre-operational monitoring will provide a thorough shakedown of monitoring equipment so that it will be functioning properly in time for the beginning of station operation and will provide confirmation of background conditions at startup.

Ambient air quality monitoring will consist of instruments to measure concentrations of total suspended particulates (TSP), sulfur dioxides (SO_2) and nitrogen oxides (NO_x). The NO_x monitor will also be capable of separating total NO_x into nitric oxide (NO) and nitrogen dioxide (NO_2) fractions. For better understanding of air quality measurements, a meteorological monitoring package will also be deployed to record wind speed, wind direction, temperature, and rainfall.

TSP concentrations will be determined using the EPA reference method, gravimetric analysis of filters exposed in a high-volume sampler for a period of 24 hours at a time. Filter handling will allow additional analyses as required.

Ambient concentrations of SO_2 will be measured continuously using an approved EPA reference or equivalent method. The monitoring device and associated calibration equipment will be housed in a temperature-controlled, weather-proof shelter. Measurements will be recorded continuously on a digital data logger, analog strip chart recorder, or both.

An EPA reference or equivalent monitor will also be used to measure concentrations of NO/ NO_2 / NO_x . Measurements will be made continuously and recorded for later analysis. NO_x monitoring devices will be housed along with SO_2 monitoring equipment in an enclosed, temperature-controlled shelter.

Continuous measurements of wind speed and direction will be made with sensors located atop a 10-meter meteorological tower. A temperature

sensor, and possibly a relative humidity sensor, will also be installed on the tower. Measurements will be recorded for later comparison with ambient air quality data. Depending on regulatory agency requirements, an additional tower may be needed to measure wind conditions at a level much higher than 10 meters above the ground, where conditions more representative of stack height winds could be observed. Also as part of the meteorological monitoring program, a recording rain gauge is planned for installation at the site. Rainfall levels can be used to interpret certain types of air quality measurements; for example, high particulate concentrations during dry periods. Rainfall information will also be needed as part of the hydrological monitoring program to estimate runoff from coal piles and other sections of the site.

The number and location of ambient air quality monitoring stations cannot be specified at this time. Monitoring needs will depend in part on the characteristics of other monitoring programs existing in the vicinity of the Putnam Site during the year prior to startup of Unit No. 1. The characteristics in this case encompass location, monitoring equipment, calibration procedures, sampling frequency, data availability, and probability of long-term continued operation.

It is likely that one meteorological tower and at least two air quality stations, each equipped to monitor TSP, SO_2 and $\text{NO}/\text{NO}_2/\text{NO}_x$, will be included in Seminole's operational ambient air quality monitoring program. Impact analysis modeling (described in Section 5.1.2) indicates that highest short-term ambient concentrations will occur within 10 kilometers of the Seminole stacks. Additional modeling or assessment of previous modeling results will be needed to specify distance/direction combinations at which high concentrations are likely to occur often enough to be detected by a limited number of sampling stations. In reaching a decision on placement of monitoring sites, consideration will also be given to locating a station within a nearby residential area or near agricultural land where crops particularly vulnerable to airborne contaminants may be grown.

8.2.2 Intake Structure

Section 5.2.2.2 contains a description of an in situ model screen test to be conducted in 1979. The purpose of the test is to determine the smallest feasible screen-opening size under operating conditions in the St. Johns River. Referred to as a "fouling test," the experiment will give a good indication of the plugging and maintenance problems that can be expected for various screen-opening sizes and will provide a means for selecting the smallest opening that can be used without experiencing unmanageable fouling problems. Concurrently, as outlined in Section 5.2.2.2, a biological testing program will be conducted to assess the impingement and entrainment potential of the various screen-opening sizes. Thus, the results of the fouling test will include an assessment of the potential impacts to the aquatic ecosystem of the selected screens.

8.2.3 NPDES Monitoring

Sampling Points

The facility intake and four wastewater streams within the plant complex will be sampled to assure compliance with State of Florida standards for thermal discharges; and the U. S. Environmental Protection Agency (EPA) Effluent Guidelines and Standards for Stream Electric Power Generating Point Sources, 40 CFR 423. The four internal sampling locations will be: 1) the treated effluent from the Central Wastewater Treatment System (Section 3.6.15), 2) the treated effluent from the Sanitary Treatment Facility (Section 3.7), 3) the cooling tower blowdown, and 4) the combined wastewater steam discharged to the St. Johns River.

Parameters and Schedule

The final selection of parameters and sampling frequency will be a result of agency consultation with the permit applicant. At a minimum, the parameters specified by the aforementioned effluent guidelines will be monitored; namely, flow, total suspended solids, pH, oil and grease, copper, iron, zinc, chromium, phosphorus, and total chlorine residual.

Several internal wastewater streams, in addition to those outlined in this section, may be monitored, as required, to assure that the waste streams meet predetermined standards. These systems include the makeup demineralizing system (Section 3.6.3), the condensate polishing system (Section 3.6.4), and boiler chemical cleaning wastes (Section 3.6-14).

8.2.4 Ground Water Quality

The program described in Section 8.1.3 will be continued. The data obtained will provide an overall assessment of ground water quality changes, if any. Additional ground water quality monitoring wells will be constructed at specific locations where localized changes may be expected because of the proximity to contaminant producing facilities. For example, monitoring wells will be installed down gradient from facilities such as the coal pile and the solid waste disposal areas.

The additional wells will typically be four-inch diameter, cased, and will penetrate Layer 1 sands (Section 2.2). The well casing will be screened to allow sample extraction at any depth. Wells will be located as close as practical to the potential source of contamination. For example, if dikes or dams are provided to contain liquid or semi-solid wastes, the wells would be located at the toe of the embankment. This will ensure that changes in ground water quality will be detected as early as possible so that mitigating measures can be taken.

Samples will be taken in the four-inch diameter wells at the top and bottom, and at two intermediate points, for a total of four samples per well. Parameters listed for detailed analyses in Section 8.1.3 will be tested on these additional wells. Frequency of sampling will depend on the nature and volume of leachates and rate of ground water movement.

8.3. ENVIRONMENTAL REGULATORY COMPLIANCE MANAGEMENT

Seminole Electric Cooperative, Inc. (SECI) has proposed an environmental regulatory compliance department within SECI that will be independent of its production functions with sufficient authority and responsibility to meet environmental regulations, licensing, and planning needs of SECI.

Department objectives include:

1. To assure that the Executive Department is kept informed of existing and potential licensing, permitting, or other environmental regulatory requirements and their potential impact on SECI operations, and recommend appropriate action to be taken in achieving applicable compliance.
2. To assure that planning for new operating capacity (including generation, transmission, and distribution) is conducted with due consideration for existing and potential environmental regulations.
3. To act as the principal responsibility center within SECI for assuring coordinated preparation and timely filing of permit and license applications.
4. To act as the principal responsibility center for coordinating and applying the technical resources within SECI and those of outside consulting agencies to achieve compliance with applicable regulations.
5. To act as the principal liaison between local, state, and federal governmental agencies and SECI for all environmental licensing and regulatory activities.
6. To provide coordination and quality control of all water and air monitoring programs and to assure accurate and timely reporting of required information to regulatory agencies.

An organizational and functional chart is shown in Figure 8.3-1. The Environmental Engineer, reporting to the Director of Engineering, will provide the staff capacity to carry out the departmental objectives in areas of regulatory liaison, regulatory compliance, and compliance monitoring.

Regulatory Liaison

Environmental regulatory compliance activities will be coordinated through the Environmental Engineer. Liaison with local, state, and federal agencies, and SECI management and production departments will be maintained to identify and evaluate applicable regulations, develop programs for compliance activities, and assure compliance objectives.

Regulatory Compliance

The Environmental Engineer will be responsible for maintaining records of compliance activities and reporting results to appropriate local, state, and federal regulatory agencies.

Compliance Monitoring

The Environmental Engineer will be responsible for planning, organizing, staffing, and implementing testing and monitoring systems; assuring that the systems are operated to specified performance criteria; assuring that the resulting data are representative of the source sampled and that actions are taken to provide appropriate notice of corrected system malfunctions.

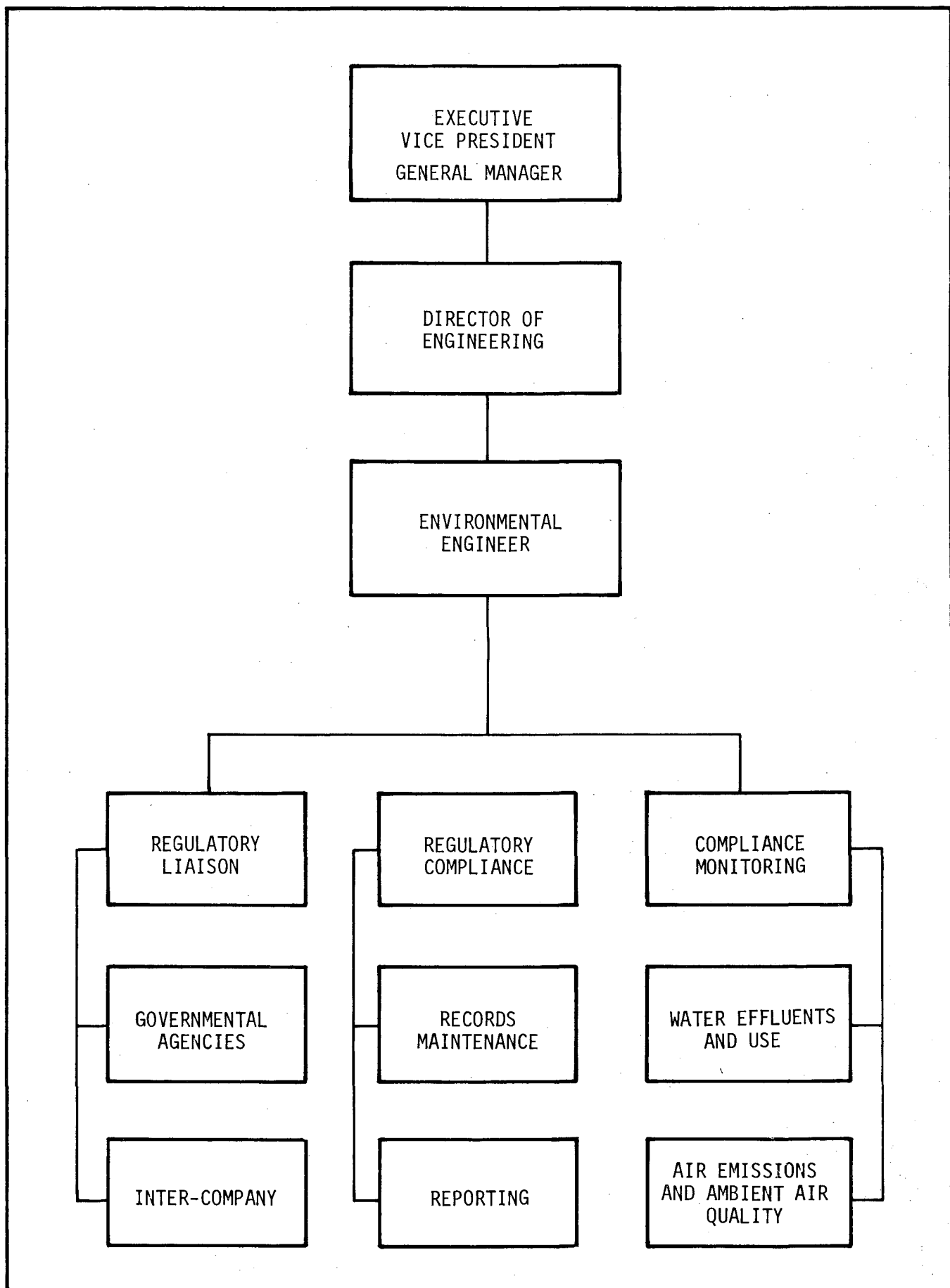


Figure 8.3-1. Environmental Regulatory Compliance Management.

9.0

ALTERNATIVES TO PROPOSED DEVELOPMENT

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9.0 ALTERNATIVES TO PROPOSED DEVELOPMENT

9.1 ALTERNATIVE ENERGY SOURCES AND SITES

9.1.1 Alternatives to New Generation

Alternatives to new generation are discussed in Section 1.3.

9.1.2 Alternatives Requiring New Generation

9.1.2.1 New Sites

9.1.2.1.1 Introduction

To develop the proposed project in a systematic, environmentally conscious manner allowing both sound engineering decisions and compliance with federal and state regulations, Seminole Electric Cooperative, Inc. (SECI) initiated a two-phase site selection and evaluation program in the Fall of 1976.

Phase I of the program, conducted by Stanley Consultants, Inc., consisted of four basic tasks:

1. Preparation of a site selection methodology,
2. Coordination of the site selection study with appropriate governmental agencies,
3. Documentation of the site selection process, and
4. Recommendation of alternate site locations.

These tasks are described in Appendix K and are summarized in Section 9.1.2.1.2. The Phase I study resulted in the recommendation by Stanley Consultants of 11 site locations. Of these 11 locations, four were rated by Stanley as worthy of immediate detailed evaluation and property optioning.

Phase II of the site selection and evaluation program, conducted by Dames & Moore, consisted of environmental analyses of the four site locations recommended by Stanley Consultants. These analyses were designed to identify "fatal flaws" that would jeopardize the use of these sites for power generation. As with Phase I, Phase II was coordinated with appropriate governmental agencies. A discussion of Phase II is provided in Section 9.1.2.1.3.

9.1.2.1.2 Phase I Site Selection Study

Before siting investigations were begun, general plant design and site requirements were established, as follows:

1. The base plant was assumed to have two 600-MW (net) coal-fired generating units with electrostatic precipitators and flue gas desulfurization (FGD);
2. 20,000 gallons per minute (gpm) of makeup water would be required;
3. 3 million tons per year of coal would be required;
4. 425,000 tons of ash per year would be produced;
5. Up to 840,000 tons of FGD sludge per year would be produced; and
6. Approximately 1,000 acres of land would be required for plant facilities, including solid waste disposal.

These parameters and requirements were considered to be maximum estimates that would not be exceeded by final plant requirements.

Initially, the entire state of Florida was reviewed to identify "candidate siting zones." Two general siting criteria were employed to identify these zones: (1) adequate water availability, and (2) reasonable transportation and transmission access. Criteria definition is contained in Appendix K.

A system of overlays for a base map of Florida was used to identify these candidate siting zones (Appendix K). Next, these zones were examined in terms of four environmental criteria relating to air quality, prime agricultural land, sensitive areas, and land use. The application of these criteria, plus the requirement that siting locations have reasonable access to the SECI service area, resulted in the identification of search areas in which the next level of investigations could be conducted.

The study of detailed maps and other readily available information resulted in the identification of 53 locations (defined as 36-square-mile areas) within the search areas. The best representative locations were then identified by means of county highway maps, ground water data, and other detailed information. This screening process narrowed the choice to the eleven 36-square-mile locations shown in Figure 1 of Appendix K. These 11 siting locations were reevaluated using the siting criteria of water availability, transportation and transmission access, air quality, prime agricultural land, sensitive areas, and fringe growth area locations. A modified Delphi-structured (i.e., group consensus) decision-making process was conducted by specialists within Stanley Consultants to produce quantifiable, detailed criteria specific to SECI's site selection needs. The criteria are described in Appendix K.

Following the development of the weighted criteria, the 11 siting locations were re-evaluated. cursory site inspections were conducted. The results were then informally presented for review to Florida's Division of State Planning and Department of Environmental Regulation (DER).

This final stage of Phase I resulted in a grouping of the 11 locations into three groups, A through C, with A containing the top-rated locations, B the second, and C the third. These groupings were as follows:

Group A	Group B	Group C
L-7 Bostwick	L-2 High Springs	L-11 Charlotte Harbor
L-1 Branford	L-5 Lake Rosseau	L-10 Flagler
L-6 Bushnell	L-3 Santa Fe	L-8 Rodman
L-9 Satsuma	L-4 Silver Springs	

Appendix K provides descriptive data for each of these locations.

The Phase I study concluded in April 1977 with the recommendation that the Group A siting locations should be used to identify a preferred and several alternate sites for development of the proposed 1,200-MW generating facility. Following this recommendation, SECI located specific properties within the four candidate locations in Group A.

9.1.2.1.3 Phase II Site Evaluation Studies

Methodology

In June 1977, Dames & Moore was retained by SECI to conduct Phase II of the site selection and evaluation program, preliminary environmental analyses of specific sites from the Group A siting locations:

Putnam (within Stanley's 36-square-mile Bostwick siting location) -
SECI's Preferred site.

Suwannee (within Stanley's 36-square-mile Branford siting location).

Sumter (within Stanley's 36-square-mile Bushnell siting location).

Satsuma (within Stanley's 36-square-mile Satsuma siting location).

The Phase II studies were designed to verify the viability of the four sites. The investigations were to accomplish this purpose by:

1. examining each site in a preliminary manner to uncover conditions that would result in unacceptable impacts to the environment, should the proposed 1,200-MW station be built and operated at the site, and
2. determining if such conditions, if present, would constitute a "fatal flaw" in the proposed action; that is, if the condition would result in the unsuccessful completion of licensing actions.

Each site investigation included seven separate areas for study: land use, ground water hydrology, geology/geotechnical, air quality, surface water hydrology, terrestrial biology, and aquatic biology. The

site investigations proceeded in steps designed to provide a systematic approach to uncovering critical issues and to explore each issue in sufficient depth to determine the site's viability. The steps were as follows:

1. Preliminary examination of available data to identify potential issues of concern.
2. Preparation of a proposal outlining the issues of concern and the study approaches to explore the issues.
3. Review of the proposal by SECI.
4. A decision by SECI and Dames & Moore as to what issues of concern appeared to be most critical, that is, those issues judged to be most likely to include site development problems.
5. Initial study of most critical issues of concern. Less critical issues were deferred pending the outcome of the initial studies. In the case of sites for which no particular critical issues were identified, investigation into all areas proceeded at once.
6. At the conclusion of the initial studies, if a "fatal flaw" or serious problem was uncovered, the subsequent studies were deferred and a preliminary report was made to SECI so that a decision could be made whether to continue investigation of the site. If the initial studies did not uncover serious problems, the procedure called for completion of the balance of the studies.
7. Preparation of a final report.

In each case, state and local agencies were contacted early in the investigation to identify their concerns and to obtain existing information regarding the sites. Comments from the agencies helped to focus the investigations and to identify potential regulatory difficulties that might be encountered during the permitting and licensing process.

Since the Bostwick Siting Location (L-7) was the best rated site in the Phase I study, it was the first site investigated in Phase II. The report of this investigation, completed in July 1977, indicated no environmental problems at the site that could not be mitigated. Encouraged by this finding, SECI designated this best-rated site as the "preferred" site for the proposed plant, and the remaining three sites were considered as "potential" sites, as required by the Florida Electrical Power Plant Siting Act. As specific properties within the three remaining siting locations were identified, they were likewise subjected to preliminary environmental analyses.

Site Comparison

A comparison of the ecological, hydrological, geotechnical, air quality, and land use characteristics of the four top-rated sites is presented in Table 9.1-1. Although not reflected in this table, the investigations indicate, from both an engineering cost and a "fatal flaw" point of view, the Putnam Site (Bostwick L-7) remains the preferred site for development of the proposed 1,200-MW steam electric generating station. Complete reports of the investigations conducted for each site are on file with SECI.

9.1.2.2 Alternative Fuels

Fuel alternatives for the proposed project are discussed in Section 1.3.

Table 9.1-1

Environmental Comparison of
Four Alternate Sites

ECOLOGY		
<u>SITE</u>	<u>Advantages</u>	<u>Disadvantages</u>
PUTNAM (Bostwick L-7)	1. No unique or critical habitat on site. 2. Onsite habitats disturbed by past activities. 3. No "wetlands" as defined by the U.S. Corps of Engineers occur on site.	1. 10 percent of site is wetland. 2. Gopher tortoise, a protected species, is found on site. 3. St. Johns River is inhabited by manatee, an endangered species.
SUWANNEE (Branford L-1)	1. A large portion of the site (about 70 percent) is pasture, crops, or pine plantation. Therefore, the development will cause little change of important habitat on the majority of the site.	1. Part of site (30 percent) is relatively undisturbed habitat contiguous to the Santa Fe River. 2. Santa Fe River is a high-quality aquatic resource with an abundant sport fishery.
SUMTER (Bushnell L-6)	1. Highly disturbed by past quarrying activities.	1. None
SATSUMA (Satsuma L-9)	1. Much of usable portion of the site has been disturbed by past and present logging/clearing	1. St. Johns River is inhabited by manatee, an endangered species. 2. Wetlands (300 acres) as defined by the U. S. Corps of Engineers occur on site, are relatively undisturbed, and are contiguous to navigable water

Table 9.1-1 (Continued)

<u>SITE</u>	<u>WATER</u>	
	<u>Advantages</u>	<u>Disadvantages</u>
PUTNAM	1. Adequate surface water source for cooling-cycle makeup (St. Johns River). 2. Adequate ground water source for plant water (Floridan Aquifer). 3. 80 percent (1,700+ acres) is at relatively high elevation and is not flood prone. 4. Proximity to adequate Point of Discharge (POD) of plant blowdown discharge.	1. Surface water source (St. Johns River) is relatively high in dissolved solids.
SUWANNEE	1. Adequate surface water source (Suwannee River or Santa Fe River, minimum flows 1,530 and 609 cfs, respectively). 2. Adequate ground water source for minor plant water (Floridan Aquifer). 3. Large portion (80 percent) of site is not flood prone. 4. Proximity of adequate receiving waters (minimum flows need to be $\geq 1,056$); Suwannee River.	1. Limestone comprising the Floridan Aquifer is either exposed or covered by a relatively thin layer of clean sand. Therefore, Floridan Aquifer would be potentially exposed to leachate from coal/waste storage.
SUMTER	1. Adequate ground water source for minor plant water (Floridan Aquifer). 2. Site appears not to be flood prone.	1. Surface water sources are inadequate for cooling water makeup. Ground water may be adequate, but would result in a major stress on the resource. 2. Marginally adequate Point of Discharge would be the Withlacoochee River, 8.5 miles from site.

Table 9.1-1 (Continued)

<u>SITE</u>	<u>WATER</u>	
	<u>Advantages</u>	<u>Disadvantages</u>
SATSUMA	1. Adequate surface water source for plant cooling water makeup (St. Johns River). 2. Adequate ground water source for minor plant water (Floridan Aquifer). 3. 70 percent (700 acres) of site is not flood prone. 4. Proximity to adequate POD (St. Johns River).	1. Surface water source is relatively high in dissolved solids.

Table 9.1-1 (Continued)

GEOTECHNICAL		
<u>SITE</u>	<u>Advantages</u>	<u>Disadvantages</u>
PUTNAM	1. Floridan Aquifer (primary source of potable water) protected by a thick, relatively impervious aquaclude, the Hawthorn Formation. 2. No evidence of solution activity in underlying soils. 3. High permeability of surface soils will allow for percolation of sanitary effluents.	1. Surface soils are clean, poorly graded sand to depth of 40 to 50 feet; there are no onsite construction materials except sand (i.e., no limestone, no fine, cohesive soils). 2. High permeability of soils offers limited opportunity for sealing or containment of liquid wastes. 3. Sands, coupled with high water table, may present excavation, earthmoving, or dewatering problems.
SUWANNEE	1. No high water table onsite to interfere with construction activities. 2. Limestone for scrubber system is available locally. 3. Presence of existing quarries for storage of stabilized wastes.	1. Presence of numerous sinkholes and solution features onsite; potential high foundation costs. 2. Little, if any, fine material on or near the site for construction of dikes.
SUMTER	1. Limestone for scrubber system is available locally. 2. Presence of existing quarries for storage of stabilized wastes.	1. Presence of numerous sinkholes and solution features on site; potential high foundation costs.
SATSUMA	1. Floridan Aquifer protected by Hawthorn Formation on main part of site. 2. No surface expression of solution activity on main part of site. 3. High permeability of surface soils will allow good percolation of sanitary wastes. 4. Apparently low water table conditions in higher site elevations.	1. Onsite surface soils are apparently clean sands with high permeability; little opportunity for sealing or containment of liquid wastes. 2. Waste storage potential appears to be limited on main part of site; presence of sinkholes southeast of site may cause potential leachate impacts to Floridan Aquifer if that area is used for waste storage

Table 9.1-1 (Continued)

AIR QUALITY		
<u>SITE</u>	<u>Advantages</u>	<u>Disadvantages</u>
PUTNAM	1. Ambient air quality is good. 2. Site is in a PSD Class II area. 3. Nearest PSD Class I area is Okefenokee National Park, over 100 km distant.	1. Duval County, 43 km from site, is a non-attainment area for particulates. 2. FP&L Palatka station source (13 km) and Hudson Pulp and Paper source (7 km) are competing emission sources; however, these are not situated in a straight line and would not be additive concurrently with proposed station.
SUWANNEE	1. Ambient air quality is excellent. 2. No existing nearby major emission sources. 3. Site is in PSD Class II area. 4. Nearest PSD Class I area is Okefenokee National Park, 80 km distant.	1. None
SUMTER	1. Ambient air quality is good. 2. Site is in a PSD Class II area. 3. Only one moderate-size emission source in area (Dixie Lime Company).	1. Class I PSD area, Chassahowitzka National Wildlife Refuge, is only 50 km distant, and could be impacted by station. 2. Polk County non-attainment area is 50 km from site and could be impacted.
SATSUMA	1. Ambient air quality is good. 2. Site is in a PSD Class II area. 3. Nearest PSD Class I area is Okefenokee National Park, over 100 km distant. 4. Nearest non-attainment area is Duval County, about 63 km distant.	1. FP&L Palatka Station (12 km) and Hudson Pulp and Paper (15 km) are competing emission sources; however, these are not situated in a straight line and would not be additive concurrently with proposed station.

Table 9.1-1 (Continued)

<u>SITE</u>	<u>LAND USE</u>	
	<u>Advantages</u>	<u>Disadvantages</u>
PUTNAM	1. No high density residential areas are nearby. 2. Adjacent to rail transportation. 3. Adjacent to water transportation-- St. Johns River barge channel. 4. About 50 percent of site designated "development." 5. No unique farmland on site.	1. About 50 percent of site designated "conservation/preservation."
SUWANNEE	1. No high density residential areas are nearby. 2. Adjacent to rail transportation. 3. No known conflicting land uses.	1. No access to water transportation.
SUMTER	1. No high density residential areas are nearby. 2. Adjacent to rail transportation. 3. No known conflicting land uses.	1. No access to water transportation.
SATSUMA	1. Adjacent to rail transportation.	1. No access to water transportation. 2. Several nearby fishing resorts. 3. Large nearby residential development.

9.2 ALTERNATIVES TO STATION SYSTEMS DESIGN

9.2.1 Flue Gas Emission Control System

The air emissions control system for the proposed station consists of three parts: (1) flue gas desulfurization (FGD), (2) particulates control, and (3) nitrogen oxides control.

9.2.1.1 Flue Gas Desulfurization

Introduction

To meet existing and proposed federal and state New Source Performance Standards for sulfur dioxide (SO_2) emissions, specifications for the evaluation of alternative FGD systems included 79 percent SO_2 removal efficiency and an emission limitation of at least 1.2 lbs of SO_2 per million British thermal units (lbs/ 10^6 Btu) of heat input. (An FGD system removal efficiency of 79 percent coupled with coal washing at the mine will provide overall sulfur removal of 85 percent.) Since the New Source Performance Standards for the electric utility industry have only been proposed and not promulgated, any change in the final promulgated standards would require reevaluation of the alternatives to assure cost effective regulatory compliance.

Three FGD systems were designated for assessment: non-regenerative limestone scrubbing, non-regenerative lime scrubbing, and various regenerative scrubbing systems. Considerations for choosing the preferred FGD system were:

1. Ability to achieve required removal efficiency,
2. Proven high availability and reliability,
3. Capital and operating costs,
4. Availability and cost of reagent,
5. Engineering design, and
6. Environmental impact potential

Numerous documents, including U. S. Environmental Protection Agency (EPA, 1977b) publications, recently published Draft and Final Environmental Impact Statements EIS's (U.S. Corps of Engineers [COE] 1978a, 1978b; EPA, 1978a, 1978b) discuss the various types of regenerative and non-regenerative FGD systems on the market and evaluate the relative merits of each.

Regenerative Systems

In general, regenerative systems produce a byproduct that is potentially marketable, plus a relatively small amount of waste material. Depending on the particular process, the byproduct material may be elemental sulfur or a compound of sulfur such as sulfuric acid, calcium sulfate, or sodium sulfate. However, the process equipment is generally much more expensive than other scrubber types, and the quality and marketability of the byproduct is uncertain. Furthermore, these systems are presently less widely used, and their operating history has not been well established. Many of these processes are currently not commercially available, as only small pilot-plant experience is documented. Because these systems do not meet the criteria of proven high reliability, because of uncertain market conditions for sale of the byproducts, and because of probably high capital and potentially high operating costs, regenerative systems were eliminated from consideration.

Non-Regenerative Systems

Non-regenerative systems, otherwise known as "throwaway processes", are characterized by the requirement of relatively large quantities of relatively inexpensive reagents that will react with sulfur dioxide in flue gas. These reagents are used once; the reaction forms wet solid waste, which is then disposed of.

The available systems considered for use for the Putnam Site are categorized by the reagents used: limestone, lime, alkaline fly ash, and sodium carbonate. Of these, only limestone and lime systems have proven reliable. Past installations utilizing lime scrubbing have experienced plugging and mechanical problems, and the trend in new unit design is away from lime and toward limestone scrubbing. As of November 1977 there were 32 FGD systems in utility operation, and 100 more in various stages of construction, design, and planning. Of the 32 operating systems, 12 were limestone scrubbers, 13 were lime scrubbers, and 7 used other processes. Of the 100 other systems, 44 were committed to limestone scrubbing, 22 to lime scrubbing, 5 to other process, and 29 had not been selected. Limestone and lime scrubbing systems thus comprise 78 percent of all operating systems and 66 percent of systems in design or under construction (Burns and Roe, 1978).

Other types of non-regenerative systems are not well established and have not performed over a comparable length of time. Therefore, they do not meet the criteria of high availability and proven reliability and were rejected on that basis.

Selection of FGD System

The process for removing Sulfur Dioxide (SO_2) from the flue gas stream will be a wet limestone scrubbing process. The system in combination with washing at the mine is capable of reducing sulfur content by 85% in accordance with the proposed New Source Performance Standards published in the Federal Register, 29 November 1978. The system will contain one complete spare scrubbing module. Limestone will be crushed and blended with water to form the make-up reagent slurry to the scrubbers. A bleed stream of scrubber sludge of approximately 10% - 15% solids will be removed from the absorbed tank and will be pumped to thickeners where the solids content will be increased to approximately 35%. Overflow water will be returned to the scrubbing cycle. Underflow (sludge) from the thickeners will be transported to the sludge stabilization system.

9.2.1.2 Particulates Control

To meet the proposed $0.03 \text{ lbs}/10^6 \text{ Btu}$ federal and state New Source Performance Standards for particulate emissions, specifications for particulate control alternatives include at least a 99.6 percent removal efficiency. As revisions to the New Source Performance Standards for particulates are promulgated, control alternatives will be reevaluated in light of these changes to assure cost-effective regulatory compliance.

While there are several methods commonly used to remove particulates from flue gases, electrostatic precipitators are the most widely used and proven method for coal-fired steam electric stations.

Baghouse filters were also evaluated. Baghouse filters offer the same particulate removal efficiency as electrostatic precipitators. Given the type of fuel to be used at the proposed station, however,

baghouse filters would be a less economical choice, as they have higher operating costs, particularly related to bag replacement. Further, no baghouse filter system of the size required for the proposed station has been in operation long enough to have established an operation and maintenance history.

A third alternative, combined flue gas/particulate scrubbers, may provide the same removal efficiencies achieved by electrostatic precipitators. However, industry experience to date with such combined scrubber systems has not been good. It is therefore an industry standard, with few exceptions, to separate particulate removal from flue gas desulfurization.

9.2.1.3 Nitrogen Oxides Control

The only proven method of limiting nitrogen oxides (NO_x) emissions is to control the combustion process. Some methods presently used to accomplish NO_x control during combustion are (1) overfire air, (2) flue gas recirculation, and (3) combustion in a reducing atmosphere in lieu of an oxidizing atmosphere. Furnace design, using one or more of the above methods to reduce NO_x emissions, is a requirement imposed on the boiler manufacturer by the utility. The boiler must be guaranteed by the manufacturer to limit NO_x emissions to meet the proposed federal emission limitation for nitrogen dioxide of $0.6 \text{ lbs}/10^6 \text{ Btu}$.

9.2.2 Station Service Water Sources

Three water sources exist at the proposed Putnam site: the Floridan Aquifer, the water table aquifer, and the St. Johns River. As described in Section 3.4, the proposed plant service water source arrangement consists of (1) use of the St. Johns River for the makeup water requirements of the heat rejection system and station services (stack wash, air preheater wash, and boiler fireside wash); and (2) use of the Floridan Aquifer to supply such other station water requirements as fire protection, potable water system, condensate polisher makeup, auxiliary and main boiler makeup, and miscellaneous station uses.

9.2 ALTERNATIVES TO STATION SYSTEMS DESIGN

9.2.1 Flue Gas Emission Control System

The air emissions control system for the proposed station consists of three parts: (1) flue gas desulfurization (FGD), (2) particulates control, and (3) nitrous oxide control.

9.2.1.1 Flue Gas Desulfurization

Introduction

To meet existing and currently anticipated federal and state New Source Performance Standards for sulfur dioxide (SO_2) emissions, specifications for the evaluation of alternative FGD systems included 90 percent SO_2 removal efficiency and an emission limitation of at least 1.2 lbs of SO_2 per million British thermal units (lbs/MBtu) of heat input. Since the New Source Performance Standards for the power industry are currently under revision, and the 90 percent efficiency is a proposed standard, any change in this proposal would require reevaluation of the alternatives to assure cost effective regulatory compliance.

Three FGD systems were designated for assessment: non-regenerative limestone scrubbing, non-regenerative lime scrubbing, and various regenerative scrubbing systems. Considerations for choosing the preferred FGD system were:

1. Ability to achieve 90 percent removal efficiency,
2. Proven high availability and reliability,
3. Capital and operating costs,
4. Availability and cost of reagent,
5. Engineering design, and
6. Environmental impact potential

Numerous documents, including U. S. Environmental Protection Agency (EPA, 1977) publications, recently published Draft and Final Environmental Impact Statements EIS's (U.S. Corps of Engineers [COE] 1978a, 1978b; EPA, 1978a, 1978b) discuss the various types of regenerative and non-regenerative FGD systems on the market and evaluate the relative merits of each.

Regenerative Systems

In general, regenerative systems produce a byproduct that is potentially marketable, plus a relatively small amount of waste material. Depending on the particular process, the byproduct material may be elemental sulfur or a compound of sulfur such as sulfuric acid, calcium sulfate, or sodium sulfate. However, the process equipment is generally much more expensive than other scrubber types, and the quality and marketability of the byproduct is uncertain. Furthermore, these systems are presently less widely used, and their operating history has not been well established. Many of these processes are currently not commercially available, as only small pilot-plant experience is documented. Because these systems do not meet the criteria of proven high reliability, because of uncertain market conditions for sale of the byproducts, and because of probably high capital and potentially high operating costs, regenerative systems were eliminated from consideration.

Non-Regenerative Systems

Non-regenerative systems, otherwise known as "throwaway processes", are characterized by the requirement of relatively large quantities of relatively inexpensive reagents that will react with sulfur dioxide in flue gas. These reagents are used once; the reaction forms wet solid waste, which is then disposed of.

The available systems considered for use for the Putnam Site are categorized by the reagents used: limestone, lime, alkaline fly ash, and sodium carbonate. Of these, only limestone and lime systems have proven reliable. Past installations utilizing lime scrubbing have experienced plugging and mechanical problems, and the trend in new unit design is away from lime and toward limestone scrubbing. As of November 1977 there were 32 FGD systems in utility operation, and 100 more in various stages of construction and design. Of the 32 operating systems, 12 were limestone scrubbers, 13 were lime scrubbers, and 7 used other processes. Of the 100 other systems, 44 were committed to limestone scrubbing, 22 to lime scrubbing, 5 to other process, and 29 had not been selected. Limestone and lime scrubbing systems thus comprise 78 percent of all operating systems and 66 percent of systems in design or under construction (Burns and Roe, 1978).

Other types of non-regenerative systems are not well established and have not performed over a comparable length of time. Therefore, they do not meet the criteria of high availability and proven reliability and were rejected on that basis.

Based on the availability of limestone in Florida, and on the more favorable operational history, limestone scrubbers were selected for Seminole Plant Units No. 1 and No. 2. However, the exact process has not yet been selected for the following reasons:

1. As discussed in Section 9.2.6, several ultimate waste disposal methods are under consideration, but a final decision has not been made. The scrubbing process and the ultimate waste disposal method should be designed as a unit.
2. The U. S. Environmental Protection Agency has not yet promulgated the New Source Performance Standards required by the Clean Air Act, and the scrubber to be selected must satisfy the requirements of these standards.

9.2.1.2 Particulates Control

To meet the currently anticipated 0.03 lbs/MBtu federal and state New Source Performance Standards for particulate emissions, specifications for particulate control alternatives include at least a 99.5 percent removal efficiency. As revisions to the New Source Performance Standards for particulates are promulgated, control alternatives will be reevaluated in light of these changes to assure cost-effective regulatory compliance.

While there are several methods commonly used to remove particulates from flue gases, electrostatic precipitators are the most widely used and proven method for coal-fired steam electric stations.

Baghouse filters were also evaluated. Baghouse filters offer the same particulate removal efficiency as electrostatic precipitators. Given the type of fuel to be used at the proposed station, however,

baghouse filters would be a less economical choice, as they have higher operating costs, particularly related to bag replacement. Further, no baghouse filter system of the size required for the proposed station has been in operation long enough to have established an operation and maintenance history.

A third alternative, combined flue gas/particulate scrubbers, may provide the same removal efficiencies achieved by electrostatic precipitators. However, industry experience to date with such combined scrubber systems has not been good. It is therefore an industry standard, with few exceptions, to separate particulate removal from flue gas desulfurization.

9.2.1.3 Nitrous Oxides Control

The only proven method of limiting nitrogen oxides (NO_x) emissions is to control the combustion process. Some methods presently used to accomplish NO_x control during combustion are (1) overfire air, (2) flue gas recirculation, (3) tilting burners, and (4) combustion in a reducing atmosphere in lieu of an oxidizing atmosphere. Furnace design, using one of the above methods to reduce NO_x emissions, is a requirement imposed on the boiler manufacturer by the utility. The boiler must be guaranteed by the manufacturer to limit NO_x emissions to meet anticipated federal emission limitations for nitrogen dioxide of 0.6 lbs/MBtu.

9.2.2 Station Service Water Sources

Three water sources exist at the proposed Putnam site: the Floridan Aquifer, the water table aquifer, and the St. Johns River. As described in Section 3.4, the proposed plant service water source arrangement consists of (1) use of the St. Johns River for the makeup water requirements of the heat rejection system and station services (stack wash, air preheater wash, and boiler fireside wash); and (2) use of the Floridan Aquifer to supply such other station water requirements as fire protection, potable water system, condensate polisher makeup, auxiliary and main boiler makeup, and miscellaneous station uses.

Three other water source arrangements were considered and rejected:

1. Supplying all water requirements--cooling tower makeup as well as potable and boiler makeup--from wells drilled in the Floridan Aquifer. This alternative was ruled out because it would cause excessive drawdown of the Floridan Aquifer and potentially increase salt water intrusion. The Floridan Aquifer supplies drinking water in the site area.
2. Supplying all water from the St. Johns River. This alternative was ruled out because the water quality of the river is not as good as that of the Floridan Aquifer. Further, the river's water quality is quite variable. These conditions would result in higher equipment and chemical costs and a greater quantity of water treatment wastes.
3. Supply potable and boiler makeup from the shallow water table (non-Floridan) aquifer beneath the site. This alternative was ruled out for the same reasons ruling out Alternative 2: the presence of variable water quality, higher equipment and chemical costs, and greater quantity of water treatment wastes. Further, the ability of the water table aquifer to supply the required water over a sustained period of time is doubtful.

9.2.3 Heat Dissipation System

9.2.3.1 Introduction

Two heat dissipation systems were considered for the proposed station: once-through cooling and cooling towers. In the former case, two alternatives were considered: straight once-through cooling and once-through cooling with topping towers. In the latter case, natural draft towers and mechanical draft towers were the alternatives considered. Each of the alternatives was evaluated under different river

conditions; the cooling tower system alternative evaluation included variations in the cycles of concentration and a winter peak case as well as a summer peak case.

The thermal impact of the proposed project on the St. Johns River is important because of the presence of the manatee, an endangered species. Manatee are attracted to warm water areas. Where such an area is created by the thermal effluent of a power station, there is a danger that this warm water area would suddenly be eliminated were the station to completely shut down for any reason. Such a sudden elimination of the warm water area during winter conditions, when the ambient river temperature may be as low as 47 degrees F, could subject the manatee to cold shock.

As the following discussion indicates, once-through cooling methods create a considerably larger and warmer thermal plume than do cooling towers, which have been chosen as the proposed heat dissipation system for the Putnam Station.

The choice of cooling towers was between the two most feasible types for a Florida site, natural and mechanical draft, wet-type towers. The choice, natural draft, was based on total evaluated costs taking into consideration capital and operating costs.

9.2.3.2 Once-Through Cooling System

Once-Through Cooling

The once-through cooling method was evaluated by modeling for the critical river flow condition known as minimum absolute flow (see Sect. 2.3.1 for definition). A description of the model is provided in Appendix C.4. The parameters used in the modeling study are shown in Table 9.2-1.

For the once-through cooling method under the minimum absolute flow condition, extensive thermal impact would be felt throughout almost the entire investigated reach of the river. The 1°F delta-T isotherms (1 degree F above ambient) extended up to approximately 3 miles away in either direction at certain tidal stages. The 3°F delta-T isotherms (3 degrees F above ambient) extended to about 90 percent of the river's cross section; in violation of existing Florida Rules on Pollution of Waters, Chapter 17-3, Florida Administrative Code.

Once-Through Cooling With Topping Tower

This heat dissipation method was shown by the modeling study to have a less extensive impact than the once-through cooling method. The 1°F delta-T isotherms (1 degree F above ambient) extended to less than 2 miles from the point of discharge; the 2°F delta-T isotherms (2 degree F above ambient), at their extreme, extended to less than 0.5 mile from the point of discharge. However, as with once-through cooling without a topping tower, virtually the entire river cross section would be raised above ambient.

As is indicated by Table 9.2-1, both the once-through cooling with topping tower and the straight once-through cooling have very high intake volumes: 1,886 cubic feet per second (cfs) for the former and 1,900 cfs for the latter. These intake volumes would be expected to cause impingement/entrainment problems (see Section 5.2.2.2).

9.2.3.3 Cooling Tower System

Cooling tower types that were evaluated for dissipating heat removed from the turbine cycle are the following:

1. Wet-type mechanical draft cooling towers -- the capital cost of these towers is less than the capital cost of a natural draft tower. However, with rapidly escalating fuel costs over the life of the proposed station, the power requirements of the mechanical draft towers drive the evaluated costs for the mechanical draft towers higher than those for the natural draft towers, which have relatively low operating costs.
2. Natural draft cooling towers -- the capital cost of these towers is high while the operating costs are low.

Both of these tower types represent proven technology. From an environmental point of view, natural draft towers offer the advantages of limited or no incidences of ground-level fogging (or icing in severe

conditions); greater dispersion and lower maximum salt deposition rates and ground-level salt concentrations; and lower noise levels. The chief environmental disadvantage is related to the impact of these towers on scenic resources (a typical tower is over 400 feet high and over 400 feet in diameter at the basin; the elevated plume from these structures can often be seen for miles).

The final selection of tower type was strongly influenced by an economic evaluation considering capital and differences in present worth energy costs for water pumping and for operation for the mechanical draft towers. The results of the analysis, along with assumptions used in the analysis, are given in Table 9.2-2.

The other tower type evaluated was the dry tower. There is presently only minimal use of dry cooling towers in the United States. These towers require the use of higher condensing pressure, which requires more steam for the same power output. This increases boiler and auxiliary boiler sizes and costs. Because of the limited operating experience and overriding economic considerations, this alternative was eliminated.

9.2.3.4 Other Alternatives

Spray ponds or cooling lakes were rejected for two reasons. First, the site contains insufficient land area for use of either spray ponds or cooling lakes. The land requirements may be in excess of 1,500 acres for a 1,200 MW station. A second, and more important, reason is that site geological and soil conditions are not suitable for the construction of ponds or lakes because of the absence of impermeable soils in the near-surface layers at the site. Section 2.2 indicates that suitable dike construction soils exist some 100 feet below the surface. A suitable lake would require excessively high site preparation costs, either in excavating to suitable soils or importing suitable soils from distant sources.

9.2.3.5 Sale of Steam

An interest to purchase process steam from the generating station was shown by a neighboring facility. SECI investigated the feasibility of providing process steam to this facility and the effect this might have on the design of the power plant.

The investigation showed the sale of process steam increased the cost and complexity of the power plant steam cycle equipment; increased the demand for boiler makeup water; and, in turn increased the volume of ground water withdrawal at the power plant site. The concept was subsequently abandoned.

9.2.4 Alternative Chemical Waste Treatment System

9.2.4.1 Introduction

The Chemical Waste System described in Section 3.6 provides systems to neutralize strong wastes at the source, separate oil before pumping, collect and equalize the wastes in one of two ash pond areas, then adjust pH and reduce any remaining oil, heavy metals, and suspended matter by coagulation and sedimentation before monitoring and release. Alternatives would include a number of small, labor-intensive batch treatment systems with reduced total reliability.

9.2.4.2 Well Water Pretreatment Wastes

Sludge from the lime softening clarifier (see Section 3.6.2) could be collected locally and treated to remove suspended solids and to adjust pH. However, it is not practical or economical to treat small quantities of waste produced intermittently. Several batch treatment vessels, chemical feeds, and sophisticated pH controls would be required. Furthermore, the overall reliability of small, complex systems is questionable.

Filter backwash water (see Section 3.6.2) could also be collected in a batch treatment system and treated to remove suspended solids and to adjust pH. However, treatment of three batches of backwash water per day would require excessive operator attention and equipment similar to that discussed in the preceding paragraph.

9.2.4.3 Makeup Demineralizer System Wastes

The Activated Carbon Unit backwash water (see Section 3.6.3) will be produced in batches two or three times per week. Batch treatment could be consolidated with batch facilities in the Well Water Pretreatment System. These facilities are, however, remote from the Makeup Demineralizer System, and they have separate operators. Consolidation of treatment would require an additional, expensive wastewater line to the Well Water Pretreatment area, which, furthermore, might be used only two or three times per week. Coordination problems between equipment operators sharing the same batch treatment facility would reduce reliability.

Nonrecoverable demineralizer acid and alkaline wastes are proposed to be batch-neutralized as part of the automatic regeneration procedure (see Section 3.6.3). The waste is to be checked by the demineralizer operator before release to the Central Wastewater Treatment Facility. An alternative would be to dilute the proposed integral neutralizing system and rely on chance mixing and neutralization elsewhere. Neutralizing systems to treat wastes ranging from 2 to 4 percent sulfuric acid to 3 to 4 percent sodium hydroxide, on a continuous flow basis, are complex and unreliable.

9.2.4.4 Boiler Blowdown Wastes

Boiler blowdown (see Section 3.6.5) will contain very small quantities of salts and ammonia resulting in a pH range of 9.0 to 9.6. Infrequently, such as during startup operations, some suspended matter will be present. An alternative to the system described in Section 3.6.5 would be a system that would add 1 or 2 parts per million of acid to a small flowing stream for pH adjustment. Such a system would be complex and unreliable; therefore, it is not proposed.

9.2.4.5 Floor Drain Wastes

Floor drain wastes (see Section 3.6.6), which are produced intermittently, could be collected as they are produced and pumped to an oil-water separator before release. However, pumping of oil/water mixtures produces emulsions that are difficult to treat, especially on an infrequent-batch basis. This type of system would be complex and unreliable, and therefore is not proposed.

9.2.4.6 Bottom Ash Sluice Wastewater

Bottom ash sluice wastewater (see Section 3.6.9) could be discharged to the Flue Gas Desulfurization System (FGD) rather than treated in the Central Wastewater Treatment Facility before release. This would be undesirable in that the recirculated sluice water may become saturated with salts that would have an adverse impact on the operation of the FGD system in the form of scaling and plugging of the water spray system.

9.2.4.7 Boiler Chemical Cleaning Wastes

An alternative to the procedure outlined in Section 3.6.14 would be the following. Spent alkaline and acid cleaning solutions might be trucked offsite by the cleaning contractor. This would require disposal in a state-licensed facility, supervised by others. The onsite treatment method is more economical and more reliable.

An organic acid or solvent might be substituted for hydrochloric acid. The spent acid portion of the total waste could then be incinerated in a portable burner. However, this could produce an air pollution problem; further, the alkaline wastes would still require treatment or disposal.

9.2.4.8 Central Wastewater Treatment System

There are no viable alternatives to the proposed final wastewater treatment process. Physical equipment variations are possible, but the process should include pH control, chemical coagulation, flocculation, sedimentation, and monitoring before release.

9.2.5 Sanitary Waste Treatment System

The proposed Sanitary Waste Treatment System consists of a pre-fabricated, digestion-type sewage treatment plant. The alternative considered was a sewage disposal system including the collection of all sanitary wastes in large holding tanks which would be periodically emptied and transported to offsite treatment facilities by an outside contractor. The proposed system is considered more desirable because it would be under the control of SECI. There are no particular cost or environmental advantages associated with the alternative system.

9.2.6 Solid Waste Disposal System

9.2.6.1 Introduction

Three major kinds of solid waste will be produced by the proposed station: dry fly ash, wet bottom ash, and sludge from the flue gas desulfurization (FGD) system (SO_2 limestone scrubber).

Fly ash is proposed to be removed from the precipitator hoppers by a dry pneumatic system and deposited in concrete silos. The dry ash will be available for offsite sale and re-use. Unsold ash will be added to the scrubber sludge. Bottom ash will be collected in a wet hopper located beneath the boiler and removed by sluicing directly to dewatering bins. Scrubber sludge is proposed to be pumped from a thickener to a chemical processing plant. Solid wastes would be deposited in the northern portion of the site (Figure 3.1-1).

Four methods for ultimate disposal of solid wastes were considered. These methods were (1) wet ash and sludge to unlined ponds, (2) wet ash and sludge to lined ponds, (3) sludge dewatering and mixing with ash to produce stabilized cake, and (4) the use of chemical stabilizers to improve the handling characteristics of the stabilized cake. In addition, sale of fly and bottom ash as an alternative to onsite disposal was investigated by SECI.

The makeup water requirements for the FGD system depend on the method chosen for sludge disposal. A wet-sludge-to-pond system would include provisions to reuse decanted water from the pond as the sludge settles. Assuming seepage losses from the pond are minimized, the estimated makeup water requirements were estimated to be 2000 gpm. If seepage losses from the pond are large, the makeup water requirements will increase accordingly since less decanted water will be available for reuse. If a sludge stabilization or fixation method is used, the makeup water requirements are estimated to be 1200 gpm. As will be discussed, the required amount of makeup water will affect the environmental impact of the system.

9.2.6.2 Method No. 1, Wet Ash and Sludge to Unlined Ponds

This method would include a dewatering process to produce a mixture of scrubber sludge and fly ash at about 30 percent solids (70 percent water). The mixture would be placed in an unlined pond(s) in the northern portion of the site. Bottom ash would be disposed in a separate unlined pond(s). The makeup water requirements are estimated to be 2000 gpm plus any seepage losses from the pond system. The makeup water would be supplied by cooling tower blowdown (Figure 3.4-1).

Leachate from products of coal combustion is expected to contain trace elements in varying quantities. Disposal of such products (ash, scrubber sludge) in unlined ponds may be the most economical alternative available to SECI. The primary disadvantage of this method of disposal is potential impacts to ground water quality. Ground water investigations conducted by Dames & Moore (Section 2.3.2) have indicated that the principal ground water aquifer in the Putnam Site region, the Floridan Aquifer, is protected from potential impacts from surface storage of wastes by a confining layer known as the Hawthorn Formation. These investigations have also, however, indicated the presence of a second, shallow ground water body, termed the water table aquifer, that is not so protected. This aquifer exists in the upper layers of highly permeable sands on the site and receives its principal recharge from surface percolation.

The soil characteristics at the Putnam Site are such that any drainage through, or leachate from, solid wastes will freely leave an unlined pond, move through the soil, and enter the water table aquifer (see Section 5.5). Dames and Moore is of the opinion that, under existing conditions in the northern part of the site, water from the water table aquifer enters the swamp and the small unnamed ditch north of the site. This ditch discharges to Cedar Creek that eventually discharges to the St. Johns River. Therefore, impacts to the water table aquifer have the potential of extending to the small ditch and possibly to Cedar Creek and to the St. Johns River.

9.2.6.3 Method No. 2, Wet Ash and Sludge to Lined Ponds

This method would be identical to Method No. 1 except that the ponds would be lined by impermeable (or relatively impermeable) natural (clayey soil) or man-made (fabric membrane) materials. The purpose of the lining would be to protect the water table aquifer from leachate impacts.

Lining the disposal pond base with clayey materials may substantially reduce pond seepage and increase the attenuation of trace elements in the leachate. This alternative is more costly than the unlined pond alternative because clayey materials are not available onsite and would have to be transported to the site from considerable distances.

Lining the pond base with an impermeable membrane would prevent leachate seepage. This type of lining material would also greatly increase pond costs. Other types of lining material under consideration are bentonite, sludge and ash fixed with a chemical stabilizer, and asphalt concrete.

One effect of providing lining material to the ponds is that more

water would be available for recirculation in the FGD system (less water would be lost through seepage). The result would be a reduced requirement for FGD makeup which would be obtained from cooling tower blowdown, and an increase in discharge and blowdown impacts to the St. Johns River. The difference in blowdown discharge flows cannot be accurately estimated with the information at hand, but would be equal to the difference in seepage rates for unlined and lined ponds and would depend on the nature of the lining material and the configuration of the pond system.

The environmental tradeoff of pond lining would be potential impacts of seepage to the water table aquifer versus increased potential impacts of blowdown to the St. Johns River.

9.2.6.4 Method No. 3, Stabilized Cake

This method would involve a process whereby scrubber sludge would be dewatered and mixed with fly ash and bottom ash to produce a semi-solid stabilized cake containing 50 to 60 percent solids. The resulting material would be easier to handle and would be reduced in volume compared to Methods No. 1 and No. 2. Makeup water requirements would also be reduced because more water would be recovered from the material. It is estimated that the volume of waste material would be reduced by 40 to 50 percent and that makeup water requirements would be reduced to 1200 gpm. The waste material would be land-filled in the northern portion of the site.

Among the disadvantages of this method is its cost since a separate solid waste processing plant is required. The increased cost would include both capital and operation.

Another disadvantage of this process is the reduced requirement for system makeup water which would be obtained from cooling tower blowdown.

Thus, similar to the effect of providing pond lining (see Section 9.2.6.3), using this process would result in increased blowdown discharges to the St. Johns River. It is estimated that this process would require about 1200 gpm compared to 2000 gpm required for a wet sludge system. The difference, 800 gpm (or 1.78 cfs) would be equal to the increase in blowdown to the river. The result would be that 3.79 cfs would be discharged to the river if this method is used compared to 2.0 cfs if a wet-sludge-pond system is used, an increase of about 90 percent.

9.2.6.5 Method No. 4, Chemical Fixation

This method would involve a process almost identical to that for Method No. 3. The difference would be that chemical fixation agents would be added to the ash and sludge mixture to produce a stabilized solid material with the following characteristics: (1) compressive strength of 300 to 500 pounds per square inch, (2) low permeability, and (3) high chemical stability.

The material would be landfilled in the northern portion of the site. Because of the low permeability of the material, no lining material is likely to be required. This would tend to offset the higher cost of the process (operational costs would be increased over Method No. 3 because of the necessity of purchasing fixation chemicals).

An advantage of Method No. 4 is that the landfill material can be covered with native soil and planted with native vegetation. The end result would be the land could later be used for any one of a variety of purposes such as open space and timber production.

Relative impacts with respect to quantity of blowdown to the St. Johns River would be identical to that of Method No. 3 since the expected process water makeup is the same as for Method No. 3, 1200 gpm.

9.2.6.6 Choice of Ultimate Disposal Method

In October, 1978, an economic and engineering analysis of flue gas desulfurization systems was completed. The wet limestone process was shown to be the most feasible. On the basis of this selection, Seminole performed a site-specific, economic analysis of disposal alternatives:

Method No. 1, Method No. 2, and a combination of Methods No. 3 and 4. Factors included, as applicable, were: average capital cost of equipment and erection, present worth of combined energy and capability costs, estimated cost of pond excavation and fill, average evaluated additive cost, estimated cost of lining, present worth of operating labor, present worth of land fill equipment, and present worth of maintenance requirements. Not evaluated, but subjectively identified as associated costs were ground water monitoring, and short term and long term mitigative and maintenance measures that may be required if unconfined leachates were shown to pose a problem to public health and welfare.

The results of the evaluation showed that the combined Methods No. 3 and 4 was the most economical and most environmentally protective alternative. Studies have shown that the chemically stabilized cake yields a monolithic, nearly-impermeable mass which will not reliquify, channel, or permit permeation or runoff to any appreciable degree. The costs of the combination of Methods No. 3 and 4 resulted in a 2 percent savings over Method No. 1 and a 3 percent savings over Method No. 2. Additionally, the disposal area is effectively reduced from 460 acres to about 300 acres. This reduction results from the ability to use the stabilized sludge as material for the formation of dikes and lining. On this basis, Seminole is proposing to use a stabilized-cake, sludge-ash disposal procedure.

9.2.7 Intake Structures

9.2.7.1 Introduction

Six intake structure designs were evaluated for the proposed station. A biological evaluation of the alternative structures has been performed. The U.S. Environmental Protection Agency guidance document (1977a) was used in the evaluation, along with other pertinent field data and literature.

Of the screening systems proposed for the alternative structures, only fine-mesh screening can keep out the smaller life stages of the smallest fish present in the site area. A net mesh size of about 0.5 millimeter (mm) is used to collect eggs and larvae of most fish species. Such an opening size on a screening device would ensure almost total

protection of fish eggs and larvae from entrainment. Such an opening size is not, however, likely to be the most practical considering its potential for plugging (fouling).

In addition to a small opening size, a low intake velocity of less than 0.5 feet per second (fps) through the screen is necessary to prevent impingement and retention of smaller fish on the screen. Almost all fish, including larvae, impinged at less than 0.5 fps will be able to free themselves from entrapment.

It may not be feasible to protect all life stages of a given species from entrainment because of plugging and fouling problems associated with extremely fine-mesh screens. Also, from a biological point of view, entrainment of the earlier life stages of a species may be an acceptable impact because of the nature of the reproductive cycle. Aquatic biological studies going back 20 years have shown that the removal of early-life-stage fish is less damaging to the overall population of a species than removal of more mature fish (McFadden, 1977; W. Van Winkle, 1977; Copeland, Hodgson, and Berket, 1975). The removal of some young individuals when natural mortality is still compensatory is at least partially balanced by increased survival and/or growth of the remainder. This is not an unexpected phenomenon, when one considers the naturally high mortality rate of newly hatched fish, which may exceed 99.9 percent for many species.

The final selection of a screen opening size and intake velocity for the proposed station intake will be based on an evaluation of the expected biological impacts and the engineering and cost feasibility of the intake structure required to accommodate screens of various sizes.

The six intake alternatives that were considered are:

Scheme 1 - Modified conventional intake with standard traveling screens. The modifications for fish protection include "flush mounting" of the screens and the provision of fish escape passages through the outside walls of the structure.

Scheme 2 - The same general configuration as Scheme 1, but with the traveling screen itself modified with the Surry-type, dual-spray fish recovery system.

Scheme 3 - Perforated (or wedge-wire) pipe offshore intake, with pump structure on shore.

Scheme 4 - Perforated (or wedge-wire) pipe shoreline intake, utilizing multiple removable screen units.

Scheme 5 - Radial well system (Ranney collectors).

Scheme 6 - Cylindrical, wedge-wire shoreline intake, utilizing multiple removable screen units.

A location key plan for the proposed intakes is shown on Figure 9.2-1.

9.2.7.2 Scheme 1 - Conventional Intake with Flush-Mounted Traveling Screens

A plan and section of the Scheme 1 intake structure are presented in Figure 9.2-2. This structure can have either one or two screens.

If only one screen is employed, the only modification that would be made to the "conventional" traveling screen intake design would be a fish escape passage provided in both outside walls of the structure. The screen baskets could also be modified so that the side plates do not protrude forward of the screen face. It is believed that such a modification would allow small fish to swim unimpeded to the right or left of the immediate screen face.

If two screens are employed, the supporting wall between the screens would also stop at the screen face, giving a clear passage for fish across the entire face of both screens to the escape ports in the outside walls. A dredged channel to deep water would be required.

The advantages of this intake design are:

1. it is a proven intake type that uses technology known to be reliable, and
2. the shoreline location of the intake structure would make it less visible to residents along the river. If necessary, the structure can be covered with a frame or block building.

The disadvantage of this scheme is that, of all the alternate screens, this is least likely to mitigate potential entrainment impacts that could occur at the Putnam Site. This evaluation assumes a relatively large (3/8 inch or 9.5 mm) screen opening and an intake velocity of less than 0.5 fps (to comply with U.S. Environmental Protection Agency guidelines). With this low intake velocity, large fish in good condition will, for the most part, be able to avoid impingement. Entrainment impacts on small organisms would not be mitigated. Impacts to the aquatic biota associated with channel dredging would occur during intake construction and channel maintenance.

9.2.7.3 Scheme 2 - Conventional Intake with Surry-Type Screen

This intake, shown on Figure 9.2-3, would be structurally identical with Scheme 1, including the fish passages. The only difference would be in the details of the traveling screen, which would be modified as follows:

1. Water- and fish-holding buckets would replace the conventional lifting lips on each 2-foot-high screen panel.
2. Two spray-and-trough systems would be provided instead of one. The first encountered by the moving screen would be a gentle spray or deluge which would discharge fish into a fish recovery flume. The second would be a conventional high-pressure spray system blasting debris into a debris flume. The fish recovery flume would carry the fish back to the river. This screen must operate continuously when performing its fish recovery function to keep to a minimum the time that impinged fish must remain trapped on the screen face.

While this type of design is a recognized conventional intake type, it has several disadvantages:

1. it is more complicated than the Scheme 1 design; and
2. it has higher initial and maintenance costs than Scheme 1.

This scheme is believed to be only slightly better, from a biological point of view, than Scheme 1. If the screen openings are relatively large (9.5 mm), the potential entrainment impacts of the intake would not be mitigated by this design. With low velocities (less than 0.5 fps) maintained through the screen openings, the fish recovery system would serve little use because large fish in good condition would, for the most part, be able to avoid impingement. Impacts associated with construction and maintenance dredging would still be present.

9.2.7.4 Scheme 3 - Perforated (or Wedge-Wire) Pipe Offshore Intake

This intake system, shown on Figure 9.2-4 would consist of an offshore screen unit, a gravity pipe leading to shore, and a pump structure at the shoreline (or set back, as may be desirable for aesthetic reasons).

The offshore intake unit would consist of one or more perforated (or wedge-wire) cylindrical pipe sections. The wedge-wire winding screen would have the standard 9.5 mm opening. A cleaning platform to allow brush-scrubbing of the face of pipe screens is also included in this design. Routine cleaning would normally be done by a backwash of either compressed air, water, or a combination of the two.

Advantages of this scheme are the following:

1. Assuming sufficient water depth is encountered at reasonable distances offshore, neither confined channels to trap fish nor construction/maintenance dredging are required,
2. Many of these intakes are in service and have performed well from a reliability standpoint,

3. Mechanical design is simplified by the elimination of traveling screens, and

Disadvantages of this system are:

1. Most intakes of this type have been placed in fairly fast - moving water whose current assists in keeping the screen clean. Performance in relatively quiet water such as exists at the Putnam Site is not known,
2. The screen units must be placed in relatively deep water, well offshore. Visible protective barriers that may affect the scenic quality of the river must be installed to protect both the screens and passing boats,
3. Mechanical design is complicated by the addition of an air and/or water backwash system, and
4. Mechanical cleaning by brush may be required to prevent fouling. If so, the offshore location would make it extremely difficult to achieve brush scrubbing because of access difficulties.

9.2.7.5 Scheme 4 - Perforated (or Wedge-Wire) Pipe Shoreline Intake

This type of intake structure, shown on Figure 9.2-5 would be located at the shoreline in the same manner as Schemes 1 and 2. A dredged channel would carry water to shore. Multiple, readily removable screen units utilizing extremely small (1 to 2 mm) openings would be provided. These would be mounted on a wall. Screen units would be removed by overhead hoists and carried to a cleaning deck for scrubbing. Appropriate valving would be provided to permit isolation of individual units for in-place backwashing and for complete removal. From a biological point of view, this is the second most desirable intake design as indicated in Section 9.2.7.8.

This type of intake is a recent development. It has no service history beyond that of a test facility of the Delmarva Utility Company. The major reason for using such a design, rather than the offshore type of perforated pipe intake, would be to permit normal, periodic removal of the screen units to brush-clean biological growth from both the outside and

inside of the screen units. Thus, they are advantageous only when biological growth is expected. Such growth has not been a problem to date in fresh water, but can be a serious problem in salt water. It is not known whether biological growth would be a problem at the Putnam Site.

9.2.7.6 Scheme 5 - Radial Well System (Ranney Collector)

The radial well, shown on Figure 9.2-6, is a horizontal version of the vertical water well. Horizontal collector pipes are jacked out of a pump caisson into the surrounding aquifer. The inflow capacity of these pipes is developed in a manner similar to vertical wells.

Preliminary information regarding the subsurface material at the site indicates that a radial well system installed at the site may have the following characteristics:

1. Two 16-foot inner diameter (19-foot outer diameter) caisson units spaced as far as 1,500 to 2,000 feet apart. Two river-front properties would therefore be required.
2. Six radial collector pipes for each caisson; each pipe would be 16 inches in diameter by 250 feet long.

This intake can only be used where a suitable aquifer is available.

The following are the advantages associated with this type of intake scheme.

1. As indicated in Section 9.2.7.8, the radial well system is the most desirable from a biological point of view. Water is drawn in from the bed of the river at nearly imperceptible velocities.
2. The radial well system causes minimum disruption to the environment during construction. The pump caisson is lowered into the ground without the necessity of cofferdams or dredging. The horizontal collector pipes are jacked out under the river without disturbing the riverbed.
3. Radial wells have been in service about 40 years and have an excellent record of performance where favorable geologic conditions exist.

Disadvantages of this scheme are as follows:

1. Occasionally, the radial well system must be redeveloped as a maintenance procedure after some period of operation.
2. This type of intake is suitable only where favorable geologic conditions exist (i.e., an aquifer with high transmissivity and a hydraulic connection to the river).

9.2.7.7 Scheme 6 - Cylindrical Wedge-Wire Screen Intake

This scheme would employ a simple, semi-circular layout shown in Figure 9.2-7. The screen would consist of eight cylindrical wedgewire screens units.

The screen structure will be located near the shoreline to allow access by maintenance personnel. A crane will be provided so that screen units can be lifted out for cleaning by water pressure hoses and brush scrubbing. This would be accomplished by cutting off flow through a screen unit by closing its sluice gate before lifting it out.

The screen surface area will be designed to achieve a through-screen velocity of 0.2 feet per second (fps) with clean screens. Screens will be cleaned when fouling reduced the screen opening area to the point that through-screen velocities reach about 0.4 fps.

At the centerline of each screen unit will be an embedded air backwash pipe. An air compressor equipped with a flexible air line will be provided. This will allow each screen unit to be cleaned in place by following these steps. First, the sluice gate for the unit to be air cleaned will be closed. Second, the flexible air line will be attached to the unit's air backwash pipe. Third, compressed air will be forced through the unit in the reversed direction from normal flow. This procedure will reduce the required frequency for mechanical removal and brush cleaning.

The final selection of screen opening size is expected to be within the range of 1 to 2 mm, and will be the smallest feasible opening size that will not cause excessive fouling (Section 5.2.2.2).

The advantages of this intake scheme are as follows:

1. Low capital costs.
2. Few anticipated operational problems since it is mechanically simple.

Disadvantages of the scheme are as follows:

1. A dredged intake channel is required. Thus, some construction impacts can be expected. Also, impacts of maintenance dredging can be anticipated.
2. The design concept is relatively new and untried.

9.2.7.8 Environmental Ranking of Intake Schemes

Based on the aquatic ecology characteristics of the St. Johns River in the Putnam Site area, the six intake schemes were ranked according to their desirability. The following list begins with the most desirable intake scheme:

Scheme 5 - Radial Well Intake. This is most desirable because virtually no aquatic impacts are expected.

Schemes 4 and 6 - Perforated (or wedge-wire) pipe or cylindrical wedge-wire screen units utilizing the smallest feasible screen opening size and through-screen velocities less than 0.5 fps. These two schemes are considered equal in biological protection and will mitigate against entrainment impacts to the maximum extent practicable.

Scheme 3 - Perforated (or wedge-wire) pipe offshore intake with 9.5 mm screen openings and through-screen velocities of 0.5 fps or less. Because ambient river velocities are slightly higher offshore (as compared to onshore) and because of the positioning of the screen openings relative to currents, some entrainment mitigation may be realized compared to an onshore structure that utilizes screen opening sizes of equal size.

Scheme 2 - Conventional intake with Surry-type fish recovery system and standard 9.5-mm mesh screen. While the fish recovery system may save larger fish, smaller species and early-life-stage fish will be adversely impacted by entrainment.

Scheme 1 - Conventional intake with standard 9.5-mm mesh screen. This is the least desirable intake since little mitigation of potential impacts of impingement and entrainment is offered.

9.2.7.9 Choice of Intake Design

Scheme 6 was chosen for this project. The other schemes were rejected for the reasons explained below.

Intake Schemes Eliminated from Consideration

Scheme 1 was rejected because of unacceptable biological impacts.

Scheme 2 was rejected for the same reason as Scheme 1.

Scheme 3 was rejected because of probable difficulty in maintaining and cleaning of screens, and because of expected unacceptable entrainment impacts.

Scheme 4 was rejected in favor of Scheme 6 because of higher relative construction costs.

Scheme 5 was rejected because of the existence of unfavorable geologic conditions. As seen in Table 9.2-3, the presence of fine materials (silts and plastic clays) preclude the existence of a suitable aquifer with hydraulic connections to the river.

Description of Selected Intake

The selected intake (Scheme 6) is shown in Figure 9.2-7. The screen units will be the wedge-wire type screens manufactured by the Johnson Division of U. O. P., Inc. They have been successfully used to mitigate against entrainment by virtue of their small openings and surface boundary effects and against impingement by their uniform low through-screen velocities. The finally selected screen opening size will be 1 or 2 mm as determined by a screen test.

Intake Screen Test

To determine the final design of the shoreline screen structure (Scheme 6), an in situ test described in Section 5.2.2.2 is planned for the Spring and Summer of 1979. The screen test will lead to the final selection of screen opening size.

9.2.8 Discharge Structure

A single discharge pipeline will be provided to carry cooling tower blowdown and discharges from the Central Wastewater Treatment System and

sanitary system to the St. Johns River. Two basic alternatives were considered. The difference between them relates to location of the discharge point with respect to the shoreline rather than type of discharge structure. The choice of location depends on the final location of the intake structure.

Preliminary model studies indicated that a separation of 150 feet is necessary between the points of intake and discharge to prevent excessive recirculation of discharged water to the intake. Since it is desirable to limit the consumption of land area for pipeline corridors, it was decided to utilize a single, narrow corridor for both the intake and discharge pipelines. In order to achieve desirable separation of the intake/discharge points, the following alternatives were considered:

Nearshore Discharge - This would be used if the intake is located offshore. In order to provide sufficient water depth at the discharge point, it may be necessary to provide a dredged channel from the discharge point to deep water. The channel would be angled away from the intake structure so that discharged wastewater would be directed away from the intake.

Offshore Discharge - This is the selected alternative since the intake will be either radial well or near shore. If a shoreline intake (Scheme 4 or 6) is used, the discharge point will be located at least 150 feet from the entrance to a dredged intake channel and far enough offshore to encounter water of appropriate depth.

The type of discharge structure is described in Section 3.5.3.

Table 9.2-1

Parameters Used in Estuarine Modeling Study
of Thermal Discharge to the St. Johns River
for Once-Through Cooling

<u>Parameter</u>	<u>Once-Through Cooling</u>	<u>Once-Through With Topping Tower</u>
Discharge Rate (cfs)	1900	1886
Discharge Temperature (°F)	101	92
Ambient River Temperature (°F)	87	87

Table 9.2-2

Summary of Results of an Economic Analysis
of Natural Versus Mechanical Draft,
Wet-Type Cooling Towers.

Assumptions:

Number of towers	2
Heat Load	5.94×10^9 Btu/hr.
Circulating Water Flow	600,000 gpm
Approach	10 °F
Range (ΔT)	19.8 °F

<u>ITEM</u>	<u>NATURAL DRAFT</u>	<u>MECHANICAL DRAFT</u>
Pump Head, ft.	43.9	42
Δ Pump Head, ft.	1.9	Base
Δ Pump hp	306	Base
Fan hp	None	3,816
Total Δ Hp	306	3,816
Total Δ Energy (kW)	228	2,922
Total Capital Cost	\$21,000,000	\$16,688,000
Present Worth of Energy*	\$ 866,400	\$11,103,600
Total Evaluated Cost	\$21,866,400	\$27,791,600

*Present Worth of Energy is based on \$3800 per kilowatt (kW). This figure is based on the capitalized and annualized cost of providing the energy and is consistent with the economic evaluations in SECI's electric power needs study.

Table 9.2-3

Description of Soils from Log
of Bore Hole Located in
the Preferred Pipeline Corridor
(Ground Elevation at Boring = 14.33 ft)

<u>Depth (feet)</u>	<u>Soil Description</u>
0 - 4	Dark gray fine sand
4 - 19.5	Light brown clay and silt, medium plastic
19.5 - 31.5	Gray clay, very highly plastic
31.5 - 46	Soft dark gray clay
46 - 51.5	Fine sand, trace fine silt with shell frag- ments

Source: Burns and Roe, Inc.

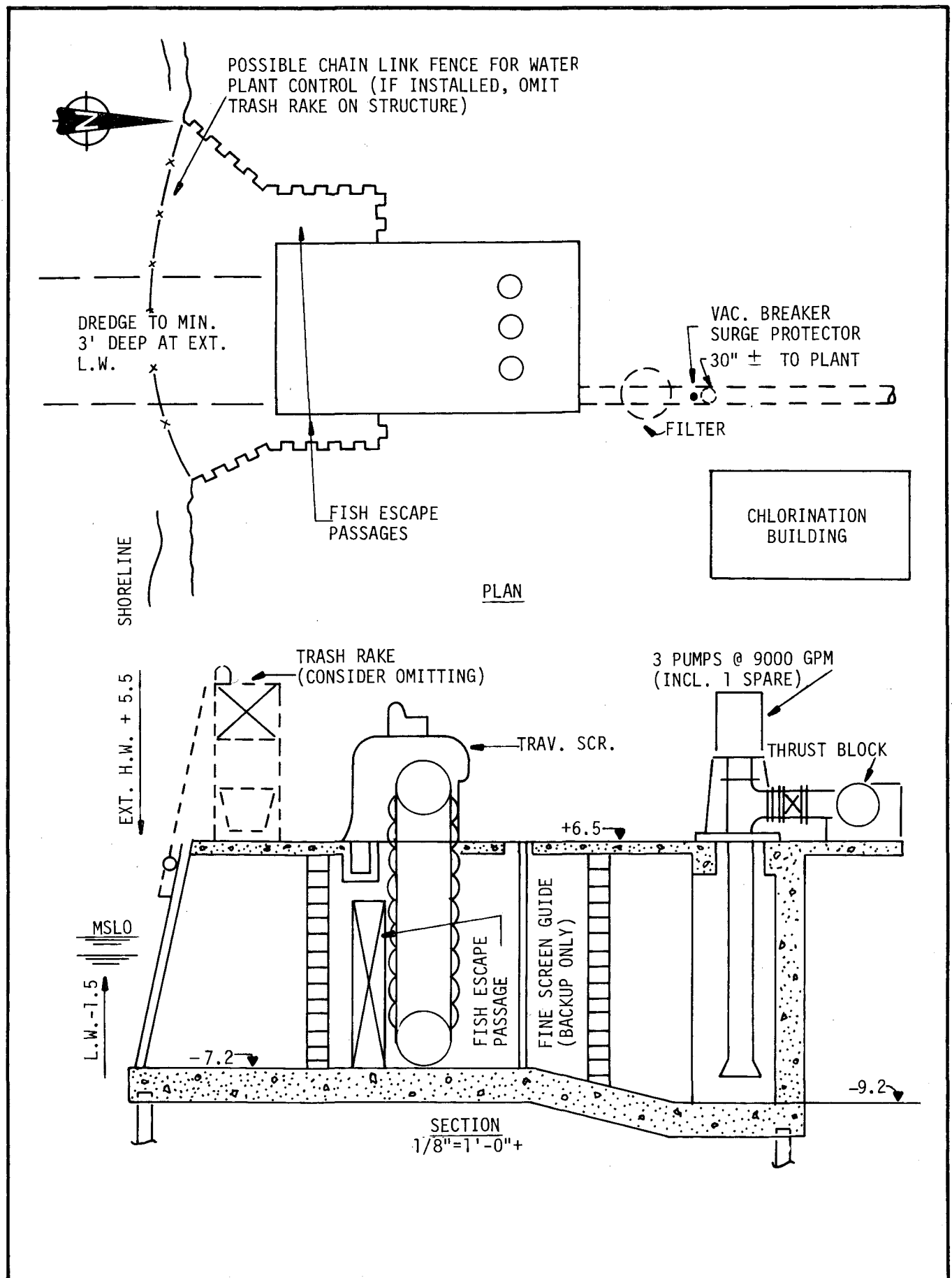


Figure 9.2-2. Scheme 1-Conventional Intake with Flush-Mounted Traveling Screen.

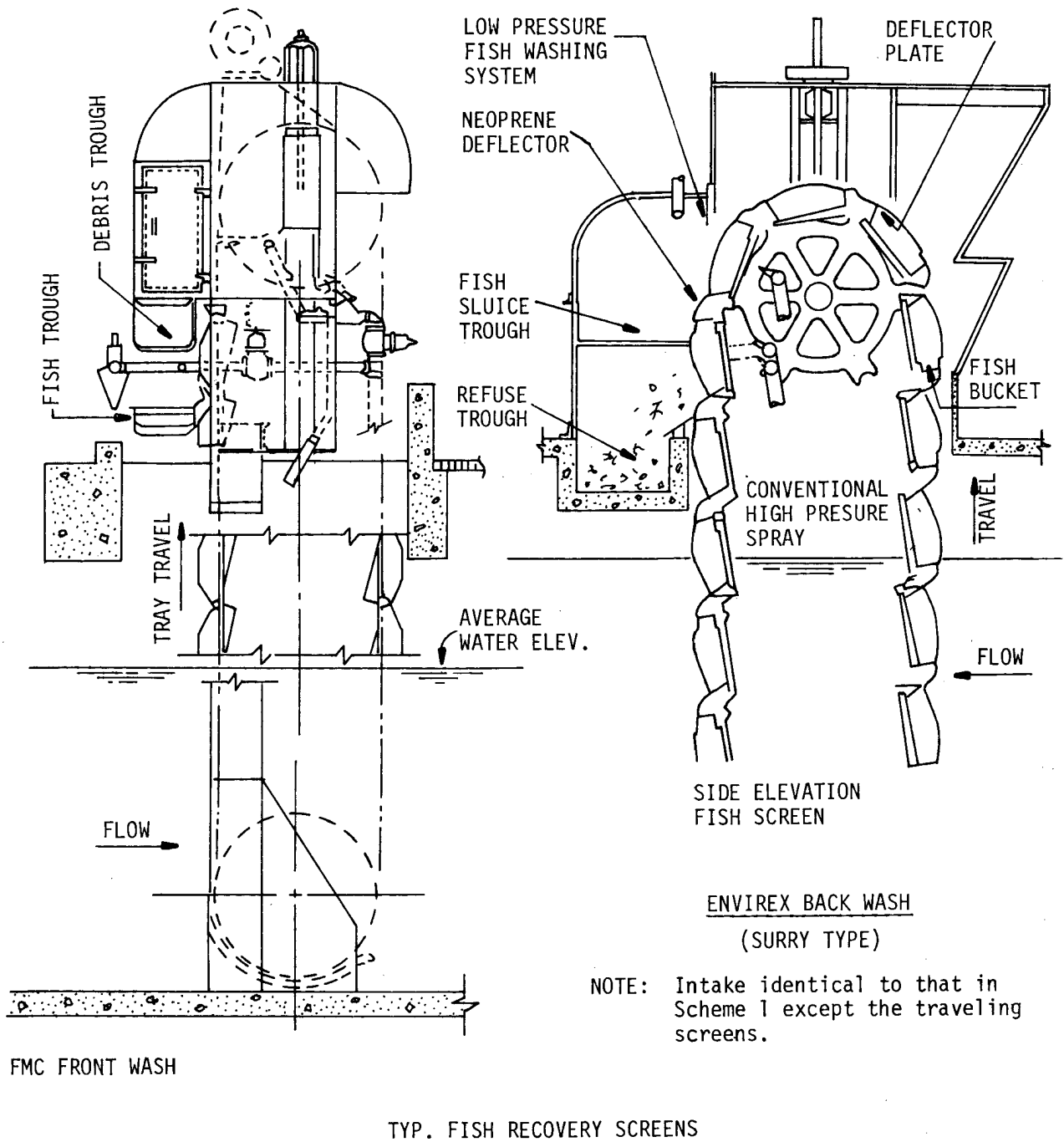


Figure 9.2-3 Scheme 2 - Conventional Intake With Surry - Type Fish Recovery System

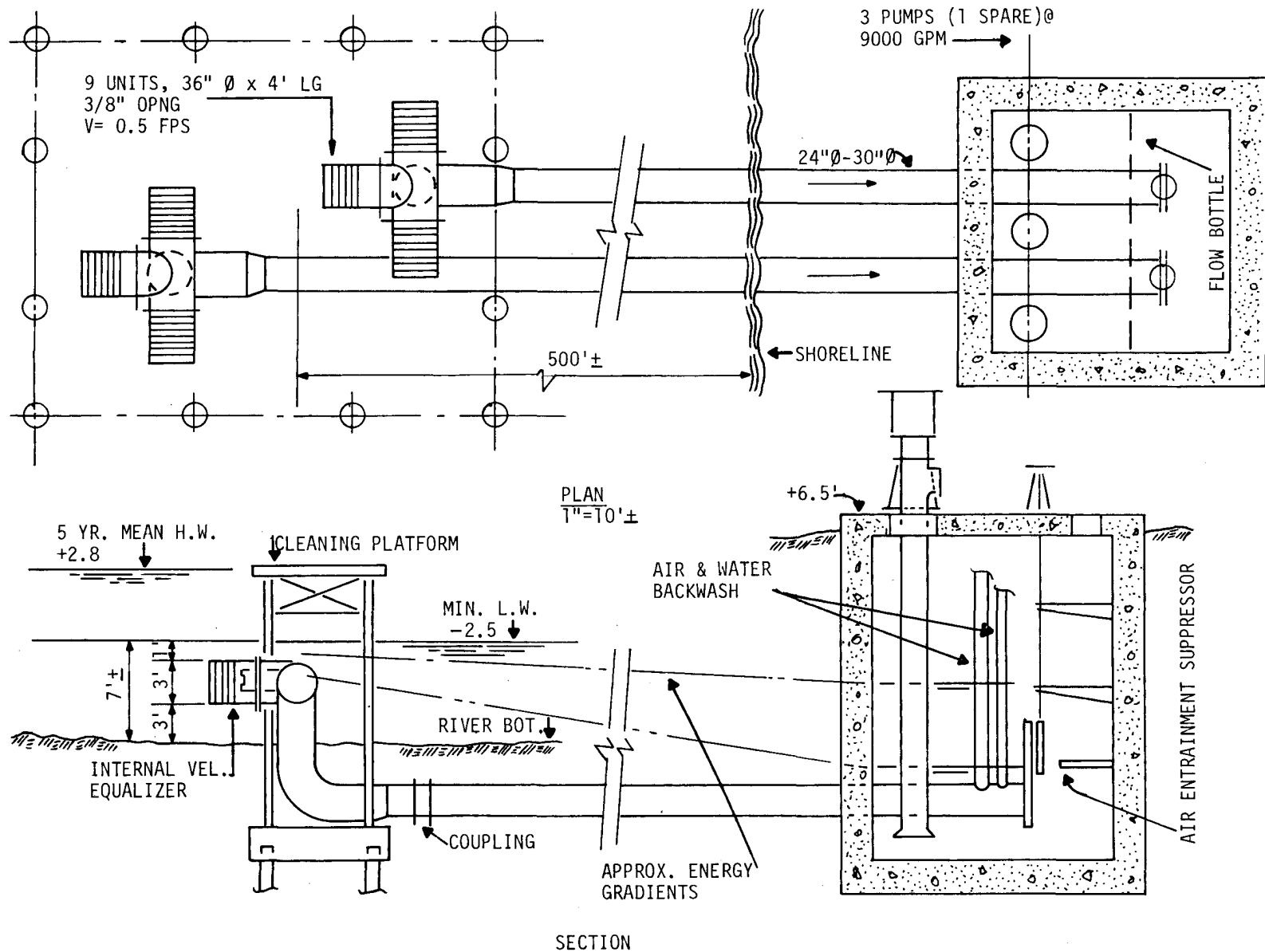


Figure 9.2-4. Scheme 3 - Perforated (or Wedge-Wire) Pipe Offshore Intake.

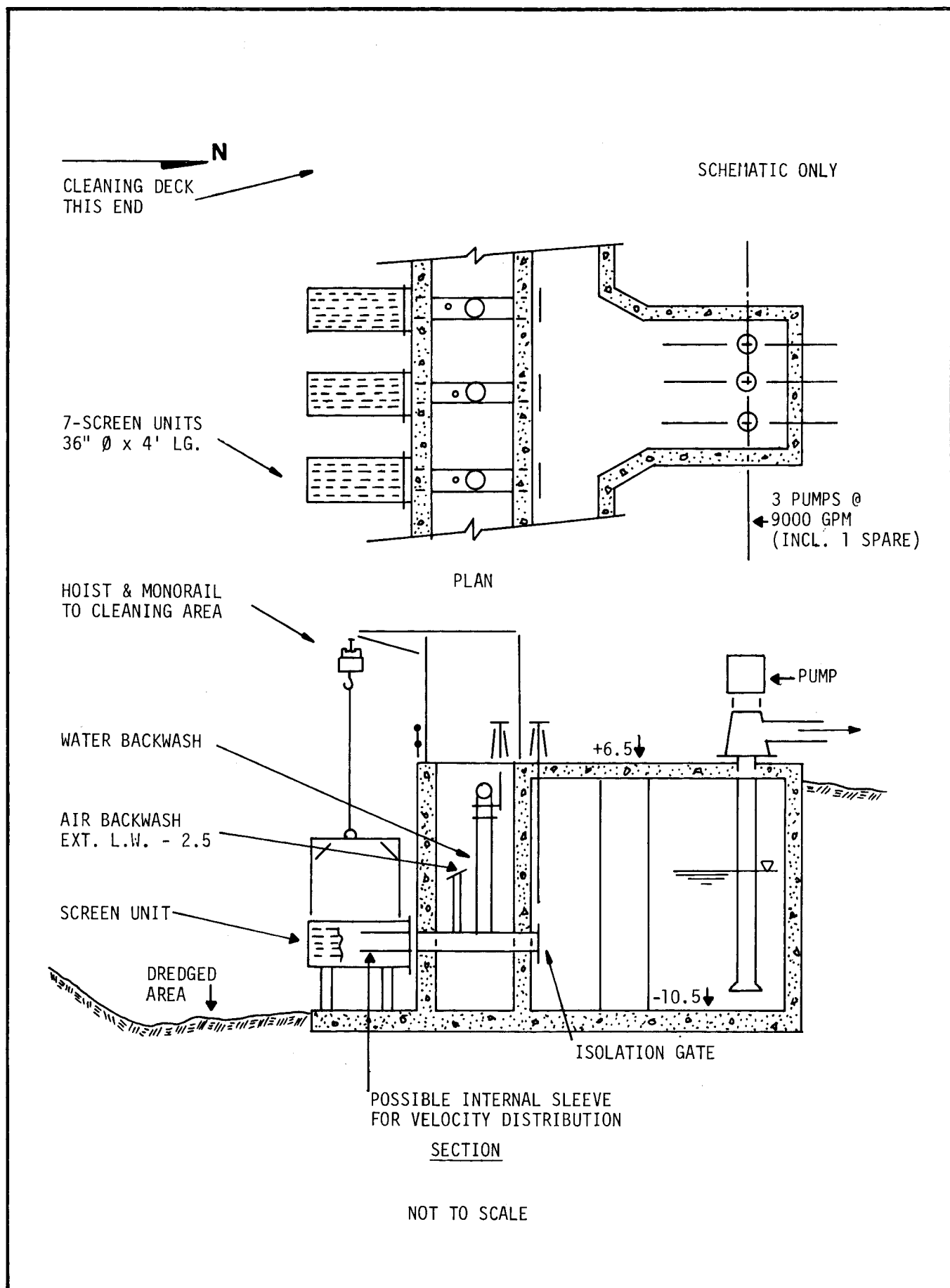


Figure 9.2-5. Scheme 4 - Perforated (or Wedge-Wire) Shoreline Intake.

FOR SEMINOLE ASSUME:

2 CAISSONS - 16' I.D., 19' ϕ .D.

6 HORIZ. SCR. PIPES PER CAISSON - 16" O x 250' LG

2 PUMPS @ 6000 GPM
(4 TOTAL INCL. 1 SPARE)

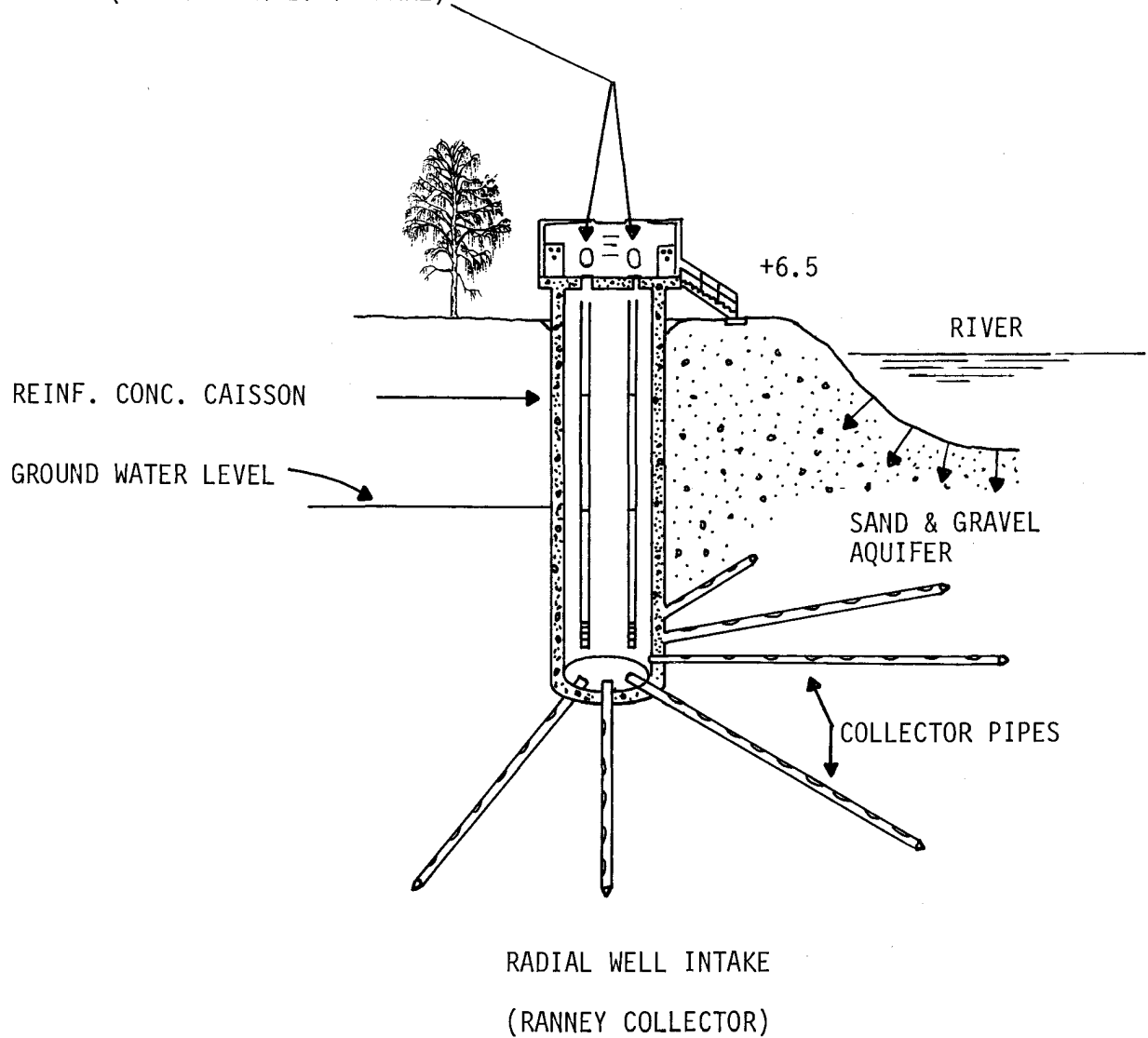


Figure 9.2-6. Scheme 5 - Radial Well System.

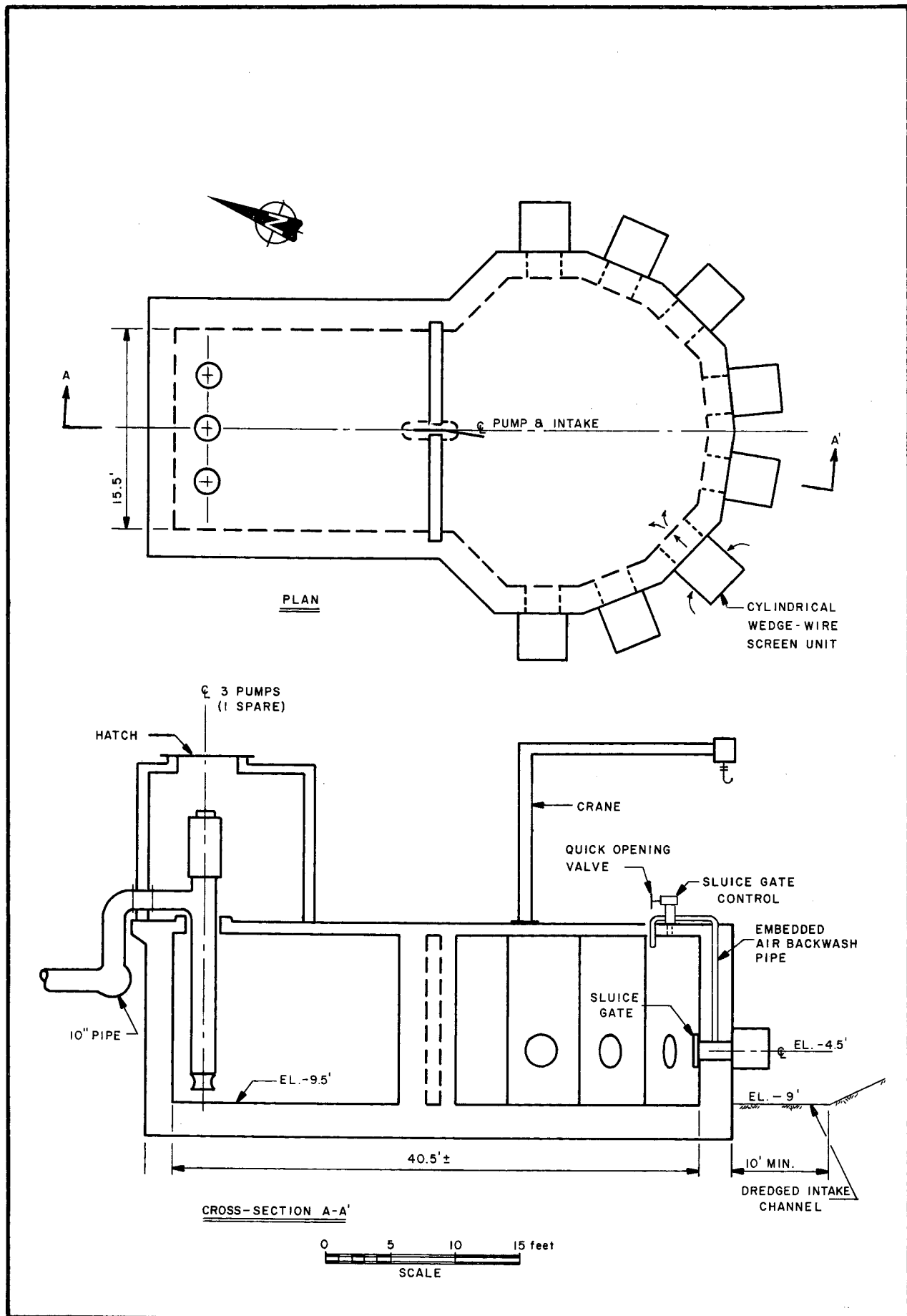


Figure 9.2-7. Scheme 6 - Cylindrical Wedge-Wire Screen Intake.

9.3 ALTERNATIVES TO SITE UTILIZATION

9.3.1 Environmental Site Layout Guidelines

Recognizing the importance of integrating environmental knowledge into the engineering design process, SECI initiated a series of conferences between the environmental consultant, Dames & Moore, and the architect/ engineering consultant, Burns and Roe, Inc. (BRI). The conferences were an important part of the interaction between parties structured to achieve the goal of developing a facility design that fully reflects site-specific environmental conditions and state and federal environmental regulatory compliance requirements.

Among the specific objectives of this interaction was to develop a facility layout that will optimize site utilization with respect to the site's environmental characteristics as well as engineering design requirements. To achieve this objective, Dames & Moore developed a series of recommendations that were formalized as "Environmental Site Layout Guidelines," and are presented in this section. The final layout of major station facilities (Figure 3.1-1) is based, in part, on these guidelines.

The Environmental Site Layout Guidelines are presented along with the rationale for their development. The zones (A through D) referred to in the following discussion are shown on Figure 9.3-1. These zones were identified from studies of the site's environmental characteristics.

Ash and Sludge Disposal Should be Confined to Zone A

The following items present the rationale for confining ash and sludge disposal to Zone A:

1. In Zone A, ground water flow is predictable and is in one direction (downslope toward the north). See Section 2.3.2.
2. Few residents are located downslope in the direction of ground water movement (Figure 2.8-4).

3. More fine material exists in surface soils within the lowland area in Zone A, compared to other parts of the site (Section 2.2.7). This fine material would help to mitigate subsurface movement of leachate from waste materials.
4. Compared to other parts of the site, fewer site preparation activities (in the form of dike construction, cut-off trenches, etc.) would be required to confine wastes, if this becomes necessary. Therefore, less environmental impact and lower costs would result.

The recommendation to use Zone A containing the lowland at the northern extension of the site for the indefinite storage of coal-combustion waste materials considered several favorable and unfavorable factors. Factors unfavorable to this proposed use of the lowland included:

1. The lowland is designated a "preservation" area in the Coastal Zone Management Atlas (Figure 2.8-2).
2. The lowland is designated as a flood-prone area in the USGS Flood-Prone Atlas (Section 2.3.1).

Factors that tend to favor the utilization of the lowland included:

1. The lowland is not contiguous to navigable waters (Section 2.3.1).
2. The lowland has apparently been extensively disturbed by past logging activities (Section 2.7.1).
3. The lowland is only periodically inundated; it is thus unlikely to be an important aquatic resource (Section 2.7.1).
4. The lowland is not a unique or critical habitat; many thousands of acres of this type of habitat exist in Florida (Section 2.7.1).

The Most Desirable Location for Coal Storage is in Zone A; The Second-Best Area is Zone B

Because of potential runoff impacts from coal, the rationale given for the ash and sludge disposal recommendation also applies to coal storage in Zone A. Zone B is also acceptable, but not as good as Zone A. Zone B contains fine surface soils that would help to contain or control leachate and runoff, but the direction of ground water flow is less certain in Zone B than in Zone A.

Avoid Placing Leachate-Contributing Facilities on the South Slopes of the Site

Migrating leachate from facilities on the south slopes of the site might reach wetlands contiguous to the St. Johns River. Most residences in the site vicinity are located south of the site on the bank of the St. Johns River. To preclude the potential of contamination of domestic wells, sludge and ash disposal facilities should not be located on the south slopes of the site.

Heavy Structures Should be Located on Flat Areas; Zone C is Most Desirable; Zone B is Second Best

Construction of heavy structures on flat ground would result in less earthwork, less chance of differential settlement, less construction impact, and lower costs. Zone C represents the best flat ground on the site. Zone B is also a flat area. However, there is evidence that standing water has existed in that area. Therefore, there is a greater risk of solution activity in underlying materials. Zone B is also considered second best because some organic soils exist there (Section 2.2). Construction in Zones B and C would make maximum utilization of the area designated "development" in the Coastal Zone Management Atlas Figure 2.8-2).

Maintain Distance Between Cooling Towers and Other Features

A separation of 2,000 feet or greater is desirable between cooling towers and local highways. This will reduce the potential for fog development, especially if low-profile mechanical draft cooling towers are used.

If high-profile, natural draft cooling towers are used, the distance between the towers and the flue-gas chimneys must be at least equal to or greater than three times the height of the towers. This distance is necessary to prevent wind-wake effects from disturbing flue-gas plume development.

An adequate separation between cooling towers and the switchyard, and between the coal storage area and the switchyard, should be maintained in order to prevent possibility of corrosion and flashover. In addition, placing the switchyard on the west side of the site to minimize transmission line length, and to avoid crossing other structures, was also recommended.

Maintain 300-Foot-Wide Buffer Zones Around Site, Particularly Along West Side of Site Near U.S. Route 17

A 300-foot-wide buffer zone with trees would achieve an attenuation of 10 decibels of construction- and operation-generated noise. In addition, a buffer zone would provide a visual screening of construction and operation activities and facilities.

The buffer zone should include the entire south slope in order to maintain erosion protection as well as noise attenuation and visual screening.

9.3.2 Pipeline Corridors

9.3.2.1 Introduction

Pipeline corridors for transporting plant effluent and cooling tower makeup between the plant and the river were identified on the basis of the following factors:

1. Proximity to the site
2. Existing residential structures

3. Location of the navigational channel in the St. Johns River - this channel should be a sufficient distance offshore that no interference with barge or boat traffic would result from intake and pipeline placement.

The studies conducted to evaluate Corridors A, B, and C (Figure 9.3-2) included a terrestrial ecology reconnaissance, a complete aquatic sampling program, a bathymetry survey, and an archeological reconnaissance.

9.3.2.2 Environmental Comparison of the Pipeline Corridors

The results of the comparative evaluation of the pipeline corridor alternatives are displayed in Table 9.3-1. On the basis of economic, terrestrial ecological, land use, and archaeological advantages, Corridor A appears to be the best choice. The most important consideration is the potential impact on aquatic resources. Based on the results of the aquatic sampling program that found markedly smaller numbers of fish and other nekton species and individuals at Corridor A, it was selected as the best location for the intake structure (Section 5.2.2.2).

Table 9.3-1

Generic Environmental Comparison
Alternative Pipeline Corridors

ECOLOGY		
	<u>Advantages</u>	<u>Disadvantages</u>
CORRIDOR A	1. The shortest route; disruption would be kept to a minimum. 2. Aquatic species numbers and diversity are markedly lower than at other corridors. 3. No encroachment on wetlands. 4. Almost no presently undisturbed habitats would be affected.	1. Some hardwood forest species would be disturbed along shoreline.
CORRIDOR B	1. None	1. One of the longest routes; would disturb a relatively large area during construction. 2. Aquatic species numbers and diversity were markedly higher than Corridor A (about the same as Corridor C). 3. Some minor wetlands may be disturbed. 4. Luxuriant growths of hardwood forest species east of State Route S209; these would be disturbed by construction.
CORRIDOR C	1. None	1. 1 through 4. Same as Corridor B.

Table 9.3-1 (Continued)

LAND USE-SOCIOECONOMICS		
	<u>Advantages</u>	<u>Disadvantages</u>
CORRIDOR A	1. Only three residences are within 1,000 feet of the intake location (they are 600 feet, 700 feet, and 900 feet distant). 2. Shoreline is 2,500 feet from barge channel. 3. Corridor length from powerhouse to shoreline is 7,300 feet.	1. Corridor crosses 1,200 feet of land not under option by SECI.
CORRIDOR B	1. Nearest residence (to intake) would be over 1,000 feet distant 2. Shoreline is 2,000 feet from barge channel.	1. Corridor length from powerhouse to shoreline: 19,300 feet. 2. Corridor crosses 14,300 feet of land not under option by SECI. 3. Two archaeological sites (middens) that may be considered eligible for inclusion in the National Register of Historic Places lie within corridor (Appendix J).
CORRIDOR C	1. Nearest residence about 2,000 feet distant. 2. Shoreline is 3,700 feet from barge channel.	1. Corridor length from powerhouse to shoreline: about 19,200 feet. 2. Corridor crosses 14,200 feet of land not under option by SECI.

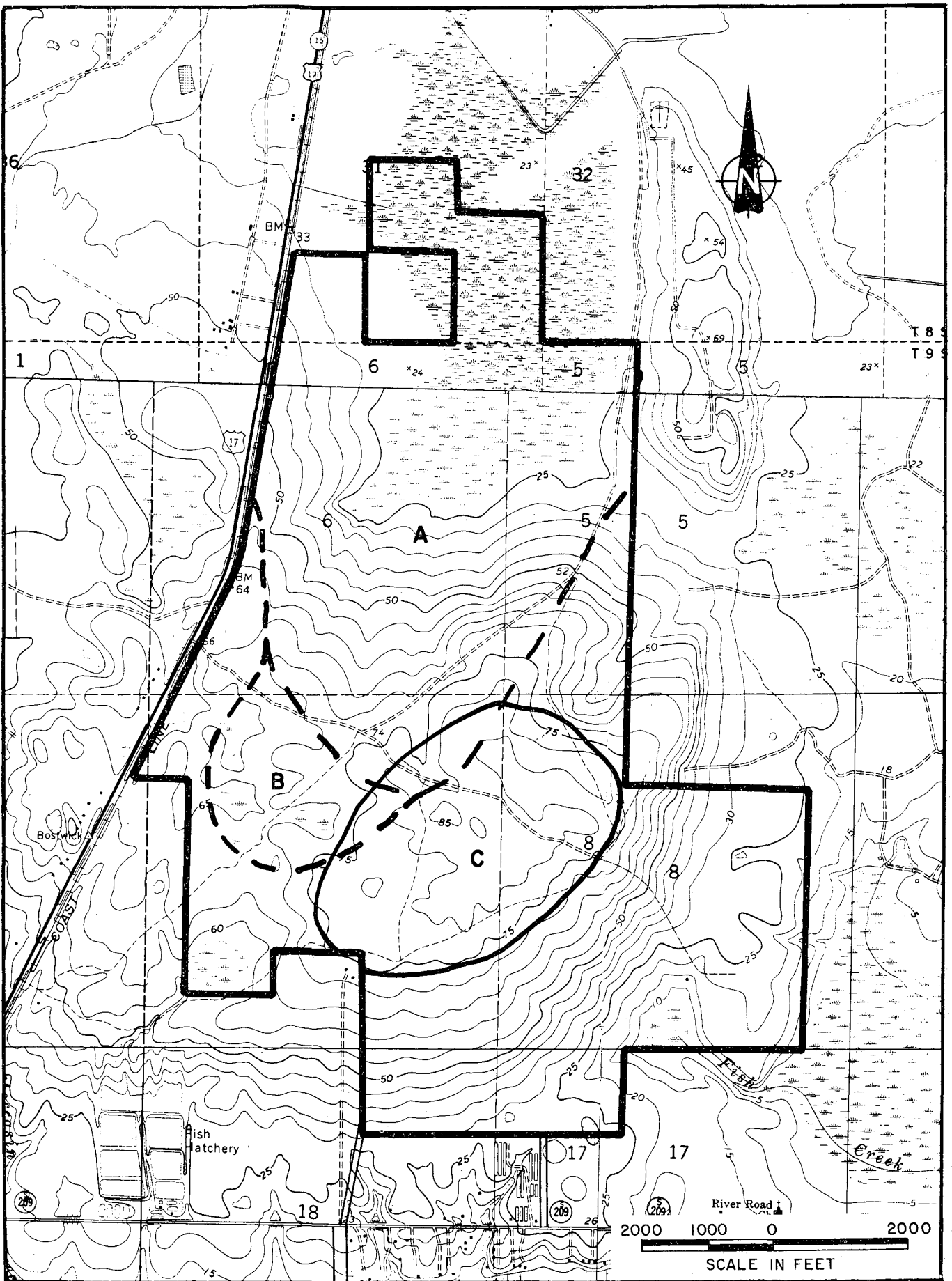
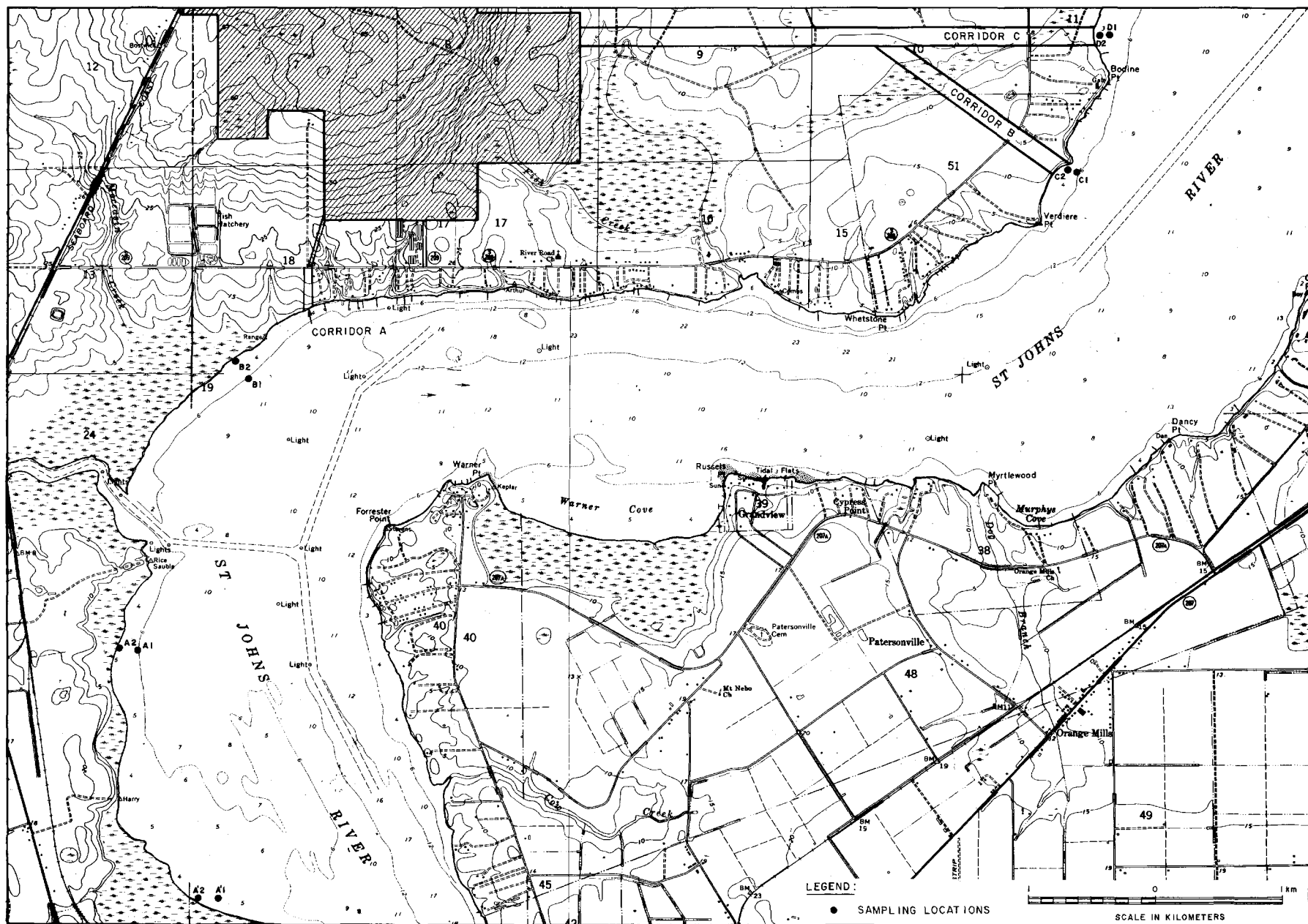


Figure 9.3-1. Site Environmental Zone Map.



REVISED 3/15/79

Figure 9.3-2. Location of Aquatic Sampling Stations and Tentative Pipeline Corridors.

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10.0

**ASSOCIATED TRANSMISSION
LINES**

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10.0 ASSOCIATED TRANSMISSION FACILITIES

10.1 INTRODUCTION AND PURPOSE

The purpose of this study is to identify one-mile-wide corridors to environmentally and economically accommodate 230 KV transmission lines linking the Seminole Electric Cooperative, Inc. (SECI) steam-electric generating station to the Florida bulk electric power grid.

A "corridor envelope" approach was selected as the most feasible and effective process for evaluating transmission route alternatives. The one-mile corridor width was selected as a practical scale for generally evaluating route alternatives, while preserving the flexibility for locating and acquiring right-of-way (ROW) easements.

The approach allows extensive use of readily available information: topographic maps, aerial photography (1:80,000 and 1:24,000 scales), planning reports, land use maps, highway planning maps, and other published data supplemented by overflights reconnaissance.

The corridor envelope approach provides a systematic, methodological approach through which (1) alternatives may be compared, (2) land use and environmental problems identified and avoided as possible and (3) specific work selection decisions may be made on the basis of clearly defined criteria.

The implementation goals in the corridor identification are:

- ° To maximize the environmental and social benefits associated with the transmission lines.
- ° To minimize the environmental impacts of constructing and maintaining the transmission lines.
- ° To minimize the cost of constructing and maintaining the transmission lines.

Criteria were developed and systematically applied to identify alternative corridors within the study area. These corridors were subjected to a general environmental assessment. "Preferred" corridors were selected on the basis of the results of the collective assessment of the corridor alternatives (Figure 10-1).

10.2 ELECTRICAL ANALYSIS AND ALTERNATIVES

SECI conducted a loadflow analysis of its existing transmission system, future State transmission system, and plant needs. The analysis identified a variety of locations and voltage alternatives.

10.2.1 Future Transmission Facilities

As the loads increase in the SECI member systems, additional transmission facilities will be needed to connect new substations either to existing SECI transmission or the State grid. Generally, substations are constructed for one or more of three reasons: capacity, voltage, and/or reliability. The SECI member systems constantly monitor their load growth to detect areas in which (1) existing facilities will become insufficient (facilities may become overloaded), (2) voltage will be too low, and/or (3) the reliability of service is inadequate.

10.2.2 Associated Plant Transmission

SECI must plan and design its transmission facilities in coordination with other utilities in Florida. The data base available for SECI's studies, developed by the Florida Electric Power Coordinating Group (FCG), is almost one year old and not as "fine tuned" as necessary. SECI could and did develop transmission alternatives based on knowledge of the State bulk transmission grid, but could not confirm the validity of these alternatives without the cooperation of neighboring utilities. A joint meeting, held in October, 1977, with representatives from Florida Power & Light Company (FP&L), Florida Power Corporation (FPC), and the Jacksonville Electric Authority (JEA) was arranged to explain SECI's intentions and solicit cooperation. SECI's initial transmission alternatives were presented, along with a request for an updated base case for computer studies. The participants agreed to jointly study the technical requirements of transmission associated with the plant, and offered additional alternatives for SECI's consideration. The group arrived at the criteria and methods to be used for the study and agreed on interchange schedules against which to test the alternatives.

The 1987 FCG Data Base Case was chosen as the basis for this study, because it is the first year that all generation projected for Northeast Florida through the 1980's is scheduled to be in service. To update this case, participating companies submitted updates of their systems to Seminole for computer merging into a base case load flow. The resultant load flow is the base for the comparison of alternatives under investigation.

SECI analyzed load flows of the various transmission and interchange alternatives using the Philadelphia Electric Company (PECO) power flow program. Single contingency line outages were analyzed using the PECO super position factors program. Copies of all output from these programs were given to each study participant for review and comment. Several joint meetings have been held to review the results of the computer work and receive additional suggestions, comments, and feedback.

The raw computer data for the transmission alternatives were given to each participant for his detailed review and study. The participants most directly affected by the study (FP&L and FPC), have agreed in principal with SECI to the tie-points proposed for the associated transmission. Both utilities have described modifications to their systems that will be required because of the impact of the associated transmission. JEA is not significantly affected electrically by the proposed transmission.

10.2.3 Associated Transmission Electrical Alternatives

The following transmission alternatives were evaluated in the joint study:

1. 230 KV double circuits from Seminole Plant to Putnam (Route 1) and from the Plant to Columbia, with single 230 KV circuits from Columbia to Suwannee and Fort White (Route 3).
2. 230 KV double circuits from Seminole Plant to Putnam (Route 1) and to Fort White.

3. 230 KV double circuits from Seminole Plant to Putnam (Route 1) and from the Plant to Silver Springs (Route 2).
4. 230 KV quadruple circuits from Seminole Plant to Putnam (Route 1), with 500 KV single circuits to Central Florida and Lake Poinsett.
5. 230 KV double circuit from Seminole Plant to Putnam (Route 1) and a 500 KV circuit to Fort White (portion of Route 3).
6. 230 KV double circuits from Seminole Plant to Silver Springs (Route 2) and from Plant to Columbia with single 230 KV circuits from Columbia to Fort White and Suwannee (Route 3).
7. 230 KV quadruple circuits to Putnam (Route 1) with 500 KV single circuits to Windermere and Lake Poinsett.
8. Variations on number 1 and number 2, with minor line and bus changes.

All alternatives assumed that a 1200 MW plant, jointly owned by FP&L and JEA, would be located at a site several miles north of the Seminole Plant. An alternative site location of the FP&L/JEA plant in Duval County was also considered. The transmission for this alternative would include a 230 KV double circuit to Columbia and the busing on existing FP&L Putnam-to-Duval 230 KV line at Seminole Plant. Accordingly, it was given a brief examination.

For all alternatives, three possible interchange schedules were considered: (1) all 1200 MW from Seminole Plant to FPC's system, (2) all 1200 MW to FP&L's system, (3) and a 50/50 split of generation exchange between the FPC and FP&L systems. The study participants felt that these extreme cases would provide the "worst case" analysis. 230 KV is predominant in these alternatives because it is the common voltage used in the State bulk power grid by all utilities in the State, and four 230 KV circuits with 1590 MCM ACSR conductor can provide the necessary capacity to transport the 1200 MW of the Seminole Plant into the State grid and provide single contingency reliability. Single contingency analysis identified potentially overloaded lines. The 500 KV option included in

alternatives 4, 5, and 7 above was dropped from further consideration, because 500 KV facilities are not planned to be in reasonable proximity of the plant location.

Alternative 2 was eliminated because of electrical problems.

10.2.4 Study Results

Alternative number 3, 230 KV double circuits from Seminole Plant to Putnam (Route 1) and from Seminole Plant to Silver Springs (Route 2), is preferred by SECI. The choice of Putnam and Silver Springs as the tie-points to the State grid was based on several factors: (1) enhances the reliability of the bulk power system, (2) the increase in total system losses for the bulk transmission grid was the lowest of the alternatives studied, and (3) this alternative requires the fewest miles of transmission construction. This transmission alternative can be broken down into two Phases, A & B. Phase A will be associated with Seminole Unit No. 1, and Phase B with Seminole Unit No. 2.

Phase A:

Phase A is a double circuit 230 KV line from the Seminole Plant to FPC's Silver Springs Substation. The in-service date of July 1982, corresponds with the construction schedule requirement for high voltage for equipment checkout. FPC has agreed in principle to this tie, detailing substation additions and modifications required at Silver Springs. Additionally, SECI intends to serve a portion of its load in the FPC control area in the first years of the Plant's operation.

Phase B:

Phase B is a double circuit 230 KV line to FP&L's Putnam Station concurrently with the construction of Seminole Unit No. 2. FP&L has proposed modification of its transmission system south of Putnam as being necessary. These modifications and additions are now under study. Putnam was selected as the FP&L tie-point for several reasons. It is a transmission hub with five 230 KV lines into the

State grid. It is a probable location of a 500/230 KV substation some years in the future. Physically, it is a short distance from the Seminole Plant. Electrically, it is very near a large SECI load of Clay Electric Cooperative; and it provides flexibility for future power displacement and supply arrangements to increase the reliability of service to SECI's members.

In addition to the alternatives in Phase A and Phase B above, a third alternative was considered viable, but less attractive than the Plant-to-Putnam route. The environmental assessment of possible corridors for this route was undertaken to provide a backup possibility. Route three consists of two 230 KV circuits from the Seminole Plant to Columbia, then single 230 KV lines from Columbia to Fort White and Suwannee. This alternative is considered less attractive than Plant-to-Putnam for the following reasons: the transmission losses are higher, the total economic and environmental impact is greater because of the increased line length, the ROW for this route may conflict with future 500 KV lines connecting Florida and Georgia, and FPC may require extensive transmission additions in the event of additional generation at the Suwannee site.

10.3 EXISTING TRANSMISSION FACILITIES

SECI and its member cooperatives own and operate a combined total of approximately 650 miles of 138, 115, and 69 KV transmission. Typically, much of this transmission is radial from a tap or breaker on the State bulk transmission grid to a member-owned substation. The majority of this transmission is in northeast Florida and belongs to Clay Electric Cooperative, Inc., or is in southwest Florida and belongs to Lee County Electric Cooperative, Inc. SECI owns approximately 31 miles of 69 KV line from Cedar Key to Otter Creek and then on to Bronson, in Levy County, Florida. In addition to these two lines, SECI has eight other 69 and 115 KV lines in various stages of design and construction for a total of approximately 75 miles. SECI is also supplied by the Florida bulk power grid. The owners of this grid most affected by associated plant transmission are JEA, FP&L, and FPC.

10.3.1 SECI Transmission Facilities

Figure 10-2 shows the study area defined by the interconnect points and the electric utility lines belonging to Clay Electric Cooperative, the member company of SECI which has the most transmission coverage in the study area. As shown on Figure 10-2, most of these are small 69 KV lines, which follow highways and which have a great many angles. In the area of the three routes, Clay Electric has a few existing lines:

A. Route 1 ~ Site-to-Putnam

Clay Electric does not have existing transmission lines.

B. Route 2 ~ Site-to-Silver Springs

A small section of transmission line, owned by Clay Electric Cooperative, is the 115 KV line from Fort McCoy Station to Highway 20 near the Intersection of Highway 20 and Highway 315.

C. Route 3 - Site-to-Columbia

Clay Electric has a number of small transmission lines along this route. As shown on Figure 10-2, a 69 KV Clay Electric line goes from the site to Keystone Heights and then proceeds in a northwesterly direction to near Lake Sampson. At this point, called TP-8, the Clay Electric 69 KV branches in three different directions. One branch proceeds north, around Lake Sampson, crosses Highway 100 and connects to the existing FP&L 115 KV transmission line. Another branch goes south from TP-8 to the Waldo Substation just southwest of the town of Waldo, and the third route goes from TP-8 to the Brooker Substation. From the Brooker Substation, the line follows Highway 18 to Worthington Springs. The third branch proceeds from Worthington Springs north to the Bland Substation which is south of Lake City. This line makes many turns in this area and crosses I-75 twice. From the Bland Substation, the line joins the FP&L 115 KV line, traverses Lake City and terminates in the Columbia Substation in the northwest section of Lake City.

These lines are of particular interest because they provide existing ROWs that may be used. The ROWs belong to a SECI member utility and their use would minimize visual, ecological, erosional, and legal problems associated with acquisition. However, the number of angles and the small size of these lines require that they be examined in greater detail.

10.3.2 Other Transmission Facilities

Figure 10-3 shows the electric utility lines for JEA, FP&L and FPC. The key transmission lines are:

- ° FP&L's 240 KV line from the Robinwood substation in Jacksonville to the Volusia substation near Daytona Beach. This line originates at a generating station near East Palatka.

- ° FP&L's 240 KV line from the Duval substation to the Putnam substation near East Palatka.
- ° FPC's 240 KV line from the Suwannee substation to the Silver Springs substation near Ocala.
- ° FPC's twin 115 KV line from the Jasper substation through the Fort White substation to the Brooksville substation.

These transmission lines are key in that they provide interconnection lines for the Seminole Plant.

The existing transmission system also provides lengths of ROW which may be used as practical by the proposed lines. These include:

Route 1 ~ Site-to-Putnam

FP&L's 240 KV line from north of Palatka to the Putnam substation.

Route 2 ~ Site-to-Silver Springs

FPC's 240 KV line from Highway 40 at Ocala to the Silver Springs substation.

Route 3 ~ Site-to-Columbia

FP&L's 240 KV line from the Clay Electric 60 KV line (Figure 10-2) to Keystone Heights.

Site-to-Fort White

No transmission lines which may be of use.

Site-to-Suwannee

No transmission lines which may be of use.

10.4 CORRIDOR SELECTION AND IDENTIFICATION

The impacts generally associated with a transmission line are:

- ° Construction Impacts
 - Clearing of woodlands or shrubs.
 - Noise and dust.
 - Erosion due to removal of surface vegetation.
 - Influx of construction labor.
 - Visibility.
- ° Operation Impacts
 - Removal of ROW from habitat and other land uses.
 - Visibility of tower and line.
 - Noise from line.
 - Maintenance of ROW clearance (either mechanically or chemically).
 - Access to lands due to corridor.
 - Radio and TV interference.

While these impacts cannot be avoided, they can be mitigated by:

1. Carefully selecting the corridor, and
2. Using good engineering design, and construction practices.

Existing transmission ROW was designated for use where possible to minimize disruption. Exclusion criteria defining areas particularly susceptible to serious impacts were mapped. Unless there was an existing transmission line corridor, these areas were avoided. Finally, limited use areas were identified. These are not exclusion areas but areas generally designated as unsuitable for transmission lines. Use of these areas would be based upon available suitable alternatives.

10.4.1 Exclusion Mapping Criteria

The exclusion mapping criteria were:

- ° Small towns were avoided. A one-mile buffer zone was assigned to preclude the relocation problems of a new ROW through towns. The one-mile radius provides a buffer zone with regard to noise and visual impact. However, use of an existing transmission line through a town was considered acceptable.
- ° Lakes were excluded from consideration to avoid impacts on migratory birds, and alterations to lake bottoms, and to minimize construction costs.

- ° Federal, State and local parks were avoided because they were considered to be legally committed lands, and are very likely to be of high recreational and biological value.
- ° State prisons, hospitals and other similar land uses were avoided.
- ° Historic places as listed in the National Register of Historic Places were avoided.
- ° Areas previously identified as sensitive habitat for rare and endangered species were avoided. Sensitive habitat is generally identified by the U. S. Army Corps of Engineers and the Florida State Game and Fresh Water Fish Commission. Such areas are of unique biological value.
- ° Areas designated for game refuge were avoided (game refuge is not to be confused with a Wildlife Management Area). Game refuges provide shelter for game species (species stocking). In addition, intensive management is often practiced in an effort to increase species populations. Wildlife Management Areas are open to hunting.
- ° Airports were avoided. A transmission line can pose a hazard to air traffic. A one mile buffer zone was chosen as adequate distance.

Areas corresponding to the existence of constraints were drawn on 7-1/2 minute topographic maps to initially exclude all constraint areas from consideration. However, under certain conditions the exclusion criteria were adjusted to minimize the social and environmental impacts of the transmission line, and the costs of its construction and operation. In line with these goals, use of existing transmission lines may compromise some of the constraint mapping criteria. This was the case where exclusion areas included existing transmission line ROW.

It is difficult to deal with problems of noise, radio/TV interference, relocation of residences, or visibility when working with a one-mile wide transmission corridor, as these are specific and not considered to be the chief general impacts of line construction. However, the intent of the exclusion criteria is to minimize visual impact or interference by avoiding population concentrations, thereby minimizing

impact on numbers of people. Therefore, unless a transmission line already passes through a town or urban area, it is desirable to avoid the town. In cases where an existing corridor is used, care should be taken, for example, to make the tower structures as unobtrusive as possible.

10.4.2 Identification of Limited Use Areas

Limited use areas were evaluated with respect to their suitability for use as transmission line ROW, not as an exclusion to use.

Three sets of criteria included were socioeconomic, environmental, and engineering. The criteria are:

Socioeconomic Criteria

Limited use socioeconomic areas are:

- Planned open space
- Planned residential areas (permanent residential areas are more sensitive than seasonal residential areas)
- Urban areas
- Wildlife Management Areas
- Intersections of major highways

Designations for socioeconomic were derived from master plans for the county and region, and from the Florida Department of Transportation (DOT).

Suitable locations for transmission lines are areas planned for heavy or light industrial needs, some commercial areas, agricultural or pasture lands and woodlands which have not been designated as biologically sensitive. Agricultural lands are considered more suitable for transmission line development than forested lands because the land has already been cleared and the transmission line does not take the land out of agricultural production. However, it may result in some problems in terms of access or crop dusting and cultivation patterns. Further, transmission lines in open agricultural land may be more visible than when in woodlands.

Environmental Criteria

Areas considered environmentally less suitable for transmission line routing include:

- ° Extensive wetland areas
- ° Areas of known importance to sport or commercial game species (this has an overlap with the Wildlife Management Areas outlined in the land use sections)
- ° The areas which could serve as suitable habitat for rare and endangered species.
- ° Open water where an overhead power line could pose a hazard to migratory water fowl.

Aerial photography, state and local data and professional judgments were used to identify sensitive biological areas.

Woodlands are considered to be of higher ecological value than other plant communities and less desirable for a transmission ROW. The use of agricultural lands or pasture lands for a transmission system produces fewer ecological impacts.

Engineering Criteria

Areas considered less suitable for constructing and operating a transmission line include:

- ° river crossings
- ° sinkhole areas or depressions
- ° areas requiring spans of more than 1500 feet
- ° marshes and swamps
- ° mining pits

In Florida, marsh and sinkhole areas are relatively common and not easily avoided. To minimize the occurrence of such areas in the transmission corridors, these areas were identified using 7-1/2 minute topographic maps and aerial photography at a scale of 1:24,000.

10.4.3 Identification of Potential Corridors

The above criteria serve two purposes: First, they identify areas which may have environmental, socioeconomic, or engineering problems; second, they allow the identification of a corridor that minimizes such problems. Using 7-1/2 minute topographic data, 1:80,000 and 1:24,000 aerial photography, and other information, the areas proscribed by the socioeconomic, environmental, and engineering criteria were drawn on 7-1/2 minute topographic maps. Several alternative corridors for each route were then located directly upon the topographic maps. Corridors were identified by:

1. Following existing transmission line ROW where possible.
2. Avoiding restricted areas, unless an existing transmission line already crossed such an area.
3. Avoiding, where possible, limited use areas, unless an existing transmission line already crossed such an area.
4. Avoiding numerous turns and spans of over 1500 feet.
5. Using the most direct routes available.

In cases in which a limited use area could not be avoided using the most direct corridor, an alternative was identified. This procedure resulted in a number of potential corridors for each route.

In general, the most efficient and, in some cases, least expensive means of running a transmission line is to follow an existing route. The reduction in costs for clearing ROW and for creating access roads or culverts over creeks and wetlands is significant; however, the realities of a 230 KV transmission line versus a 69 KV transmission line are such that many existing corridors using a 69 KV line have more turns and bends in them than is practicable for a 230 KV line. Further, a 69 KV line can follow a highway without disrupting residences along the road; it may be very difficult for a 230 KV transmission line to be as unobtrusive. These, then, are practical limitations in using existing corridors for least-cost routing.

10.4.3.1 Description of Route 1 - Site to Putnam, Potential Corridors

As shown in Figure 10-4, the transmission line exits the Plant and proceeds south just east of U.S. Route 17 to an existing FP&L 240 KV transmission line north of Palatka. Corridor AB'BC turns east, and crosses the St. Johns River using the existing corridor. The corridor then parallels the FP&L transmission corridor to the Putnam substation. The corridor goes around East Palatka. Using the existing crossing requires going through part of Rice Creek, a marsh area.

There is an alternative as shown in Figure 10-4. In alternative ABC, the transmission line exits the Plant and proceeds southeast directly across the St. Johns and eventually joins the existing FP&L transmission line. This is the least cost corridor. However, this least cost corridor will impact residential development along the northwestern bank of the St. Johns River, and it may also impact a local recreation area on the southeast bank of the St. Johns River. Once it is across the river, however, it crosses farmland before it connects with the existing FP&L transmission line.

10.4.3.2 Description of Route 2 - Site to Silver Springs, Potential Corridors

As indicated in Figure 10-5, Route 2 has several alternatives. The alternatives will be discussed in various segments and compared in Section 10.4.4.

Segment AB

Segment AB exits at the site and proceeds in a southwest direction to State Route S20. Along this route, it must avoid Palatka and the Kay-Larkin Airport by going to the west of the airport. This route, however, takes it through a Wildlife Management Area owned by Hudson Pulp and Paper Company. The paper company is in the process of harvesting portions of this tree farm. To the east of this route is a considerable amount of development associated with the town of Palatka. Just after

the transmission line comes out of the Plant, it must go across Rice Creek Swamp, which is considered to be a sensitive wildlife habitat. This swamp should be crossed at its narrowest point to minimize possible disruption of the swamp.

Segment BC

Segment BC proceeds in a southwesterly direction from Highway 20. It crosses Seaboard Coast Line Railroad. This area is fairly uninhabited; however, it does have some woodland. The route crosses Rice Creek and parts of Camp Branch at the narrowest points to minimize the potential disruption. It may be possible to follow the existing Seaboard Coast Line Railroad over the swampy areas. The corridor then proceeds to the small town of Orange Springs and crosses the stream of Orange Springs. Northeast of Orange Springs is a small area of what appears to be karst topography. Directly south of the transmission line is Lake Oklawaha which borders the Ocala National Forest. This area has been identified as a sensitive biological area as well as a protected area. The transmission line does not cross it; however, it does come within five miles of this area.

Segment BD

Segment BD follows a FP&L 69 KV transmission line along State Route S20 to Hawthorne, Florida. The transmission line is adjacent to the highway. The corridor traverses Interlachen, an area which is rapidly developing. State Route S20 is a main highway for traffic traveling between Gainesville and Palatka. As a result there are numerous homes close to the highway.

The corridor turns south at Hawthorne and follows U.S. Route 301 south to the FPC 240 KV transmission line. The corridor crosses marsh and wetlands at Lochloosa, crosses Orange Lake, and traverses Citra and Sparr, two small towns which have been identified as growth centers by the Marion County Comprehensive Plan. Orange Lake is a popular lake for sport fishing.

Segment CD

Segment CD parallels State Route S318; however, it stays north to the highway so as to provide a buffer between the highway and the transmission line. Woodlands may screen the transmission line from the highway. Just before reaching U. S. Route 301, the proposed corridor veers south to stay east of Old Highway 301 and crosses Old Highway 301 just north of State Route S316. This route goes through a mostly cleared area and eventually enters an area that is under pressure to develop.

Segment CE

Segment CE progresses southwest to a point west of Fort McCoy. The corridor is mostly forest and is part of Hudson Pulp and Paper Company's Wildlife Management Area. From Fort McCoy the corridor proceeds south-southwest to the Silver Springs substation. The corridor passes east of the Silver Springs "tourist attraction" and crosses the Silver River.

Segment DE

Segment DE follows the FPC 240 KV transmission line. This corridor crosses State Route S40, which links Silver Springs to Ocala. From State Route S200 to the Silver Springs substation the area is under heavy residential development.

10.4.3.3 Description of Route 3 - Potential Corridors

As shown in Figure 10-6, there are three parts of Route 3 - Site-to-Columbia, Columbia-to-Fort White, and Columbia-to-Suwannee. These parts are discussed by segment.

10.4.3.3.1 Site-to-Columbia

The proposed transmission line from the site to the Columbia substation in Lake City follows a number of potential alternatives as outlined in Figure 10-6.

Segment AB

Segment AB is standard for all routes in that it exits the Plant and follows the existing Clay Electric 69 KV transmission corridor west. In general, it is through woodlands; however, there appear to be a

number of dirt roads as well as the existing corridor in the area. The dirt roads could be utilized if variations on this particular segment's basic route are required.

Segment BE

There are three basic variations in Segment BE. There is the BE corridor, the northern corridor; there is the BCDE corridor, the middle corridor; and the BDE corridor, the southern corridor. Portion DE is common to Portions BCDE and BDE.

Portion BE: The BE portion is a new corridor. Basically it continues in a straight line from the AB segment north to a point just southeast of State Route S21, where it turns west, and joins the Clay Electric 69 KV transmission line just north of Keystone Airpark. This route goes north of Church's Lake, George's Lake, and Sam Hill Lake. It goes through the southern portion of the Camp Blanding Wildlife Management area and avoids numerous lakes and marshy areas to the south. This corridor is identified as being the most direct corridor for this section for the reason that it has fewer turns and is slightly shorter. This corridor goes through very little swampy area. From the 7-1/2 minute topographic maps and from the aerial photography it appears that tower foundations within the corridor would be reasonably free of karst topography. Further, the transmission corridor avoids developed areas, Gold Head Branch State Park, Magnolia State Park, the community of Keystone, Keystone Airpark and many other sensitive factors (Figure 10-6).

Portion BCD: The portion BCD follows existing FP&L transmission line corridor northwest to point C, and then west to point D. The corridor does not appear to be biologically sensitive until the Smith Lake area at which point the transmission corridor must weave through a number of small lakes, with Smith Lake to the north and a continuation of Smith Lake to the south (Smith Lake, however, is not crossed). On the west bank of Smith Lake is an area identified by the DOT as a developing area. The transmission corridor follows an existing line through this area and the access roads and culverts appear on aerial photography to be already in place.

Portion BD: The southern alternative continues to follow the Clay Electric 69 KV line west. This line follows the Georgia Southern and Florida Railroad for 7 miles, and State Route S100 for 7 miles. In addition, the existing line traverses Florahome, a small community. Just beyond Florahome, the corridor turns northwest to point D. There is evidence of scattered residential development along State Route S100.

Portion DE: This portion of the corridor follows FP&L's 240 KV transmission line to a point just east of State Route S100 and north of Keystone Heights. South of Keystone Airpark the proposed corridor crosses open land and joins the Clay Electric 69 KV transmission and proceeds north. This corridor traverses an area identified as developing. The corridor passes south of Crystal Lake and Magnolia Lake, but north of Lake Bedford and Brooklyn Lake. This entire area is under development pressure associated with Keystone Heights. West of Lake Bedford, the corridor crosses State Route S40.

Segment EF

Segment EF goes from the Keystone Airpark to just beyond U.S. Route 301 at which point the transmission line branches into three directions, north, south, and west. The southern line is not followed. Segment EF is about half agricultural land and half woodlands. Some of the woodlands are swampy in nature. No major roads are paralleled and the line goes within one mile of the small town of Hampton; however, it goes through the very northern edge of Hampton and could use existing transmission line corridor.

Segment FHI

Segment FHI starts at the substation near the intersection of State Route S227 and the Southern Railroad. The corridor follows Clay Electric 69 KV line north, wrapping around Lake Sampson, and interconnecting with the FP&L 115 KV line which follows State Route S100. The corridor then parallels State Route S100 and the FP&L transmission line to the town of Lake Butler. In the process, the transmission corridor goes across a

swampy area associated with New River, skirts a number of potential sinkhole areas, and crosses woodlands before reaching Lake Butler.

At the city of Lake Butler, the corridor passes to the south and west of the city limits, rejoining the existing FP&L corridor northwest of the city. From there the corridor proceeds northwest to Lake City. This section of the corridor was selected after consultation with representatives from the city of Lake Butler and represents a modification to the original corridor location. It follows an existing FP&L corridor which is offset from Route 100 in some places by as much as a mile. Significant factors that the corridor crosses are: 1) a portion of the Lake Butler Wildlife Refuge which belongs to Rayonier, Inc. and Owens-Illinois, 2) a narrow section of Swift Creek Swamp, and 3) Olustee Creek. Skirting to the north of the small community, Lulu, it goes through a number of very small sinkhole areas. Ultimately it approaches Lake City from the south by way of the Lake City Municipal Airport. It crosses State Route S100 and makes a number of 90 degree turns as it progresses through the town of Lake City to the Columbia substation on the northwest side of Lake City. The corridor parallels the existing FP&L corridor in traversing Lake City. Section FHI is a very direct line and uses the existing corridor. It does traverse the town of Lake City; however, any of the lines that are going to use the Columbia substation must also go through the town of Lake City.

Segment FGI

Segment FGI follows an existing Clay Electric Cooperative 69 KV transmission corridor. This corridor stays to the south of Lake Sampson and goes directly west through a swampy area east of Brooker. This area has a large number of potential sinkholes. The existing Clay Electric corridor proceeds to the north of Brooker where it crosses State Route S235. The corridor continues west until it reaches State Route S18. The highway connects Brooker to Worthington Springs. The transmission corridor follows the highway and uses the same New River crossing as the highway. At Worthington Springs, the transmission corridor turns north to Highway 18 where it turns west. The town of Worthington Springs is developing, and the DOT has indicated that there are sections of

Worthington Springs which may continue to grow. Following the Clay Electric line through Worthington Springs, the corridor follows a gas pipeline route in a west-northwest direction to a point about 2-1/2 miles east of Interstate 75. The transmission line departs the pipeline corridor and proceeds on a more northwesterly course to a point near U.S. Route 41 just north of Ellisville. At this point, the transmission corridor branches west off Interstate Route 75 and begins a wandering route on the west side of I-75, re-crosses I-75 going in a northerly direction, and finally enters an area near Bethel Church. In this particular area, the transmission line corridor for Clay Electric becomes very winding. Ultimately the transmission line joins FPC's transmission line just south of the Lake City Municipal Airport. From this point, the corridor progresses through Lake City using the FPC transmission corridor to the Columbia substation.

10.4.3.3.2 Columbia-to-Fort White

Segment HGK

At a point approximately 6 to 7 miles southeast of Lake City near the Town of Lulu, one circuit of the 230 KV transmission line proceeds in a southwesterly direction to the Fort White Substation, northwest of the town of Fort White. The transmission corridor is very straight, and it crosses several small areas of sinkhole concentrations, U.S. Route 441 near the community of Mirtis, Interstate 75 at approximately a 80 to 90 degree angle, and it progresses down through an area of gently rolling countryside, farmland, and woodlands. When it nears the Fort White substation, it follows the Seaboard Coast Line Railroad and Highway 27 for a short distance as to skirt the Ichetucknee Springs State Park. The transmission corridor does not cross the Santa Fe River or Ichetucknee Springs.

Segment JK

Segment JK exits Lake City to the west, and proceeds to a point just west of Lake Jeffrey. It crosses I-75, then proceeds south directly

to the transmission corridors west of the Ichetucknee Springs State Park. The transmission corridor joins one of the existing FPC transmission corridors going east to cross Ichetucknee Springs and proceeds into the Fort White substation. Its route takes it across State Route S247, State Route S252, and several areas that seem to have concentrations of sinkholes. Generally, the area is rolling countryside as well as woodlands and agricultural land.

10.4.3.3.3 Columbia-to-Suwannee

Segment IJLMN

This segment exits the Columbia Substation in Lake City and parallels State Route S250 for 1-1/2 miles. It proceeds in a northwest direction toward Live Oak. In the process it crosses I-75, several marshy areas, and areas of apparent sinkhole concentration. Just west of the University of Florida Suwannee Valley Experiment Station, the corridor crosses I-10. It then proceeds west, north of Live Oak and South of the Suwannee Mine. From Live Oak the corridor proceeds west, crossing I-10 again, to the Suwannee substation.

Segment ILMN

This is an alternative to segment IJLMN. It exits the Columbia substation to the north-northwest, follows U.S. 41 for 5 miles to an existing FP&L 69 KV line. The corridor follows this transmission north-west for approximately 5 miles, and then proceeds directly west following the existing transmission line for approximately 12 miles. In this length, the corridor crosses I-10, several marshes, and areas of apparent sinkhole concentrations. The corridor heads north for 4 miles to State Route S136. At this point the corridor leaves the FP&L 69 KV transmission line and proceeds west to the Suwannee Substation. The 14-mile corridor is new ROW, and it parallels I-10 to some extent. The corridor crosses a number of marshy and swampy areas as well as several areas of sinkhole concentrations. To link to the Suwannee substation, the corridor must cross U.S. Route 90 just south of Suwannee State Park.

10.4.4 Selection of Preferred Corridors

All the potential corridors accomplish the same purpose; they would connect the Seminole Generating Plant to the Florida bulk electrical distribution system. However, some of these corridors cost less and have fewer environmental problems than others. To identify the preferred corridors, each alternative was examined for environmental, socioeconomic and cost characteristics. These parameters are shown in Table 10-1.

10.4.4.1 Route 1 - Site-to-Putnam

As shown in Table 10-1, there are relatively minor differences between the two alternatives. Alternative ABC is slightly shorter than alternative AB'BC; however, AB'BC uses more existing transmission line corridor. The key factor in selecting a preferred corridor for Route 1 is the crossing of the St. Johns River. Alternative AB'BC uses the existing FP&L transmission line crossing. Although separate towers may have to be constructed to handle the proposed line, the visual and biological impacts of using the existing crossing should be less severe than those entailed in creating a new crossing. Further, examination of aerial photography indicates fewer residences near the AB'BC crossing than the ABC alternative crossing. The preferred corridor, then, is AB'BC.

10.4.4.2 Route 2 - Site-to-Silver Springs

The preferred corridor for the Site-to-Silver Springs route is a variation of corridor ABCE. Figure 10-7 indicates the preferred corridor. Alternatives ABDE and ABCDE were rejected because:

- ° They are longer.
- ° They have more angles
- ° Alternative ABDE follows U.S. 301 and Highway 20 for 28 miles
- ° They cross more heavily populated areas
- ° They cross areas identified as suitable for development by the Marion County Comprehensive Plan

These factors work strongly against the two rejected corridors. However, corridor ABCE is much more forested than the other two corridors (Table 10-1). The potential biological impact is higher than for corridor ABCDE. Further, corridor ABCE crosses the Silver River (Figure 10-5), which is heavily used by the Silver Springs tourist attraction. The potential impact, real or perceived, of the transmission line on the attraction was considered prohibitive.

The preferred corridor is an alteration of corridor ABCE. The alterations increase the corridor's mileage somewhat, but retain the routing through a sparsely populated area. The alterations are:

- a. Use an existing Clay Electric transmission corridor from Orange Springs to Fort McCoy (approximately 12 miles)
- b. Route the corridor north of the Silver Springs resort and use FPC's 240 KV transmission line corridor to cross eastern Ocala (approximately 5 miles)

These alterations reduce the biological impact of the corridor and also avoid the Silver River crossing.

10.4.4.3 Route 3

Route 3 actually involves three corridors: Site-to-Columbia, Columbia-to-Fort White, and Columbia-to-Suwannee.

Site-to-Columbia

This segment of Route 3 is the most complicated as shown in Table 10-1. Most of the alternatives utilize existing corridors for considerable distances; however, the corridors are long (76 to 84 miles) and the cost of constructing and operating the line may be high. To minimize the cost and environmental impacts, alternative ABCDEFHI is preferred. It is one of the shortest, it utilizes existing transmission line, it has the fewest major angles, and it crosses relatively little marsh or swamp. Alternative ABEFHI, which involves a rather long stretch of new corridor,

is a close second. Creation of new corridor is not desirable at this time. Overflights confirm the advantages of corridor ABCDEFHI; however, an acceptable corridor through the community of Lake Butler must be found. The preferred corridor follows an existing transmission line through Lake Butler. Potentially, use of the existing corridor minimizes impacts; however, it has not yet been determined whether the existing corridor can be used.

Site-to-Fort White

The preferred corridor is HGK because it does not cross Ichetucknee Springs. Otherwise, there is little difference between the corridors.

Site-to-Suwannee

Alternative IJLMN is preferred. It is shorter and has fewer angles.

10.4.4.4 Preferred Combination of Routes

SECI has identified use of Route 1 and Route 2 as the electrically preferred routing combination (Section 10.2.4). If possible, this combination is also preferred from an environmental, socioeconomic, and cost standpoint. Basically, Route 3 requires the most new ROW, is the longest, crosses two towns, and crosses the most highways. Although Route 3 is a viable alternative it is not preferred to Route 2. The Route 1 and Route 2 combination should be used if possible.

10.5 ENVIRONMENTAL OVERVIEW OF PREFERRED CORRIDORS

The preferred corridors (Figure 10-8) each have potential impacts which may not be avoided. This section is to provide an overview of what these impacts may be, and provide a summary of the environmental characteristics of the preferred corridors. Appendix M provides maps of the corridors.

10.5.1 Land Use

The three preferred corridors cross a variety of land uses. The most prevalent uses are woodlands, agricultural lands, and marsh. There are a number of small residential areas either crossed by or close to the corridors. Table 10-2 provides a land use inventory in terms of miles of transmission lines crossing various land uses. Assuming a 150-foot wide ROW, one mile of transmission line would require approximately 18 acres of land, Route 1 would require 252 acres; Route 2, 990 acres; and Route 3, 2,430 acres. The land required would be unavailable for most uses other than agriculture or open space. A transmission line will remove no land from agricultural use except for the area required for the tower bases. However, the transmission lines may limit access by crop dusting aircraft.

Developed areas provide difficulties in transmission line routing because of the line's visibility and noise. Table 10-3 shows the communities likely to be influenced. If a transmission line is adjacent to a community, the primary impact may be visibility. Generally, the three corridors are far enough from people for noise to be a minor factor. If a corridor goes through a community, it may be necessary to relocate residents. Such an impact may be reduced by using suitable existing transmission ROWs. There are existing transmission lines through Lake Butler, Lake City, Orange Springs, Fort McCoy, and Ocala. It has not yet been established that these existing transmission line ROWs can accommodate 230 KV transmission line. If necessary, Fort McCoy,

Orange Springs, and Lake Butler may be avoided by rerouting the line - additional cost and environmental impact will be incurred because these routes would require new ROW. Ocala and Lake City cannot be avoided because of the location of the interconnection substations.

Sensitive land uses in the vicinity of the proposed corridors are shown in Table 10-4. Wildlife Management Areas are crossed by the corridors. In each case the area is owned by a paper or paper product company (Hudson Pulp and Paper Company; Rayonier) which is using the land to grow trees for commercial purposes. The preferred corridors can use existing transmission lines to cross the Wildlife Management Areas in each case except for Hudson Pulp and Paper Company's Wildlife Management Area east of Palatka (this is the northern Hudson Pulp & Paper Company Management area). The major land use impact through these areas is the removal of the ROW from production.

Another land use concern is the highway crossings for each of the routes. Crossings are often important because of the number of travelers who see the transmission lines at the crossings. Table 10-5 presents the number of times highways are crossed by the proposed corridors. Generally, the longer the corridor the more highway crossings it will have.

The corridors do not contain any known historic sites as listed in the National Register of Historic Sites. However, sites considered by local or state groups as being of historic interest have not been investigated.

10.5.2 Terrestrial Biology

The study utilized existing information (topographic maps, published reports, and aerial photography) and overflights to examine the preferred corridors. No attempt was made to examine specific flora and fauna within the corridors. However, it is possible to provide an overview of the habitat and wildlife which may be impacted by the proposed transmission lines. Table 10-2 provides an inventory of the amount of forest and

wetlands likely to be crossed by the corridors. The major plant communities likely to be encountered by the corridors are the Pine Flatwood, the Sandhill Community, the Sand Pine-Rosemary Scrub, the Freshwater Marsh, and the Hardwood and Cypress Swamp.

Description

The Pine Flatwoods contain many of the animals associated with Florida. It is a sub-climax community which is perpetuated by occasional fires. For a discussion of the animals associated with this community see Section 2.7.1.

A large portion of the Florida Flatwoods is being managed for the production of pine pulpwood or sawtimber. This form of management calls for the removal of any tree species that might compete with pine for nutrients or growing space. Likewise all ground cover is discouraged; the ultimate result being a stand of pure pine timber. Fire is the primary tool in removing pine competition. Pines are somewhat fire resistant due to their thick, insulating bark, whereas other native plants are readily killed by fire. The monoculture resulting from this practice is unattractive to most wildlife species because of the lack of plant diversity that would offer higher-quality food sources. Also, the frequent burning (usually every three to five years) destroys any wildlife habitat which may exist. Pine stands that are not intensely managed and only infrequently burned can be quite beneficial to wildlife in the early years before the pines reach an age at which their thick canopies eliminate sunlight from the forest floor. Generally, the first seven years of the pine plantation's life are quite productive years for wildlife.

The Sandhill Community is vegetated with a longleaf pine-turkey oak overstory. This community type is disappearing in Florida due to development. Several wildlife species associated with the Sandhill Community are becoming scarce as more and more of this habitat is removed. These wildlife species include the gopher tortoise, eastern indigo snake, short-tailed snake, Florida gopher frog, Florida scrub jay

and Florida mouse. All of these species, with the exception of the short-tailed snake, are listed as threatened species by Florida. The short-tailed snake is an endangered species in Florida and the indigo snake is listed as a threatened species by the U. S. Fish and Wildlife Service.

A distinctive plant community that in general appearance resembles the pine-scrub oak forests is the Sand Pine-Rosemary Scrub. This community is well developed in central areas of the State, as well as in other isolated places, and is characterized by a number of interesting and unique wild flowers.

Shallow ponds and backwaters of river margins are usually the beginnings of freshwater marshes. Herbaceous vegetation begins to encroach on the shallow open water producing marshland. Marshlands are treeless expanses, often with dense growth of herbaceous plants such as cattails, grasses, and sedges. In marsh pools, where the water is deeper, water lilies, pond weeds and other plants become established.

Marshes are quite important to aquatic birds, especially migratory species. Numerous resident and migratory herons, ibises, and egrets may be found here as well as the Florida sandhill crane (State listed as threatened) and wood stork (State listed as endangered). The round-tailed muskrat, a State "species of special concern," is found in maidencane marshes.

Swamp, a wetland covered with trees and shrubs, is usually developed from a marsh as sediment and plant remains gradually reduce the depth and frequency of flooding. Typically wet and occasionally flooded, swamp forests often persist for a long time, especially when they are associated with streams that periodically overflow.

A multitude of animals occur in the swamp habitat because of the abundance of food, water, heavy cover and a general lack of influence from man. The abundance of water makes the swamp very attractive to the

more aquatic species such as frogs, salamanders, turtles, water snakes, the American alligator (an endangered species), and various wading birds such as great blue herons, great egrets, night herons, wood ducks, and Florida ducks.

Impacts on Flora

Various activities involved in the construction of transmission systems have an effect on vegetation. Direct impacts through displacement, removal, or damage during construction change the form, composition, and density of vegetation communities. In heavily wooded areas, the clearing of lines of sight for surveys involves cutting brush, branches and trees. ROW clearing removes all trees and brush on and next to the ROW that could interfere with the safe operation of the transmission line.

Movement of construction equipment is expected to mix, churn, rut and compact topsoil, reducing infiltration both of rainfall and surface runoff. Increased runoff velocity and reduced infiltration are expected to result in soil erosion. Further impacts to vegetation result from excavating for tower sites and substations where the vegetative cover is completely removed.

Forested areas will sustain the greatest impacts among the upland systems. Soil stabilization, nutrient retention, and moderation of environmental factors such as wind and runoff are characteristic of mature forests. When the tree canopy is removed, sunlight penetrates to the now-cleared forest floor, encouraging colonization by herbaceous and shrubby plants. Mature forest is then replaced by a condition approximately an earlier successional stage; the benefits of the forest are lost as it is cleared. However, earlier successional communities do have a higher ratio of food production to utilization than do adjacent forest communities.

Loss of topsoil and compaction of soil are expected to reduce soil productivity. Grasses and other annuals and perennials are expected to establish themselves within a year after construction is completed. Natural soil erosion control will increase gradually as ground cover is re-established.

Wetlands (marshes and swamps) are the habitats most vulnerable to construction activities. Wetland characteristics are to a large degree determined by depth and pattern of water circulation. The building of access roads will fill areas of wetland, causing the immediate area to change to a grass or old field community as well as disrupting surface water flow. Borrow pits may create areas of deep stagnant water. Erosion products from the building of the access road will accelerate the filling process. The opening of a corridor in wooded wetlands may cause increased wind damage to the shallow-rooted wetland forest.

Impacts on Fauna

Wildlife populations are generally associated with specific habitat types. When these habitat types are altered or removed, the wildlife occurring in the affected area is forced to go elsewhere to satisfy its habitat requirements.

The establishment of a transmission line across agricultural land will have very little effect on wildlife. Effects of construction noise and activity will be about the same as those occurring during normal farming operations. The more motile species, such as birds, may be disturbed and leave the area temporarily, but they should resume normal activities once construction has been completed. The transmission towers may serve as new resting places for such species as blackbirds, vultures, swallows, and flycatchers in this open habitat. Hawks, owls, and shrikes will also perch on support towers, from which they will search for prey in the surrounding fields.

The impact of ROW establishment on the forested sections of the alignment may be more substantial due to the clearing necessary in these habitats. All tall vegetation must be removed and controlled within the ROW in order to avoid interference with the power lines. This action introduces a new and not necessarily adverse habitat to the forested area. Once the forest overstory has been removed, grasses, forbs, and shrubs will become established in the ROW. In the case of overstory removal in moist areas, aquatic plants such as sedges, rushes, and hydrophytes will occur. The establishment of this corridor would create an "edge effect," which is defined as the tendency for increased variety and density of floral and faunal species at community junctions. This field-like habitat and its resultant edge would act much like natural forest openings, which have been demonstrated to be very important to wildlife. Numerous rodents, rabbits, ground-nesting birds, songbirds, raptors, and reptiles would find useful habitat within the maintained ROW.

Adverse impacts may occur where the ROW is built up for access, resulting in restriction or diversion of surface water flow. This could result in the loss of downstream vegetation deprived of necessary water. This effect can be minimized by attempting to avoid disrupting the natural surface water flow, alternate means of ROW construction, and maintenance by other than conventional land vehicles.

Endangered or Threatened Plants and Wildlife

Presently, no floral species federally listed as endangered and threatened are known to occur in Florida. However, many species are on State lists and on Federal proposed endangered and threatened plant lists. Most of these plants are found in very specific localities according to soil type, surface water conditions, successional status and adjacent plant associations.

Several species of wildlife are currently faced with the possibility of extinction. The U.S. Fish and Wildlife Service has published a list of these species as has the Florida Game and Fresh Water Fish Commission. The following is the State endangered and threatened species list with notations made of those species (also listed by the Fish and Wildlife Service). Only those which might reasonably be expected to occur in the section of Florida under study for this report are presented.

Endangered Species - species which are in danger of extinction throughout all or a significant portion of its range in Florida:

- *American Alligator (Alligator mississippiensis)
- Short-tailed Snake (Stilosoma extenuatum)
- Wood Stork (Mycteria americana)
- *Ivory-billed Woodpecker (Campephilus principalis)
- *American Peregrine Falcon (Falco peregrinus anatum)
- *Red-cockaded Woodpecker (Picoides borealis hylonomus)
- *Bachman's Warbler (Vermivora bachmanii)
- *Kirtland's Warbler (Dendroica kirtlandii)
- Florida Grasshopper Sparrow (Ammodramus savannarum floridanus)
- *Gray Bat (Myotis grisescens)
- *Florida Panther (Felis concolor coryi)

*Listed as an endangered species by U. S. Fish and Wildlife Service.

Threatened Species - species which may become endangered species within the foreseeable future in all or a significant portion of its range in Florida:

- Florida Gopher Frog (Rana areolata aesopus)
- Sand Skink (Neoseps reynoldsi)
- *Eastern Indigo Snake (Drymarchon corais couperi)
- Osprey (Pandion haliaetus)
- Southeastern Kestrel (Falco sparvelius paulus)
- Florida Scrub Jay (Aphelocoma coerulescens coerulescens)
- *Bald Eagle (Haliaeetus leucocephalus)
- Audubon's Caracara (Caracara cheriway auduboni)

Great White Heron (Ardea herodias occidentalis)
*Arctic Peregrine Falcon (Falco peregrinus turdrius)
Florida Sandhill Crane (Grus canadensis pratensis)
Florida Mouse (Peromyscus floridanus)
*West Indian Manatee (Trichechus manatus latirostris)
Florida Black Bear (Ursus americanus floridanus) Except
in Baker and Columbia Counties and in the Apalachicola
National Forest.

*Listed as a threatened species by U. S. Fish and Wildlife Service.

10.5.3 Aquatic Biology

A transmission line influences aquatic resources in several ways. During construction, excavation and other activities of tower construction in a river may increase turbidity in the immediate area. This temporary increase in turbidity, however, may be balanced by an increase in available nutrients downstream. The area of the river bottom actually used by the tower base is, of course, no longer available habitat for bottom-dwelling species, but the surfaces of the tower bases or the shelter they may provide may be attractive to other species. Runoff from clearing and construction could result in increased debris, turbidity, and sedimentation unless appropriate erosion-control measures are used. The only significant impact after construction would be due to any runoff containing herbicides used to maintain ROW clearance. Certain herbicides may affect aquatic organisms.

Table 10-6 presents the water bodies which may be influenced by the corridors. In most cases the creeks or rivers are crossed; however, with the exception of the St. Johns River the creeks or rivers can be crossed with a single 1500-foot span. It may be necessary to place towers in the St. Johns River. Use of the existing FP&L corridor will not eliminate the new towers, but it will mean that the impact will be confined to an area which has already been impacted.

Seminole did investigate the alternative of a submerged river crossing and found that in addition to a ten-to-one first cost differential between a submerged versus an overhead river crossing, there were environmental concerns such as the possibility of an oil loss to the river in the order of 10,000 gallons if, in the case of a submerged crossing, a pipe failure occurred. Seminole requires that the transmission lines carrying power from this plant be very reliable. 230 kV pipe type cable which is submerged has proven to be much less reliable when compared to an overhead line based on discussions with utilities who have installed this type of equipment, i.e., Con Edison. Seminole also found that the operation and maintenance of a submerged cable would be much more costly on a per mile basis. As a result of these factors, Seminole has had Dames & Moore consider overhead crossings only.

The lakes identified are partially within the one-mile wide corridors; however, there is room within the corridors to avoid crossing the lakes. Route 3, for instance, has a number of lakes within its corridor. All of these lakes may be avoided by using existing transmission line ROW.

10.5.4 Soil and Erosion Potential

Soil associations in the vicinity of the corridor alignments are depicted on Figure 10-9. Those soil associations traversed by the corridor are listed and described on Table 10-7 with their relative agricultural capability, flooding susceptibility, and ease of erodibility. Each soil association consists of one or more major soil components and at least one minor soil. Soil associations designated as "Subject to Flooding" in Table 10-7 consist of areas dominated by poorly to very poorly drained soils. Four soil associations have been identified as being easily erodible. Soil associations in which at least 50 percent of the soil components were easily erodible were considered.

Agricultural capability classes are developed to reflect the suitability of soils to production of most field crops. Table 10-7 tabulates the capability class.

The impact of transmission facilities construction on soils will consist primarily of the effects of necessary clearing and stripping operations. Clearing will be required along the transmission line ROW, along access roads, at the substation, and at each tower site. Clear stripping will be required along access roads, at the proposed substations and at each tower site in order to remove major stumps and root systems within these areas.

Impact on soils from transmission line construction occurs largely from increased runoff associated with removal of vegetative cover and alteration of surface water runoff patterns and velocity. Clearing, stripping, and grading operations will result in removal/disturbance of top soil and mixing of various soil layers, thereby reducing soil fertility and exposing soil to the erosive elements of wind and water. Construction equipment movement is expected to mix, churn, rut and

compact top soil, reducing infiltration of rainfall and surface runoff. This increase in the amount and velocity of runoff is expected to result in soil erosion. Sheet and gully erosion can be expected to occur, resulting in the loss or removal of top soil with formation of rills and gullies. Loss of top soil and soil compaction are expected to reduce soil productivity due either to physical removal of nutrients or by allowing nutrients to leach out.

Those soil associations along the corridor that are expected to be highly susceptible to erosion are identified in Table 10-7. Highly erodible soils are characterized primarily by their grain size characteristics, their inability to accept surface runoff and rainfall, the general steep terrain in which these soils lie, and their relative inability to regenerate ground cover due to lack of nutrients.

10.5.5 Socioeconomics

The study area is close to Jacksonville, Orlando, Daytona Beach, St. Augustine, and, to some extent, Tampa. These areas are metropolitan centers and contain a wide range of construction labor. Within the study area are Gainesville, Ocala, Lake City, and Palatka, all of which may supply construction labor and transient housing and services.

The socioeconomic impacts of constructing the proposed transmission line are not serious. The number of persons employed in building a line, 30 to 50, is not large enough to result in a regional economic or social impact. Further, the construction crew is present only a short time in any one place while constructing the line. What may be impacts in terms of socioeconomics are: (a) traffic interference; (b) noise or dust; and (c) construction camps

The impacts associated with the three corridors are very specific local impacts - construction camps, highway crossings, and noise/aesthetic

impacts. Construction camps will be located to minimize any local disruption; further, techniques such as watering will be used to reduce the impacts of construction-generated dust.

The major construction impact is likely to be the crossing of highways. Construction equipment will have to detour traffic temporarily until the transmission line is constructed. Such delays are not long; however, they will cause some inconvenience. Further, it can be expected, that the larger more heavily traveled the highway, the more significant the impact. Table 10-5 gives the major highway crossings for each corridor.

Another impact could occur if all the materials, steel, wire, etc., were purchased locally; however, it is more likely that such materials would be purchased outside the study region. Further, the proximity of Jacksonville, Daytona Beach, Gainesville, St. Augustine, and Orlando will allow construction labor to commute from these urban centers.

10.6 MITIGATION OF POTENTIAL IMPACTS

The identification of the preferred corridors was performed in a manner designed to minimize impacts by avoiding areas sensitive to them. Some impacts, however, cannot be avoided. There are two ways of further reducing impact: 1) identifying the exact ROW; and 2) mitigative design, construction or maintenance activities.

10.6.1 Identification of Right-Of-Way (ROW)

Transmission line routing criteria established in Environmental Criteria for Electric Transmission Systems (United States Departments of Agriculture and Interior), and additional criteria developed to address specific characteristics of the area will be used. These criteria are:

- 1) Existing transmission line ROWs will be used wherever practical.

Comment: Rebuilding and upgrading of existing lines, or new ROW contiguous and parallel to existing ROW, are considered preferable to entirely separate new clearing and construction. This will minimize both the human (visual/aesthetic) and ecological (minimal clearing and disruption of communities) impacts of the new lines.

- 2) Parks, monuments, scenic, recreational or historic areas will be avoided.

Comment: The corridors do avoid most parks, monuments, and historic areas. Local and State officials will be interviewed to identify areas of scenic or historic interest that may not now be identified in available publications.

- 3) Steep slopes and heavily timbered areas will be avoided where possible, as will highways and shelter belts.
- 4) Highway crossings at intersections will be avoided.
- 5) Highways, rivers, and streams will be crossed at 90° where possible.

Comment: In most cases ROW can cross at 90°. However the 90° angle may not be possible in all cases, particularly when using existing or parallel ROW.

- 6) Open expanses of water and marshland will be avoided.

Comment: In Florida, some marsh and swampland will be unavoidable. However, both the length and number of such crossings have been minimized with the routing of the corridors. While some sectors of the corridors are more sensitive than others, use of existing ROW wherever possible will minimize impacts.

- 7) When possible, towers will be located to make use of any screening afforded by existing topography and vegetation.

Comment: Except for new ROW paralleling existing ROW next to a highway, there should be no problem in screening the transmission line in open country. However, there may be unavoidable crossings of some small towns, and in such cases screening of the transmission line may not be possible. The problem is, therefore, to minimize the visual impact of the line by special pole designs, by establishing joint uses of ROW with railroads or pipelines, or by other mitigative measures.

- 8) In cases in which new transmission lines cannot avoid scenic forest or timber areas, the clearing for the ROW should be deflected occasionally.

Comment: Occasional deflections or "bends" in the cleared ROW will help to mask the line by eliminating seemingly endless straight stretches across such areas.

- 9) Areas of archaeological importance will be avoided.

Comment: Prior to identification of ROWs these corridors will be presented to the state archaeologist so that archaeologically valuable areas may be identified and avoided.

- 10) Areas of endangered or threatened species will be avoided.

Comment: Prior to selection of a final ROW, the ROW will be examined for endangered and threatened species.

These techniques must be differentiated from those related specifically to design and construction of the transmission line. These criteria are designed to avoid problems during the corridor selection phase; they cannot be expected to correct problems.

10.6.2 Mitigative Procedures

The REA Guidelines on Transmission Line Routing were considered in the corridor routing study. SECI has stated that these Guidelines will be employed during construction of the rights-of-way as practicable.

Unavoidable impacts are associated with the construction and maintenance of transmission lines. Mitigative measures are impact-minimizing procedures that can be introduced during the design, construction, or maintenance programs.

10.6.2.1 Tower Design

Various tower designs which, combined with appropriate coloring, make the towers more attractive in a given setting. In areas of particular visual sensitivity, such as a corridor through a community or a corridor adjacent to a highway, attention will be given to tower, line, and ROW design to reduce their visual intrusion.

10.6.2.2 Access Roads

Existing public roads will provide basic access to the transmission corridors. The corridor itself will provide access to the interior portions of the line. In non-swampy areas, the soil may be stable enough to support maintenance equipment, thus a road may not have to be built. In marshy areas, it may be necessary to build roads within the corridor or ROW. Such roads would be earth and rock, with culverts to allow drainage. The actual necessity of such road construction cannot be established at this point in the study; road construction would be avoided wherever practical. Access roads will not cross rivers. It should be pointed out that most of the transmission lines being paralleled are already provided with access roads.

The closest distance to which any identified corridor is situated with respect to any lands designated on the Florida map for Roadless and Undeveloped Area Evaluation II (RARE II) was determined by the Environmental Licensing Group, Inc. (ELG), a consultant retained by SECI. ELG reported that the closest any portion of the project occurs with respect to these areas is about 85 miles. This is the perpendicular distance between

a segment of transmission corridor Number 2 and the western most extent of Little Lake George, south of Palatka. Therefore, based on this determination, access roads developed for basic access to proposed transmission lines should not effect any RARE II lands.

10.6.2.3 Construction Procedures

In order to minimize the unavoidable impacts of transmission line construction and maintenance, the following procedures will be adhered to:

- A. Construction camps, storage areas, and temporary buildings required in the performance of construction activities will be located to minimize disturbance of the community. Work areas will be furnished with sanitary facilities as needed and such areas will be kept in a neat, clean, and sanitary condition at all times.

- B. 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.
- C. Erosion directly traceable to construction activities could occur as a result of one or a combination of the following factors: clearing of vegetation from unstable soils, changes in surface water drainage patterns, and movement of construction vehicles resulting in the natural soil surface being broken and unconsolidated soils being exposed.

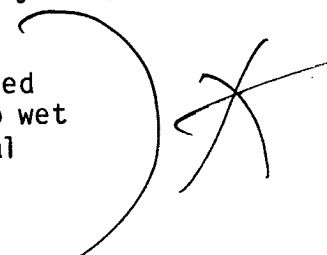
Control measures will be employed as required by site specific conditions. Examples of such controls are: control of runoff; use of sediment traps; and alert construction personnel to the potential for erosion in areas in which the transmission line crosses erodible soils.

Soil will not be pushed into stream or river channels. Upon completion of construction, damaged areas will be filled, terraced, and/or planted to control existing and eliminate future erosion.

- D. Precautions will be taken to prevent construction wastes from entering streams. Such materials as wood, litter, steel cuttings, wire, oil, grease, and domestic wastes will be stockpiled or stored in predesignated areas and periodically transported to appropriate disposal sites. Unmarketable timber and other vegetative growth will be windrowed, or chipped and used as mulch for erosion control purposes on the ROWs. Some environmental benefits which accrue are: an increase in the number of nesting and foraging sites for small animals, retardation of soil erosion, return of chemically bound nutrients to the soil, and building and binding of topsoil as organics decompose slowly in place.
- E. The Florida State Game and Fresh Water Fish Commission will be informed of the presence of any endangered or threatened animals encountered during clearing for and construction of the transmission line. Similarly, SECI will take extra care in areas of possible archaeological importance, and the State archaeologist will be notified immediately if any artifacts are uncovered.

10.6.2.4 Right-of-Way Maintenance

During its operation phase, SECI will operate and maintain its transmission lines, and lines' ROW by the following activities:

- ° Periodic inspection on foot or by vehicle.
 - ° Aerial inspection as needed.
 - ° Emergency patrol by vehicle and/or aircraft in the event of damage to line by severe weather, etc.
 - ° Clearing of brush in low-ground areas as necessary.
 - ° Clearing of dry areas of upland brush with mowing machinery as necessary.
 - ° Aerial application of herbicides under carefully controlled conditions as required in areas in which soil remains too wet for a low vegetation height to be maintained by mechanical means.
- 

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TABLE 10-1

SUMMARY OF POTENTIAL CORRIDOR CHARACTERISTICS

	<u>Route 1</u>		<u>Route 2</u>			<u>Route 3</u>						Columbia to Suwannee		Columbia to Ft. White	
	Site to Putnam		Site to Silver Springs			Site to Columbia									
	<u>ABBC</u>	<u>ABC</u>	<u>ABDE</u>	<u>ABCDE</u>	<u>ABCE</u>	<u>ABDEFGI</u>	<u>ABDEFHI</u>	<u>ABCODEFGI</u>	<u>ABCODEFHI</u>	<u>ABEFGI</u>	<u>ABEFHI</u>	<u>ILMN</u>	<u>IJLMN</u>	<u>IJK</u>	<u>HGK</u>
<u>Socioeconomics</u>															
Undeveloped Land (miles)															
0-25 Percent	6	6	30	26	39	36	56	32	52	30	44	6	11	12	6
25-100 Percent	8	6	34	32	16	44	28	42	26	48	32	34	26	9	14
Parks, Wildlife Refuges, etc.															
0-25 Percent	14	12	62	56	45	80	84	84	78	72	70	40	37	21	18
25-100 Percent	-	-	2	2	10	-	-	-	-	6	6	-	-	-	2
Parallel Facilities (miles)															
Transmission Lines	9	4	44	8	1/2	78	74	81	78	47	44	16	-	1	1
Pipelines	-	-	-	-	-	7	-	7	-	7	-	-	-	-	-
Railroads	2	-	21	4	4	8	4	5	1	4	-	-	-	-	-
Highways	2	2	33	-	-	9	16	10	13	7	10	-	-	-	-
Crossings															
Major Roads	2	1	3	3	3	7	7	7	7	8	8	8	5	6	2
Secondary Roads	10	6	74	49	30	58	48	60	80	56	46	30	29	19	18
Railroads	1	-	5	4	2	5	5	5	5	5	5	4	3	3	1
Transmission Lines	-	-	1	1	1	4	-	-	-	-	-	-	2	1	0
Telephone Lines	1	1	-	-	-	2	2	4	2	3	1	2	-	1	0
Pipelines	-	-	-	-	-	5	1	5	1	5	1	-	-	1	1
<u>Engineering</u>															
Length (miles)	14	12	64	58	55	80	84	84	78	78	76	40	37	21	20
Depressions and sinkholes (miles)															
0-25 Percent	14	12	54	50	55	80	84	84	78	78	76	36	35	11	12
25-100 Percent	-	-	10	8	-	-	-	-	-	-	-	4	2	10	8
Number of River Crossings	1	1	-	-	1	-	1	-	1	-	1	-	-	1	-
Number of Stream Crossings	3	1	7	16	12	26	21	24	19	36	29	3	4	-	-
Number of Angles															
0-19°	2	1	11	4	7	6	6	7	5	17	15	5	4	2	2
20-44°	1	1	10	10	6	17	15	14	12	13	11	3	4	1	0
45-90°	8	8	12	7	4	26	13	26	13	36	23	4	0	2	1
<u>Environmental</u>															
Miles of Forest	4	4	18	27	47	40	27	31	49	40	44	16	13	11	9
Miles of Marsh	4	-	23	3	3	9	10	8	11	10	11	2	1	3	-
Miles of Open Water	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 10-2
Land Use Inventory in Miles ¹

	<u>Agriculture</u>	<u>Commercial Forest</u>	<u>Non- Commercial Forest</u>	<u>Residential</u>	<u>Commercial or Industrial</u>	<u>Wetland</u>	<u>Other</u>	<u>Total</u>	<u>Acres</u>
<u>Route 1</u>									
Site to Putnam	5	--	4	<1	<1	4	<1 ²	14	252
<u>Route 2</u>									
Site to Silver Springs	9	16	19	2	<1	8	--	55	990
<u>Route 3</u>									
Site to Columbia	13	13	35	4	1	11	--	77	1,386
Columbia to Suwannee	14	--	19	1	1	<1	--	36	648
Columbia to Fort White	9	--	11	<1	--	<1	--	<u>22</u>	<u>396</u>
								135	2,430

¹Mileage is based on the center line of each route.

²Open water (St. Johns River)

³18 acres per mile (@150' average width).

Source of land use information: Land Use Department Analysis Maps, United States Geological Survey in coordination with the Florida Department of Planning Tallahassee, Florida.

Table 10-3

Developed Areas Influenced by Preferred Corridors

<u>Route 1 - Site-to-Putnam</u>	<u>Comment</u>
East Palatka (1,446)	Adjacent
Palatka (9,310)	Adjacent
<u>Route 2 - Site-to-Silver Springs</u>	
Fort McCoy	Crossed
Ocala (22,583)	Crossed (Eastern part of community)
Orange Springs	Crossed
Palatka (9,310)	Adjacent
<u>Route 3 - Site-to-Columbia</u>	
Keystone Heights	Adjacent
Lake Butler (1,598)	Crossed
Lake City (10,575)	Crossed
<u>Site-to-Suwannee</u>	
Live Oak (6,830)	Adjacent

Table 10-4

Sensitive Land Uses in Vicinity of
The Preferred Corridors

	Routes		
	<u>1</u>	<u>2</u>	<u>3</u>
<u>State Parks</u>			
Gold Head Branch	--	--	Adjacent ^a
Magnolia	--	--	Adjacent
Ichetucknee Springs	--	--	Adjacent
Suwannee	--	--	Adjacent
<u>Wildlife Management Areas</u>			
Hudson Pulp & Paper Co. - north	--	2 ^b	--
Hudson Pulp & Paper Co. - south	--	24 ^b	--
Lake Butler	--	--	26 ^b
Camp Blanding	--	--	Adjacent
<u>Scenic Rivers</u> ^c			
Suwannee	--	--	Adjacent
Ichetucknee	--	--	Adjacent
<u>National Forests</u>			
Ocala	--	Adjacent	--
Osceola	--	--	Adjacent

^a"Adjacent" means that the preferred corridor is within several miles of the boundary of the sensitive area, but the corridor does not cross the area.

^bMiles of Wildlife Management area in corridor.

^cUnder consideration, but not yet officially designated as scenic rivers.

Table 10-5

Number of Highway Crossings
by the Preferred Crossings

<u>Highways</u>	<u>Routes</u>		
	<u>1</u>	<u>2</u>	<u>3</u>
Interstate 10	--	--	1
Interstate 75	--	--	2
U.S. Route 17	1	1	1
U.S. Route 27	--	--	1
U.S. Route 41	--	--	2
U.S. Route 90	--	--	1
U.S. Route 129	--	--	1
U.S. Route 301	--	--	1
U.S. Route 441	--	--	2
State Route S20	--	1	--
State Route S21	--	1	1
State Route S40	--	--	--
State Route S47	--	--	1
State Route S100	--	--	4
State Route S136	--	--	1
State Route S207	1	--	--
State Route S250	--	--	1
State Route S315	--	1	--
Secondary and Tertiary Highway Crossings	10	30	130

Table 10-6

Water Bodies In or Near The Preferred Corridors

<u>Corridor</u>	<u>Water Body</u>	<u>Drainage System</u>	<u>Comment</u>
Route 1	St. Johns River	St. Johns River	Crossed
Route 2	Etonia Creek	St. Johns River	Crossed
	Rice Creek	St. Johns River	Crossed
	Sweetwater Creek	Oklawaha River	Crossed
	Alligator Creek	Oklawaha River	Crossed
	Poley Branch	Oklawaha River	Crossed
	Deep Creek	Oklawaha River	Crossed
	Bruntbridge Brook	Oklawaha River	Crossed
	Little Orange Creek	Oklawaha River	Crossed
	Orange Creek	Oklawaha River	Crossed
	Hewitt Lakes		In corridor
	Silver Lake		In corridor
	Grass Lake		In corridor
	Albrefton Lake		In corridor
Route 3	McKinney Brook	New River	Crossed
	Richard Creek	New River	Crossed
	New River	Santa Fe River	Crossed
	Swift Creek	Santa Fe River	Crossed
	Olustee Creek	Santa Fe River	Crossed
	Rock Creek	Suwannee River	Crossed
	Lake Bedford		In corridor
	Cystal Lake		In corridor
	Brooklyn Lake		In corridor
	Lake Sumpson		In corridor
	Lake Butler		In corridor
	Long Lake		In corridor
	Smith Lake		In corridor
	Magnolia Lake		In corridor
	Georges Lake		In corridor

Table 10-7

Description of Soil Associations within the Proposed Corridor Limits

<u>Soil Associations</u> ¹	<u>Descriptions</u>	<u>Designated Soils Subject to Flooding</u>	<u>Easily Erodible Soils</u> ²	<u>Agricultural Capability Class</u> ²
1. Blanton (High)-Lakeland	Nearly level to sloping excessively drained soils sandy throughout.	No	No	IV
2. Arredondo-Kanapaha	Nearly level to sloping, well drained soils, sand throughout and somewhat poorly drained soils with thick sandy layers over loamy subsoil.	No	No	III
3. Blanton (Low)	Nearly level to gently sloping moderately well drained soils sandy throughout.	No	No	III
4. Blanton (Low) Susquehanna-Bowie	Nearly level to gently sloping, moderately well drained soils, sandy throughout and somewhat poorly or well drained soils, with thin sandy layers over clayey or loamy subsoil.	No	No	III
5. Susquehanna-Bowie	Nearly level to gently sloping, somewhat poorly or well drained soils with thin sand layers over clayey or loamy subsoil.	No	No	II
6. Leon-Plummer	Nearly level, poorly drained sandy soils with weakly cemented sandy subsoil and poorly drained sandy soils with loamy subsoil.	No	No	IV

Table 10-7 (Continued)

<u>Soil Associations</u> ¹	<u>Descriptions</u>	<u>Designated Soils Subject to Flooding</u>	<u>Easily Erodible Soils</u> ²	<u>Agricultural Capability Class</u> ²
7. Alluvial land - Swamp	Nearly level, poorly and very poorly drained soils subject to prolonged flooding.	Yes	No	VII
8. Blankton-Kalmia-Swamp	Nearly level, moderately well drained soils, sandy throughout and well drained soils with thin sandy layers over loamy subsoil, and low wet swampy areas.	No	No	VII
10. Mascotte-Leon-Surrency	Nearly level, poorly drained sandy soils with a weakly cemented sandy layer underlain by loamy subsoil and poorly drained sandy soils with weakly cemented sand subsoil and very poorly drained sandy soils with loamy subsoil.	No	Yes	IV
11. Alpin-Blanton	Nearly level to sloping excessively drained soils with very thick sandy layers over thin loamy sand or sandy loam lamella, and moderately well drained soils with very thick sandy layers over loamy subsoil.	No	No	IV
12. Freshwater swamp	Nearly level very poorly drained soils subject to prolonged flooding.	Yes	No	VII

Table 10-7 (Continued)

<u>Soil Associations</u> ¹	<u>Descriptions</u>	<u>Designated Soils Subject to Flooding</u>	<u>Easily Erodible Soils</u> ²	<u>Agricultural Capability Class</u> ²
14. Chipley-Albany-Rutlege	Nearly level to gently sloping moderately well drained soils, sandy throughout and somewhat poorly drained soils with very thick sandy layers over loamy subsoil and very poorly drained soils, sandy throughout.	No	Yes	III
15. Archer-Chiefland	Nearly level to sloping, well drained sandy soils with clayey or loamy subsoil, underlain by limestone.	No	No	II
16. Leefield-Mascotte-Albany	Nearly level, somewhat poorly drained sandy soils with loamy subsoil and poorly drained sandy soils with a weakly cemented subsoil and somewhat poorly drained soils with thick sandy layers over loamy subsoil.	No	Yes	III
19. Stilson-Pelham-Mascotte	Nearly level, moderately well and poorly drained sandy soils with loamy subsoil and poorly drained sandy soils with a weakly cemented sandy subsoil layer underlain by loamy subsoil.	No	Yes	II

Table 10-7 (Continued)

<u>Soil Associations</u> ¹	<u>Descriptions</u>	<u>Designated Soils Subject to Flooding</u>	<u>Easily Erodible Soils</u> ²	<u>Agricultural Capability Class</u> ²
22. Brighton	Nearly level, very poorly drained organic soils in low marshy areas surrounded by mineral soils.	Yes	No	III
24. Kanapaha-Chipley-Scranton	Nearly level to gently sloping, poorly drained soils with very thick sandy layers over loamy subsoil and moderately well drained soils sandy throughout and somewhat poorly drained sandy soils with thick black surfaces.	No	No	III
25. Osier-Rustlege-Leon	Nearly level, poorly and very poorly drained soils, sandy throughout and poorly drained sandy soils with weakly cemented sandy subsoil.	Yes	No	V
26. Tavares-Myakka-Basinger	Nearly level to gently sloping, moderately well drained soils, sandy throughout and poorly drained sandy soils with weakly cemented sandy subsoil, and poorly drained soils, sandy throughout.	No	No	III
28. Candler-Apopka	Nearly level to strongly sloping, excessively drained soils with very thick sandy layers over thin loamy or sandy loam lamella and well drained soils with very thick sandy layers over loamy subsoil.	No	No	IV

Table 10-7 (Continued)

<u>Soil Associations</u> ¹	<u>Descriptions</u>	<u>Designated Soils Subject to Flooding</u>	<u>Easily Erodible Soils</u> ²	<u>Agricultural Capability Class</u> ²
30. Myakka-Wauchula-Placid	Nearly level poorly drained sandy soils with weakly cemented sandy subsoil and poorly drained sandy soils with a weakly cemented sandy subsoil layer underlain by loamy subsoil and very poorly drained soils, sandy throughout.	No	No	III
34. Arredondo-Gainesville	Nearly level to sloping well drained soils with very thick sandy layers over loamy subsoil and well drained soils sandy throughout.	No	No	III
36. Sparr-Lochloosa-Tavares	Nearly level to sloping somewhat poorly drained soils with very thick or thick sandy layers over loamy subsoil and moderately well drained soils sandy throughout.	No	No	III
37. Lynne-Pomona-Pompano	Nearly level, poorly drained sandy soils with a weakly cemented sandy subsoil layer underlain by loamy or clayey subsoil and poorly drained soils sandy throughout.	No	No	IV
38. Eureka-Paisley-Eaton	Nearly level, poorly drained soils with thin sandy layers over loamy subsoil and poorly drained sandy soils with clayey subsoils.	No	No	III

Table 10-7 (Continued)

¹Numbers refer to those shown in Figure 10-9.

²At least 50 percent of the soil components within the association are considered easily erodible (or have the designated agricultural capability class).

Source: The Florida General Soils Atlas for Regional Planning Districts III and IV, (and Marion County), Florida Department of Administration, Division of State Planning, Bureau of Comprehensive Planning, July, 1975.

Note: Capability Classes are designated by Roman numerals I through VIII, indicating progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants, or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to esthetic purposes.

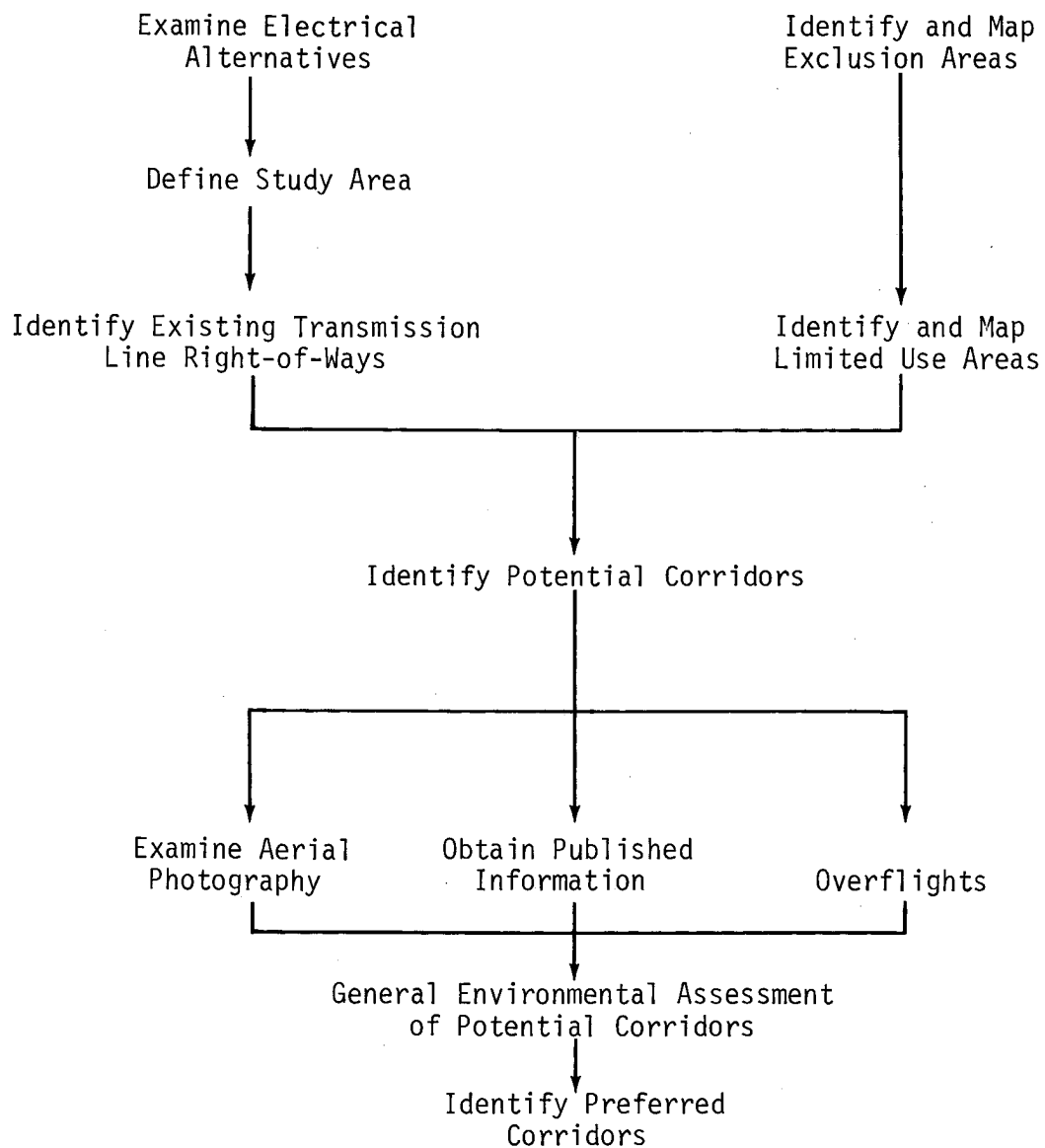
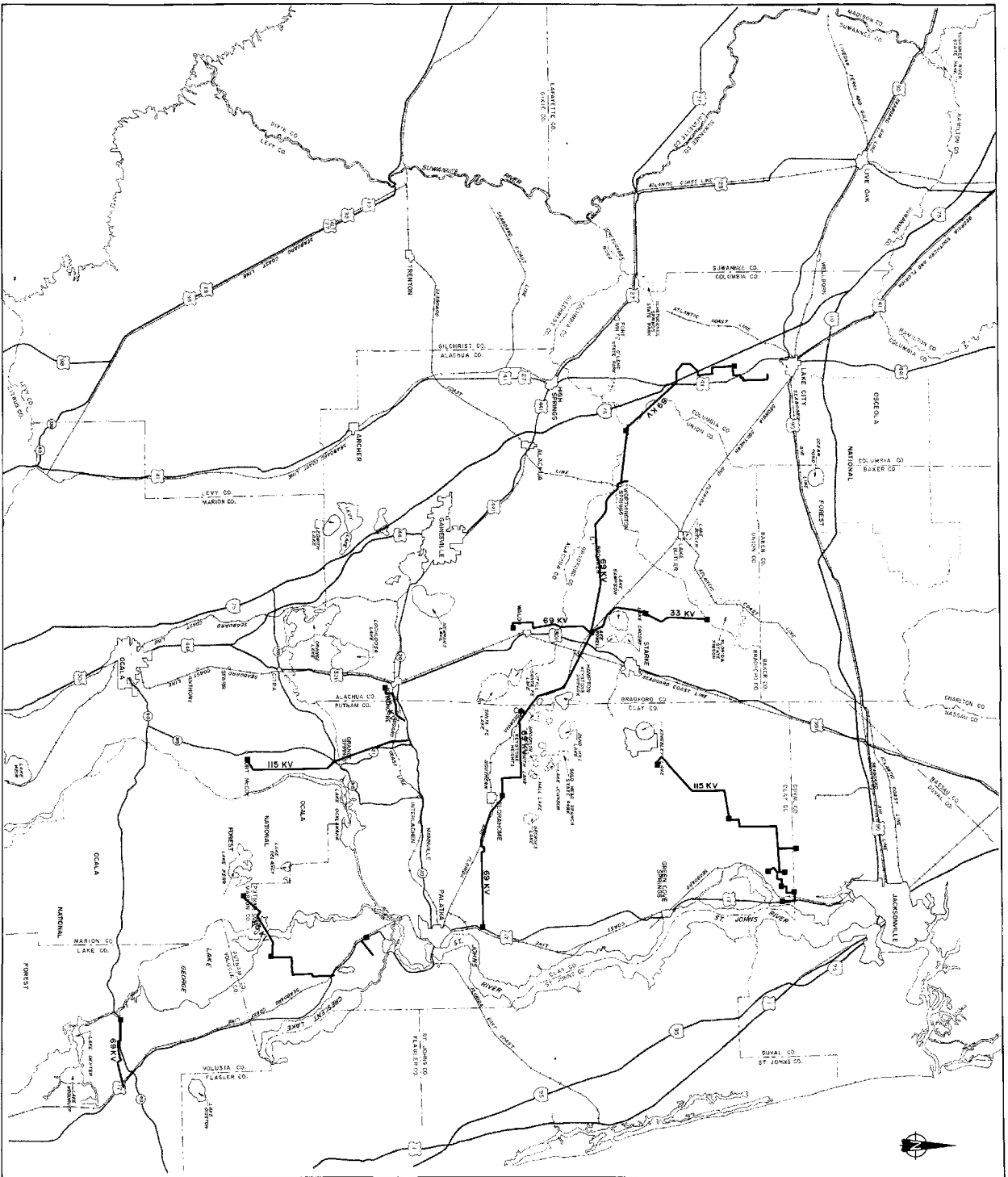


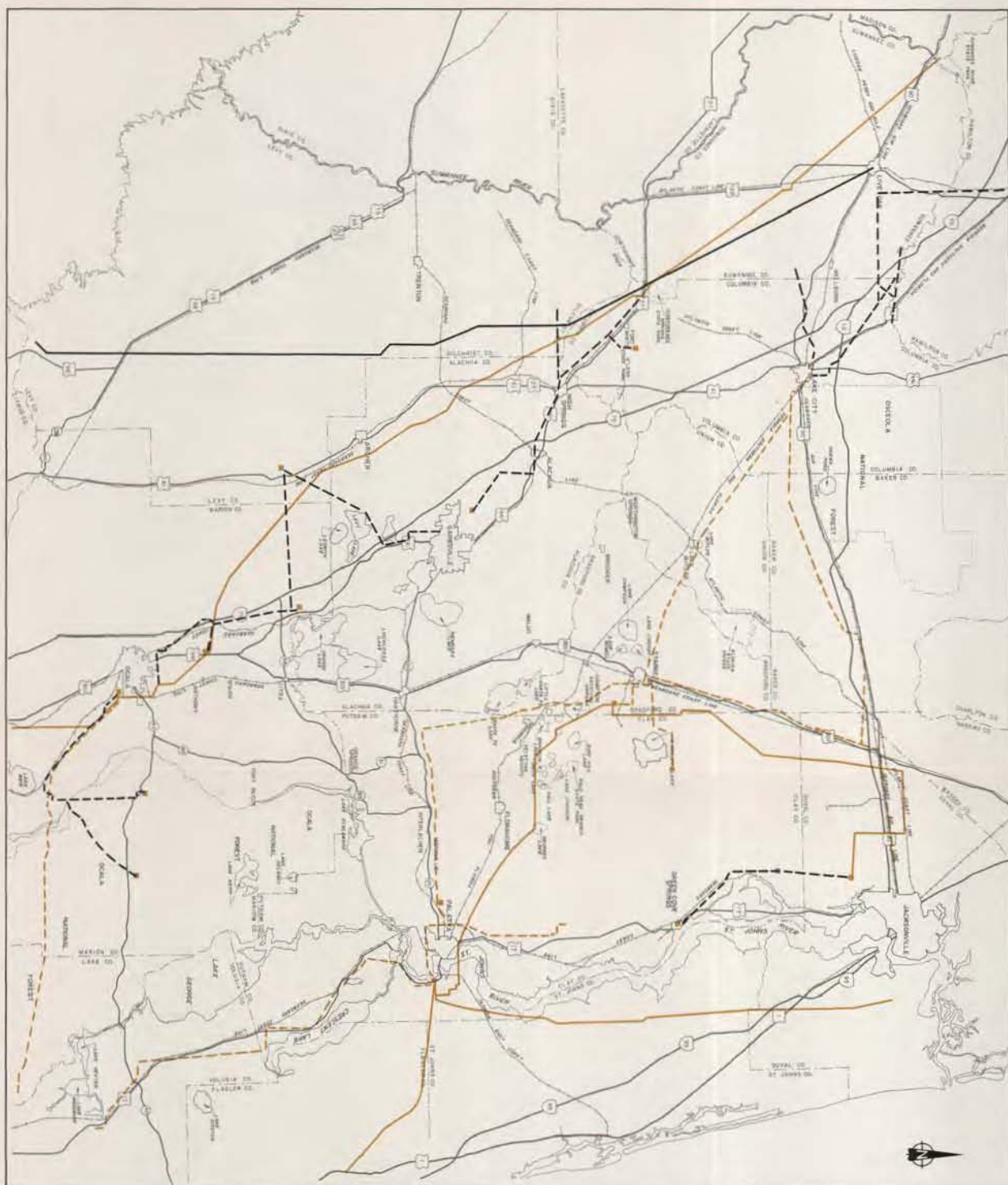
Figure 10-1. Systematic Corridor Selection Process.



LEGEND:
 ■ SUBSTATION



SYSTEM TRANSMISSION MAP
 CLAY ELECTRIC COOPERATIVE, INC.
 FIGURE 10-2

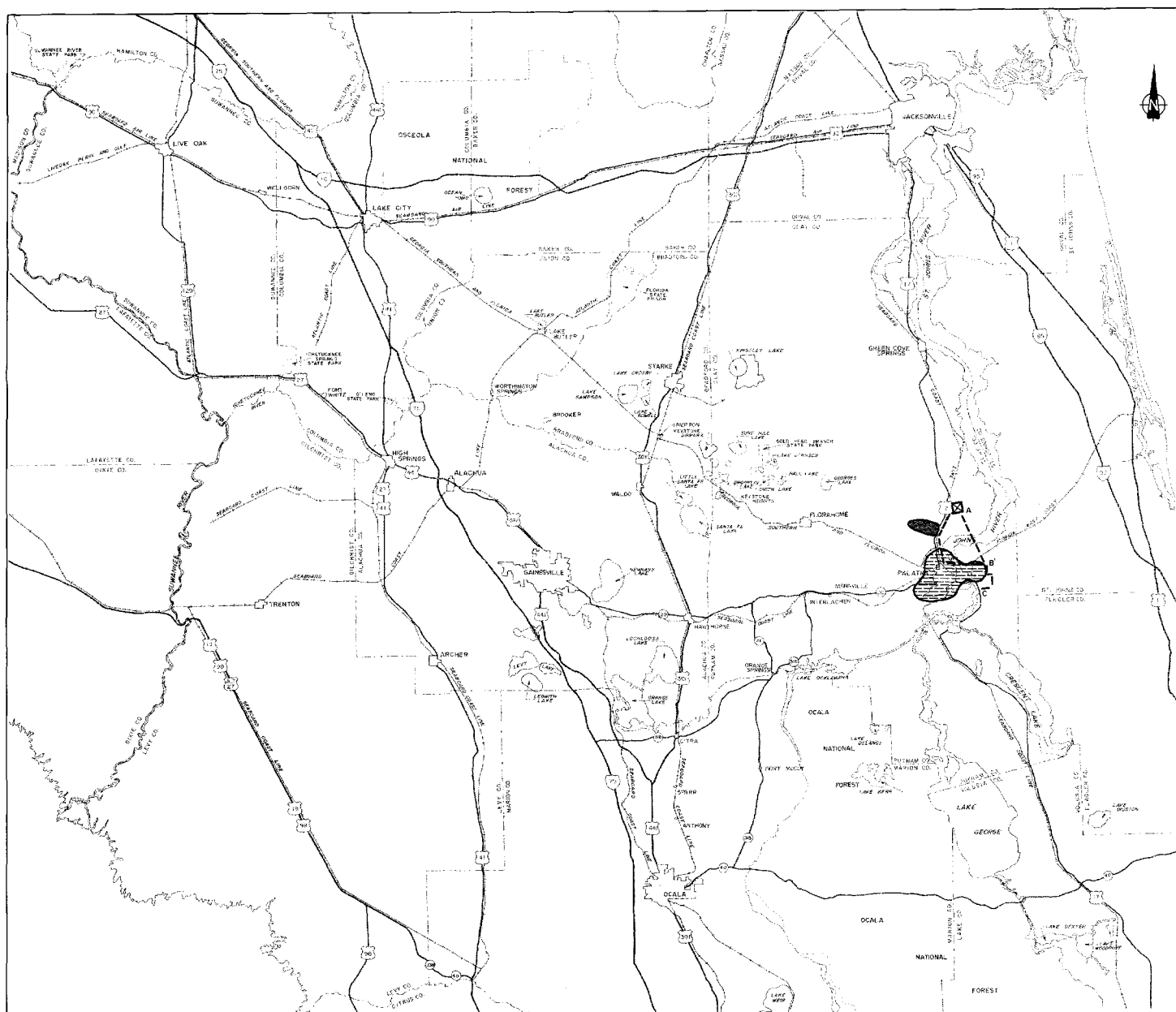


LEGEND:

	SUBSTATION
	POWER PLANT
	240 KV
	115 KV
	69 KV
	DUAL 115 KV



SYSTEM TRANSMISSION MAP
(CLAY ELECTRIC COOPERATIVE, INC.)
NOT INCLUDED
FIGURE 10-3

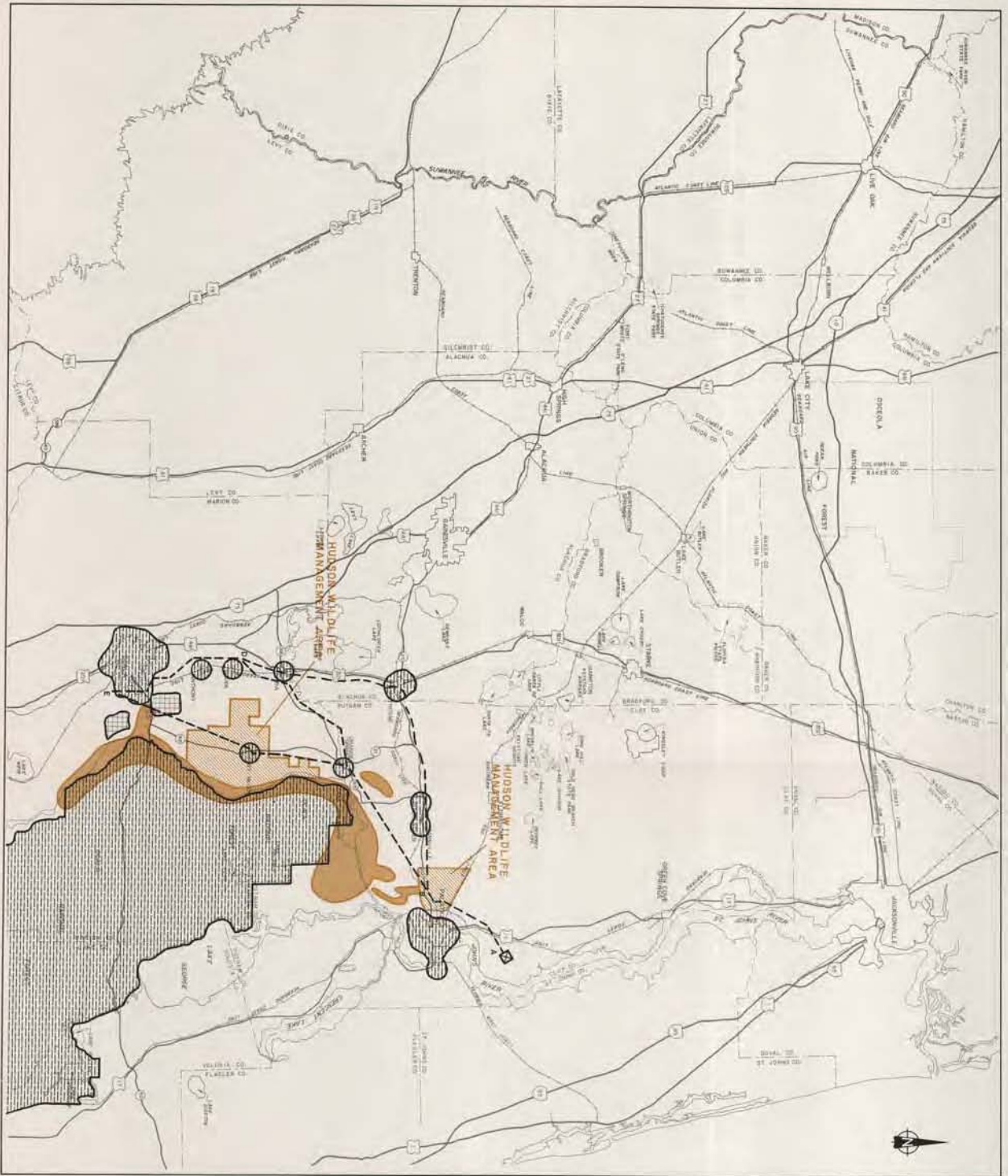


LEGEND:

- RESTRICTED AREA
- BIOLOGICALLY SENSITIVE AREA
- POTENTIAL CORRIDOR

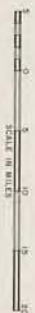
0 5 10 15 20
SCALE IN MILES

POTENTIAL CORRIDORS
ROUTE 1
SITE TO PUTNAM
FIGURE 10-4

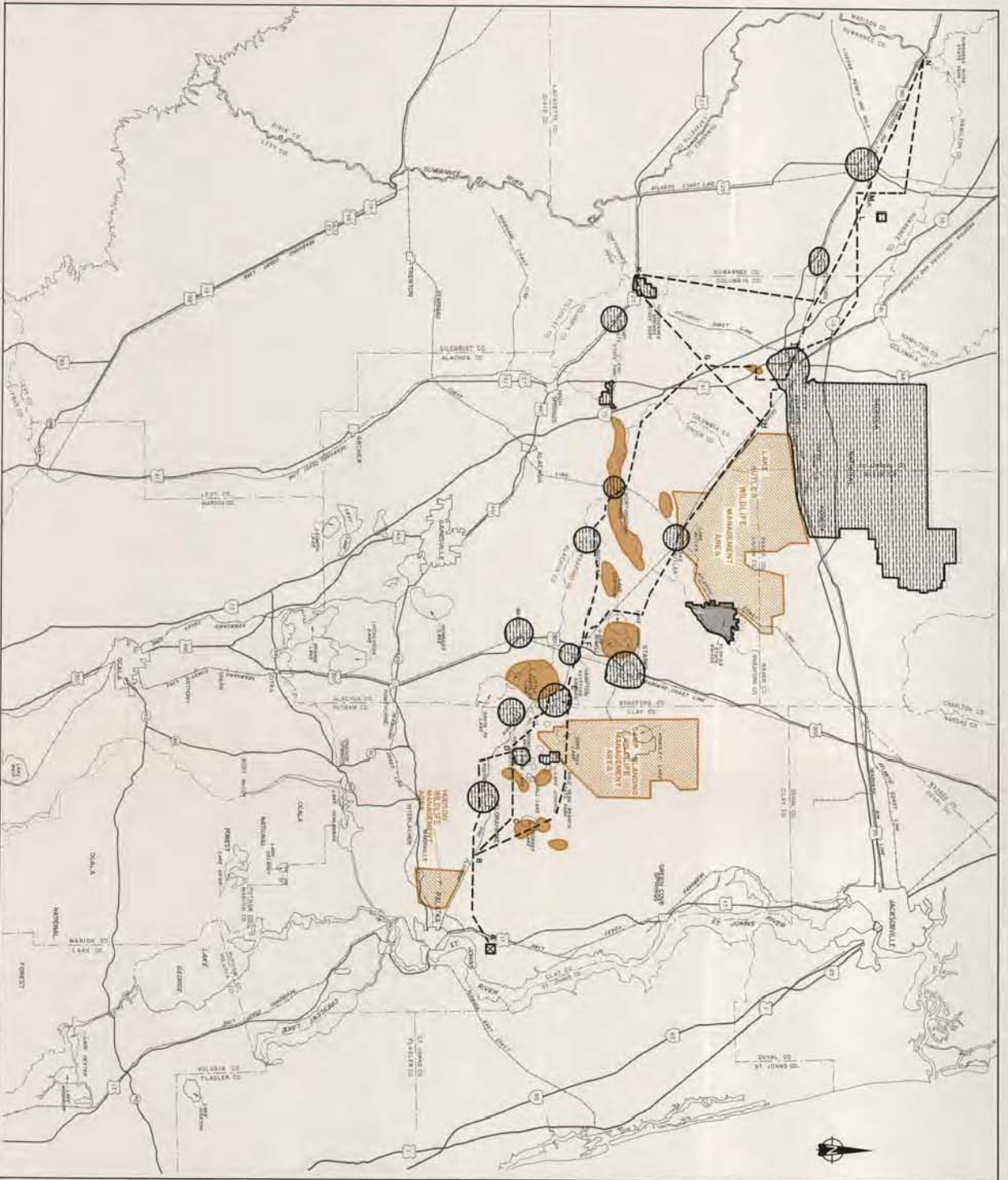


LEGEND:

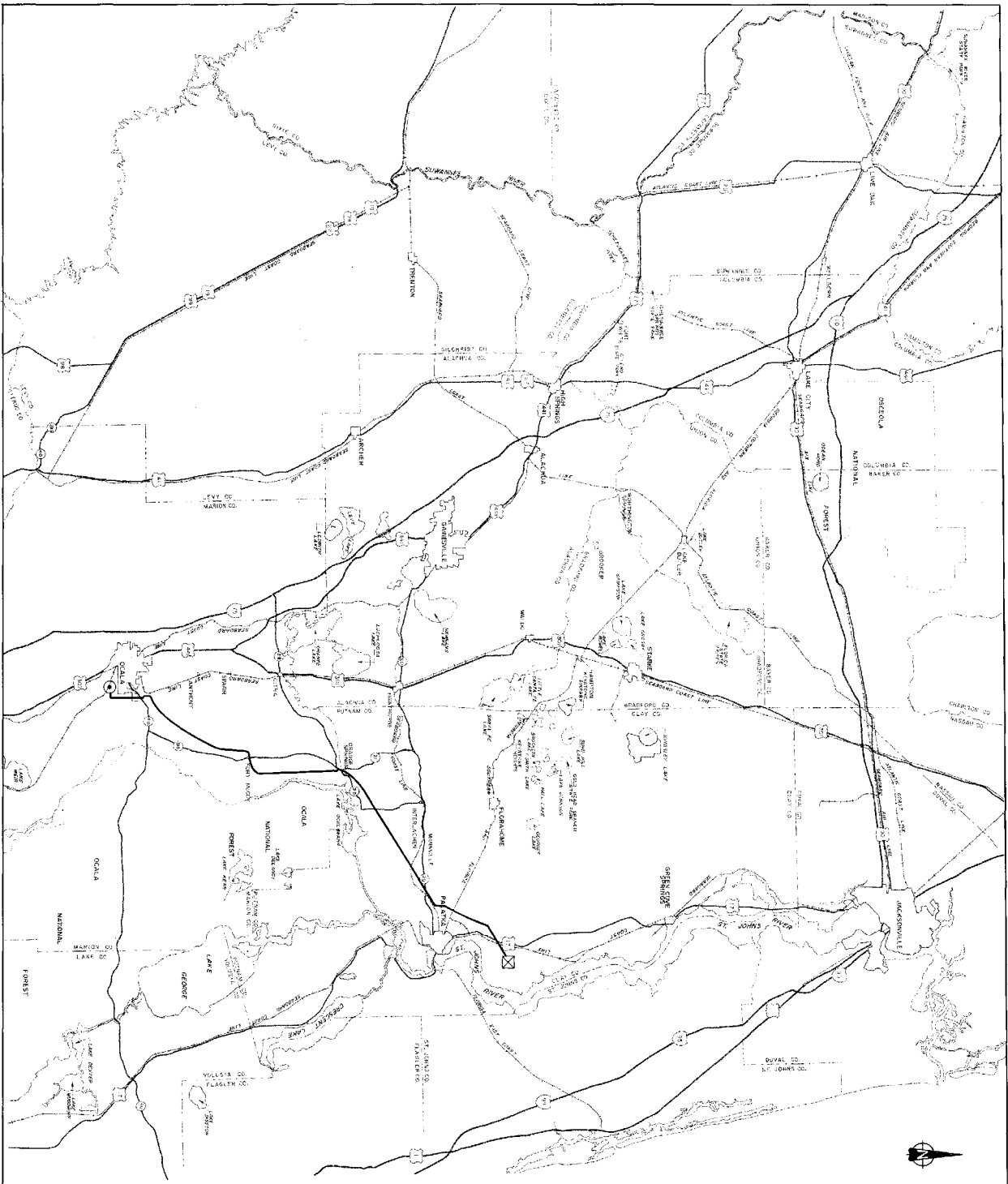
- WILDLIFE MANAGEMENT AREA
- RESTRICTED AREA
- PLANNED DEVELOPMENT AREA
- BIOLOGICALLY SENSITIVE AREA



POTENTIAL CORRIDORS
ROUTE 2
SITE TO SILVER SPRINGS
FIGURE 10-5



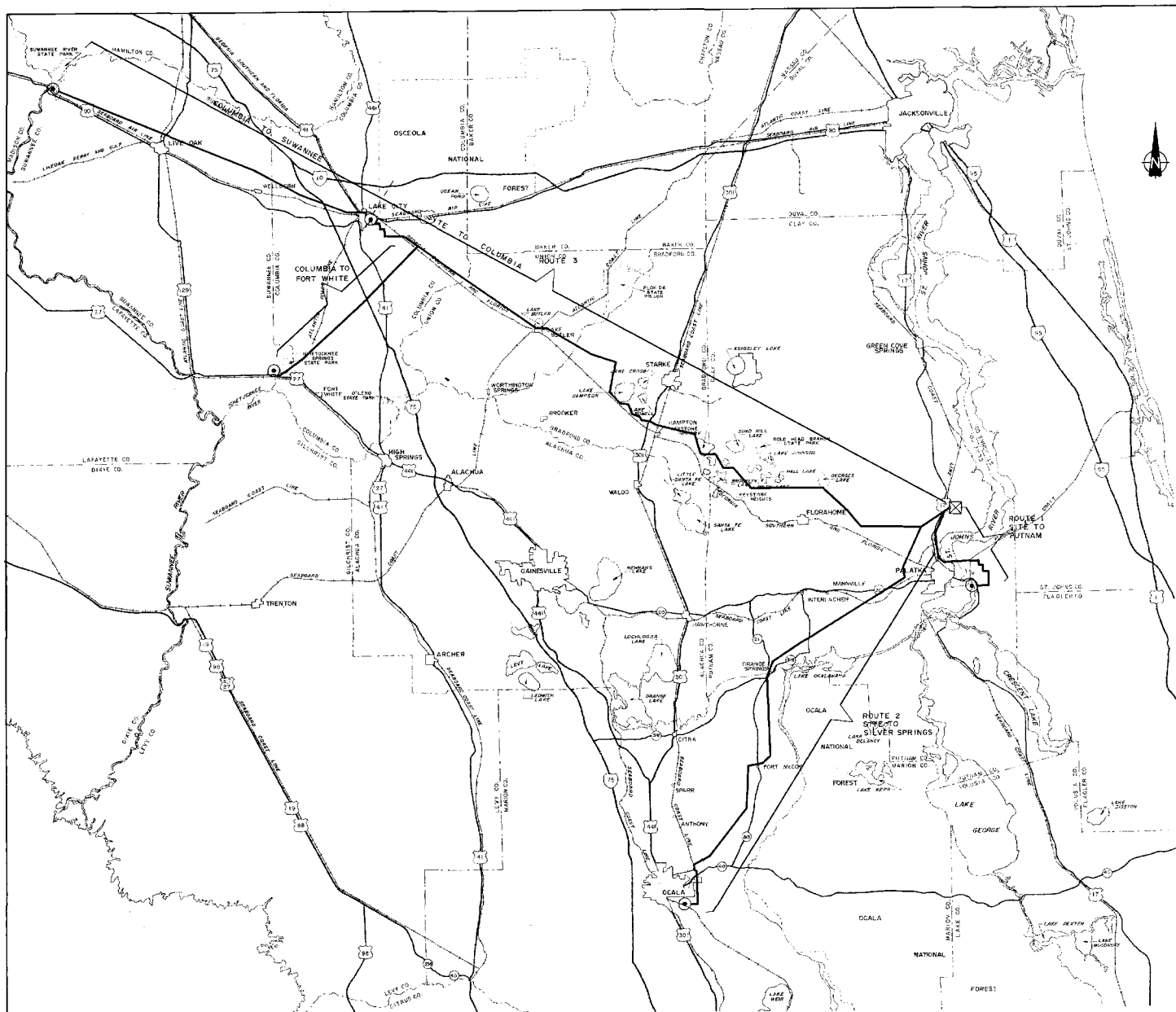
POTENTIAL CORRIDORS
ROUTE 3
FIGURE 10-6



LEGEND:
 ☒ SEMINOLE PLANT
 ○ SUBSTATION



PREFERRED CORRIDOR
 ROUTE 2
 SITE TO SILVER SPRINGS
 FIGURE 10-7

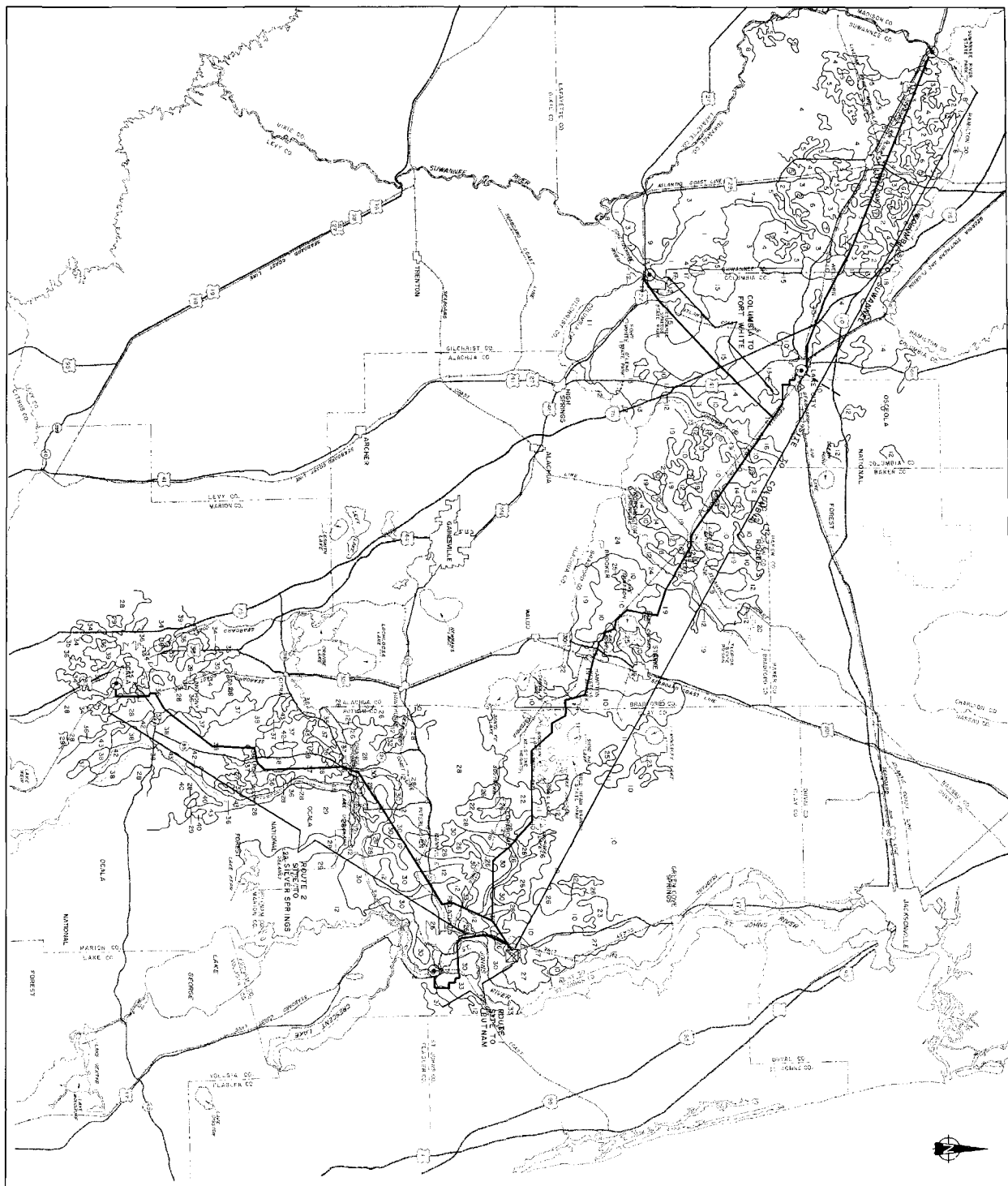


LEGEND:

- ⊠ SEMINOLE PLANT
- SUBSTATION

0 5 10 15 20
SCALE IN MILES

PREFERRED CORRIDORS
FIGURE 10-8



SOIL ASSOCIATIONS

1. BARTON (EPA)-DUNN (EPA) ASSOCIATION
2. BARTON (EPA)-DUNN (EPA) ASSOCIATION
3. BARTON (EPA)-DUNN (EPA) ASSOCIATION
4. BARTON (EPA)-DUNN (EPA) ASSOCIATION
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40. BARTON (EPA)-DUNN (EPA) ASSOCIATION
41. BARTON (EPA)-DUNN (EPA) ASSOCIATION
42. BARTON (EPA)-DUNN (EPA) ASSOCIATION
43. BARTON (EPA)-DUNN (EPA) ASSOCIATION
44. BARTON (EPA)-DUNN (EPA) ASSOCIATION
45. BARTON (EPA)-DUNN (EPA) ASSOCIATION
46. BARTON (EPA)-DUNN (EPA) ASSOCIATION
47. BARTON (EPA)-DUNN (EPA) ASSOCIATION

☒ OPEN FIELD PLANT
☐ SUBSTANTIAL

NOTE: MAP DERIVED FROM INFORMATION IN THE "FLORIDA GENERAL SOIL ATLAS FOR REGIONAL PLANNING DISTRICTS III & IV," AND MARION COUNTY BY FLORIDA DEPARTMENT OF AGRICULTURE, DIVISION OF SOILS, MARION COUNTY, FLORIDA, JULY, 1975.



SOIL ASSOCIATIONS FOR
 PREFERRED CORRIDORS
 FIGURE 10-9

11.0

STATUS OF PERMITS AND APPROVALS

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CHAPTER 11.0

PERMITS, APPROVALS, AND OTHER RELATED STATUTORY REQUIREMENTS

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11.0 PERMITS, APPROVALS, AND OTHER RELATED STATUTORY REQUIREMENTS

(Prepared by the Environmental Licensing Group, Inc.)

11.1 Status of Permits and Approvals

The licensing of a coal-fired steam electric power generating station required compliance or conformance with numerous local, state, and federal laws, regulations, and ordinances. These may impose procedural as well as substantive requirements and may mandate performance standards, limitations, consistency reviews, agency approvals, and inter-agency coordination. Table 11.1-1, State and Federal Laws applicable to the Proposed Power Generating Facility, lists the major state and federal environmental laws that have been considered in the licensing of the proposed power station. Table 11.1-2, Status of Permits and Approvals, identifies specific licensing, permitting, and approval actions and the schedule of such actions necessary for timely licensing of the proposed power station. Figure 11.1-1 presents a Master Permit Schedule which identifies the sequencing of the major permitting actions: site certification application, environmental analysis, National Pollutant Discharge Elimination System permit application, Prevention of Significant Deterioration permit application, and applications for construction in navigable waters and wetlands. Environmental permits are scheduled to be granted prior to final loan approval by the Rural Electrification Administration.

11.2 STATUS OF COMPLIANCE WITH OTHER RELATED STATUTORY REQUIREMENTS

In addition to statutory and regulatory requirements related to the issuance of permits and granting of approvals, there are other statutory requirements having special relevance to NEPA. Some of these are listed in Table 11.1-1. Seminole's status in conforming to other statutory requirements is discussed in this section.

11.2.1 National Energy Act

The so-called National Energy Act of 1978 consists of five separate pieces of legislation:

- National Energy Conservation Policy Act of 1978 (NECPA);
- Powerplant and Industrial Fuel Use Act of 1978 (FUA);
- Public Utility Regulatory Policy Act of 1978;
- Energy Tax Act of 1978; and
- Natural Gas Act of 1978

This discusses the applicability to Seminole Electric Cooperative, Inc., of (1) the National Energy Conservation Policy Act and (2) rules proposed by the U.S. Department of Energy to implement the Powerplant and Industrial Fuel Use Act.

11.2.1.1 National Energy Conservation Policy Act

The National Energy Conservation Policy Act of 1978 contains provisions that are applicable to electric utility companies that meet specific requirements. These provisions are contained in the Act at Part 1 of Title II and at Part 4 of Title VI.

Part I of Title II contains provisions to effect residential energy conservation by requiring, through state residential energy conservation

plans, that each "public utility" implement a utility program. A "public utility" is defined as:

...any person, State agency or Federal agency which is engaged in the business of selling natural gas or electric energy...to residential customers for use in a residential building.

Because Seminole Electric Cooperative, Inc., does not sell electric energy directly to residential customers, it is not, by DOE's definition, a public utility. Therefore, Seminole is not subject to the requirements of Part 1 of the Act, including the implementation of a utility program.

This distinction between a public utility that sells electric energy direct to residential customers and a utility that generates electric energy for resale is clarified further in section 211(a) of NECPA which states that Part 1 of Title II "shall apply only if...sales of electric energy by such public utility for purposes other than resale exceeded 750 million kilowatt hours" (emphasis added). All of Seminole's power is sold to its member cooperatives for resale.

Part 4 of Title VI, section 661, amends the Energy Policy and Conservation Act to incorporate, with one modification, the provisions of section 125 of the Clean Air Act that require the use of locally or regionally available coal or coal derivatives if such use is determined by the proper authorities to be necessary in order to minimize significant local or regional economic disruption or unemployment that would result from the use of other than locally or regionally available coal, petroleum products or natural gas.

Seminole Electric Cooperative, Inc., has undertaken negotiations to obtain supplies of Eastern Kentucky and/or Illinois coal for use in its Seminole Plant. In addition to coal, relatively small amounts of No. 2 oil will be burned during startup and for low load flame stabilization. Seminole does not anticipate that a change in fuel supplies will be required in order to minimize local or regional economic disruption or

unemployment. If, however, the use of other supplies of fuel were determined to be necessary by the proper authorities, Seminole Electric Cooperative, Inc., would act in accordance with the legal requirements of section 125 of the Clean Air Act and section 107 of the Energy Policy and Conservation Act.

11.2.1.2 Powerplant and Industrial Fuel Use Act

The primary purpose of the Powerplant and Industrial Fuel Use Act of 1978 is to minimize the use of petroleum and natural gas in industrial and electric utility boilers. To accomplish this purpose, the FUA prohibits, except for exemptions which may be granted by DOE, the use of petroleum and natural gas by new electric utility powerplants.

The Economic Regulatory Administration (ERA) of DOE has recently proposed rules at 43 Fed. Reg. 53974-54061 (November 16, 1978) to implement the FUA. If promulgated as proposed, these rules would classify Seminole Plant Units No. 1 and 2 as a "new electric powerplant" (see proposed section 500.2(a)(51)), and thus subject to the applicable provisions of final rules promulgated by DOE.

Section 503.2 of the ERA/DOE proposed rules would impose prohibitions on (1) the use of petroleum or natural gas as a primary energy source in any new electric powerplant and (2) the construction of any new electric powerplant without the capability to use an alternate fuel as a primary source.

According to proposed section 500.2(a)(66), "primary energy source" means:

...the fuel or fuels used for normal operation by any existing or new electric powerplant...except...
[m]inimum amounts of fuel required for unit ignition, startup, testing, flame stabilization and control use.... (Emphasis added.)

"Alternate fuel" is defined in proposed Section 500.2(a)(7) as "electricity of any fuel other than natural gas or petroleum. The term [alternate fuel] includes...coal...."

Seminole Electric Cooperative, Inc., will burn coal, an alternate fuel, as its primary energy source. Only small amounts of No. 2 oil will be burned for initial lightoff and during low load flame stabilization. Consequently, the prohibitions of section 503.2 of the FUA does not apply to Seminole Power Plant Units No. 1 and 2.

11.2.2 National Historic Preservation Act and Executive Order 11593

The National Historic Preservation Act of 1966, Executive Order 11593: Protection and Enhancement of the Cultural Environment, and other related Acts are implemented by 36 CFR 800, "Procedures for the Protection of Historic and Cultural Properties."

To assure the protection of historic and cultural properties, a survey was conducted to locate, identify, and assess the cultural resources that might exist on Seminole's Putnam site. Conducted in accordance with 36 CFR 800, this survey included archaeological field work; a review of previously known site locations recorded in the literature and in the Florida Master File; and a study of historic documents (federal and state land records, published historical studies, Spanish land grants, historical maps and plots, and county property and tax records).

The survey revealed the existence of no properties on the Putnam site that would be considered of National Register importance. Moreover, the nearest National Register properties are located in Palatka, approximately 5 miles south of the site. (October 23, 1978 letter from Mr. L. Ross Morrell, Deputy State Historic Preservation Officer to Mr. Tim Doyle, Dames & Moore, re: Cultural Resource Assessment of Seminole Electric Cooperative, Proposed Generating Facility Putnam County, Florida.)

11.2.3 Coastal Zone Management Act

The Coastal Zone Management Act of 1972 encourages the states to develop and implement coastal zone management programs to achieve wise use of the nation's coastal zone.

Currently, the State of Florida is in the process of developing its own coastal zone management program. Responsibilities for administering and implementing the state program have been delegated to the Florida Department of Environmental Regulation.

In accordance with the Florida Coastal Management Act of 1978, the Florida Coastal Zone Management Program will be based entirely on existing statutes and rules. Because Seminole Electric Cooperative, Inc., has complied with applicable existing statutes and rules, Seminole Plant Units No. 1 and 2 will comply with the provisions of the Florida Coastal Zone Management Program after the program has been adopted. In the event that the state program imposes additional requirements on the Seminole Plant, Seminole Electric Cooperative, Inc., will take appropriate actions to comply with such requirements.

11.2.4 Endangered Species Act

The Endangered Species Act mandates that federal agencies seek to conserve endangered and threatened species. Pursuant to this statutory responsibility, REA has requested that the U.S. Fish and Wildlife Service provide information concerning whether any species listed or proposed to be listed as a federal threatened or endangered species may be present in the area of the proposed Putnam site, as well as two alternate sites. (January 11, 1979 letter from William R. Dalton of REA to the Regional Director, U.S. Fish and Wildlife Service.)

11.2.5 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act requires that the U.S. Fish and Wildlife Service and state wildlife agency participate in the review of permit applications for activities that would cause any body of water to be modified.

The Field, Area and/or Regional Offices of the U.S. Fish and Wildlife Service and the Florida Game and Fresh Water Fish Commission have participated in the licensing process of the proposed Seminole Units No. 1 and 2 since the initial stages of the project in early 1977.

11.2.6 Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act establishes the policy of the United States that certain rivers of the nation, which "...possess outstanding remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit of future generations."

Throughout the process of evaluating alternative sites and in its selection of a preferred site, Seminole has considered the existence of wild and scenic rivers and those potential additions to the wild and scenic rivers system. No rivers of this designation or proposed for this designation occur within the region of the preferred site or would otherwise be impacted by construction or operation of the proposed project.

11.2.7 Executive Order 11990: Protection of Wetlands

Executive Order 11990: Protection of Wetlands directs each federal agency to:

...take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for ...(2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resource planning, regulating and licensing activities.

Specifically, the direction is to be carried out in furtherance of Section 101(b) (3) of the National Environmental Policy Act of 1969 and, to the extent possible, follow the procedures of the Council on Environmental Quality and Water Resources Council.

Seminole Electric Cooperative, Inc. has incorporated the guidance of the Council on Environmental Quality and the Water Resources Council in its planning activities and coordinated closely with both state and federal agencies whose responsibilities are to manage wetland resources.

11.2.8 Executive Order 11988: Floodplain Management

Executive Order 11988: Floodplain Management, directs that each federal agency

...shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for...(2) providing Federally undertaken, financed or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating and licensing activities.

To implement this directive, the agency must, before taking action, determine whether the proposed action will occur in a floodplain. If, for major federal actions significantly affecting the quality of the human environment, the agency determines to, or proposes to, conduct, support, or allow an action to be located in a floodplain, the agency shall evaluate the action, considering alternatives to avoid adverse effects and incompatible development in the floodplains. The Water Resources Council has developed guidelines for implementing Executive Order 11988, published in the Federal Register Vol. 43, No. 29: February 10, 1978.

Seminole Electric Cooperative, Inc., has planned the location of its proposed facilities with respect to the 100-year and 500-year floodplains. While the 100-year floodplain is shown to infringe upon the site property, no structures, embankments, or fill are planned to be placed in the 100-year floodplain. None of the principal plant equipment is located within the 500-year floodplain.

11.2.9 Secretary's Memorandum No. 1827: Policy on Prime Farmland, Range and Forest Land

The Secretary's Memorandum No. 1827: Policy on Prime Farmland, Range and Forest Land expresses concern for the continued loss of lands

well suited to the production of food, forage, fiber, and timber, and the degradation of the environment resulting from those losses. Consequently, major consideration must be given to prime lands and the long-range need to retain the productive capability and environmental values of American agriculture and forestry.

The Secretary's Memorandum sets policy requiring, where federal funds are involved, that Department of Agriculture personnel carefully explore land use alternatives which would minimize impacts on prime lands, and, where possible, avoid land use decisions which irrevocably commit prime lands to nonfarmland, non-range land uses, thereby foreclosing the options of future generations.

Seminole Electric Cooperative, Inc., has considered the potential presence of prime lands in evaluations of land use on the proposed site. No prime farmlands, range and forest lands exist on the site or will be adversely impacted by the construction or operation of the proposed project.

TABLE 11.1-1

State and Federal Environmental Laws
Applicable to the Proposed
Power Generating Facility

State

Florida Electric Power Plant Siting Act
Florida State Comprehensive Planning Act
Regulation of Public Utilities
Environmental Control
Florida Water Resources Act
Local Government Comprehensive Planning Act
Land Acquisition Trust Fund
Use of Sovereignty and Other State Owned Lands
Environmental Land and Water Management Act
Florida Archives and History Act
Florida Administrative Procedure Act

Federal

Clean Water Act
National Environmental Policy Act
(Executive Orders 11514 and 11991)
The Clean Air Act
The National Historic Preservation Act
(Executive Order 11593)
Coastal Zone Management Act
Fish and Wildlife Coordination Act
Endangered Species Act
Wild and Scenic Rivers Act
Rivers and Harbors Act
National Energy Act

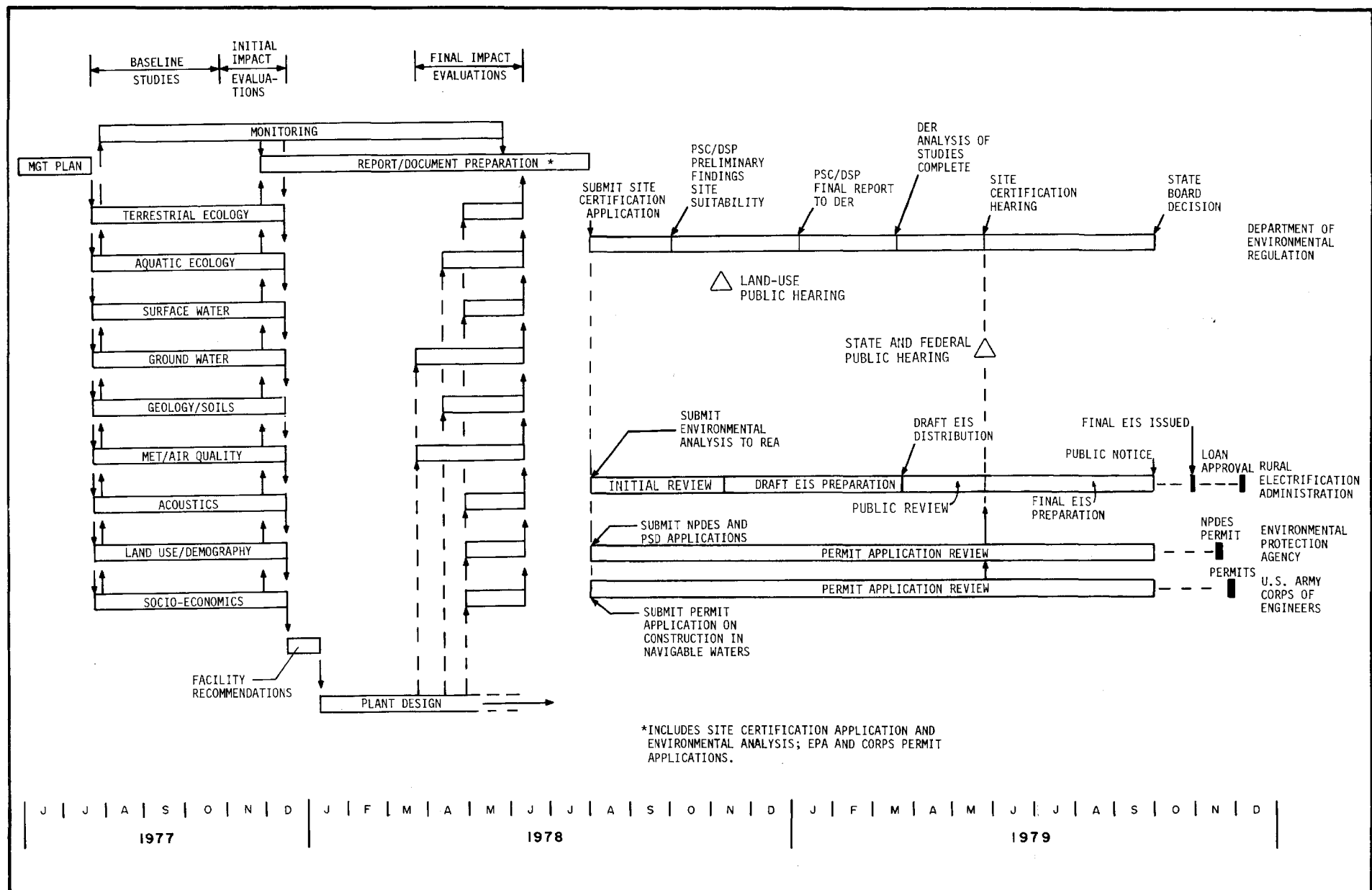


Figure 11.1-1. Master Permit Schedule.

Table 11.1-2
STATUS OF PERMITS AND APPROVALS*

Subject of Permit Application or Approval	Statutory Mandate	Administering Agency**	Date of Application (Proposed)	Approval Date (Expected)	Comments
<u>FEDERAL</u>					
Application for loan approval	Rural Electrification Act	REA	(3/79)	(12/79)	
Environmental Analysis	National Environmental Policy Act; Exec. Order 11514: Protection and Enhancement of Environmental Quality; Exec. Order 11991: Relating to Protection and Enhancement of Environmental Quality	REA	8/78	(11/79)	
NPDES	Clean Water Act (\$402)	EPA	10/78	(11/79)	Preliminary draft NPDES permit to be issued by 2/79.
Preconstruction New Source Air Quality Review	Clean Air Act (\$110)	EPA	8/78	(11/79)	This review will be conducted by the State through its Site Certification process.
PSD	Clean Air Act (\$160-169)	EPA	5/78	(Prior to 5/79)	Preliminary determination made by 2/79.
Activities in Navigable Waters	Rivers and Harbors Act (\$10)				
1. Intake/discharge structures		COE	9/78	(11/79)	
2. Transmission Lines		COE	5/79	(11/79)	

Table 11.1-2 (Continued)

Subject of Permit Application or Approval	Statutory Mandate	Administering Agency**	Date of Application (Proposed)	Approval Date (Expected)	Comments
Activities in Wetlands	Clean Water Act (\$404)	COE	NA	NA	No permit required (June 22, 1978 letter from COE)
Construction of Plant Stack	Federal Aviation Act	FAA	2/78	5/78	FAA approval contingent on DOT stack construction approval
<u>STATE</u>					
Site Certification Application	Florida Electrical Power Plant Siting Act	DER	8/78	(9/79)	
Transmission Line Road Crossings	Ch. 338 F.S. (Ch. 14-46 FAC Utilities Installation or Adjustment)	DOT	(3/79)	(5/79)	
Modifications of State Road 17		DOT	(3/79)	(5/79)	
Construction of Plant Stack	Ch. 75-16 F.S.	DOT	6/78	6/78	
Water Well Drilling	Ch. 381.031(1)(g)(3) F.S.	DHRS and DER	4/78	4/78	
Well Regulation	Florida Water Resources Act	SJRWMD	4/78	4/78	
Easement through State Owned Lands	Ch. 253 F.S. and Ch. 76-24F F.S.	DNR	10/78	12/78	

Table 11.1-2 (Continued)

Subject of Permit Application or Approval	Statutory Mandate	Administering Agency**	Date of Application (Proposed)	Approval Date (Expected)	Comments
<u>LOCAL</u>					
Land Use or Zoning Approval	Putnam County Zoning Ordinance 75-6 Chapter 163 F.S. Chapter 125 F.S.	Putnam County Commission	4/78	5/78	
Pipeline Road (209) Crossings	Putnam County Ordinance Ch. 338 F.S.	Putnam County Commission DOT	(3/79)	(5/79)	

* Status as of February 19, 1979

** Abbreviations:

REA	U. S. Rural Electrification Administration
EPA	U. S. Environmental Protection Agency
COE	U. S. Corps of Engineers
FAA	Federal Aviation Administration
DER	Florida Department of Environmental Regulation
DOT	Florida Department of Transportation
DHRS	Florida Department of Health and Rehabilitative Services
SJRWMD	St. Johns River Water Management District
DNR	Florida Department of Natural Resources
NA	Not applicable

12.0

COORDINATION WITH OTHERS

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CHAPTER 12.0 COORDINATION WITH OTHERS

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12.0 COORDINATION WITH OTHERS

(Prepared by the Environmental Licensing Group, Inc.)

From the initiation of the proposed project licensing, it has been the policy of the Seminole Electric Cooperative, Inc. to stimulate open, objective evaluation of its efforts with governmental agencies and the public alike. According to its Statement of Environmental Policy:

Seminole Electric Cooperative, Inc. recognizes the essentiality of balancing the need for reliability and economy of electric service to its members, with the need to adequately protect the environment for optimum use and enjoyment. Seminole Electric Cooperative, Inc. will:

1. Strive to design and build an efficient, reliable electric system with capacity to meet present day requirements and flexibility for continued expansion to economically meet the needs of the future in a manner consistent with the environmental objectives of our society.
2. Endeavor to avoid actions which might be detrimental to or diminish public enjoyment of existing or planned recreation resources, or resources of historic and scenic value.
3. Endeavor to avoid or minimize the effect of actions which might contribute to pollution of the air, water or land.
4. Maintain a working relationship with all Federal, State and local regulatory agencies concerned with health, safety and the environment.

Consistent with this policy, the Company is conducting its licensing activities in a manner to effect meaningful compliance with the full intent of the National Environmental Policy Act and the Florida Electric Power Plant Siting Act. The Company has emphasized the importance of the decision making process in allocating and using natural resources for power generation and transmission, by encouraging open, responsible interchange of information in the interests of the public. This approach is consistent with the policy and procedure of the proposed Council on Environmental Quality regulations for implementing NEPA.

Coordination among Seminole, governmental agencies and the public is reflected in the summary of pertinent communications, meetings and interactions included in this chapter. Through the licensing process, Seminole has developed and applied six innovative techniques for accomplishing the objectives now proposed by the Council on Environmental Quality. These include:

1. An aggressive, open public information program.
2. The early preparation and distribution of the PLAN OF STUDY, a methodological approach directed to: (1) identify, generally describe and organize the diverse activities required to develop environmental information needed to comply with applicable regulations and to design a power generating station to optimally utilize available natural resources; and (2) encourage responsible, open, extra-agency input to the decision making process through the anticipation of critical points and paths of decision making and information flow by use of a time-scaled network diagram.
3. The coordination and consolidation of state and federal requirements in the preparation of a single Environmental Analysis/Site Certification Application document.
4. Continuing, frequent interaction and interchange in the preparation and review of environmental analyses.
5. Preparation and distribution of an INTERIM REPORT midway through the environmental analyses: (1) to provide an overview and update of project activities; (2) to provide an early opportunity for participant reviewers to focus on site-specific issues and alternatives; (3) to illuminate the on-going decision making process; and (4) to assist in guiding the company and consultants by stimulating critique and recommendations from project reviewers.
6. Early, simultaneous filing of the Environmental Analysis/Site Certification Application with state and federal agencies to allow ample opportunity for public and agency reviews.

Three tables have been prepared for Chapter 12: Coordination with Governmental Agencies, Coordination with the Public and Articles and Notices of Proposed Project.

While records of coordination activities in this chapter have been documented only through January 1979, due to requirements for publication, actual coordination will continue through the federal NEPA process and state Site Certification process which is expected to be concluded by December 1979.

Table 12-1

Coordination with Governmental Agencies

DATE	AGENCY*	NATURE OF COORDINATION
10/27/76	DER, DSP, PSC	Introductory meeting among agencies, applicant and consultant to discuss the regulations and requirements for power plant site selection.
2/10/77	DNR, DSP, DOT, DER	Meeting to review progress of site alternative studies.
3/28/77	DER, DSP	Meeting to discuss alternative site studies and results.
4/12/77	DSP, DER, PSC, GFWFC, DNR-Coastal Zone Planning	Meeting of the Florida Clearinghouse Committee to discuss early siting efforts.
5/25/77	DSP	Transmittal of Minutes for 4/12/77 meeting.
6/2/77	DER	Transmittal of REA bulletin 20-21:320-21 to DER.
6/7/77	REA	Meeting to discuss proposed SECI project and REA requirements and responsibilities under the National Environmental Policy Act.
6/8/77	REA	Transmittal of SECI's <u>Site Selection Study -- Executive Summary</u> .
6/13/77	EPA, USFWS	Meeting to initiate discussion and preparation for the review of proposed electric facilities for SECI.
6/24/77	EPA, USFWS, NMFS, REA, PSC, DSP, SJRWMD, DER, COE	Invitation from SECI for "Interagency Coordination Review Meeting" to be held 7-8 July 1977. Purposes of meeting included: (1) determination of each agency's responsibilities in power plant licensing; (2) the procedures to be used to carry out these responsibilities; and (3) opportunities for consolidating the state and federal regulatory process.
6/26/77	DER	Transmittal of "Draft" outline for review and approval of a consolidated format for Environmental Analysis/Site Certification Application to unify federal and state requirements.
6/30/77	NEFRPC	Telephone conversation with Executive Director to introduce the SECI proposed 1200 MW power generating station project and solicit help in timely review of activities within planning council jurisdiction.
6/30/77	PSC	Letter to solicit comments regarding "Draft" DER application for Certification of a Proposed Fossil Fuel Power Generating Plant Site.
7/7-8/77	DER, SJRWMD, USFWS, EPA, PSC, COE, REA	Interagency coordination meeting held in Keystone Heights, Florida (see 6/24/77 for purpose of meeting).
7/14/77	NMFS	Letter outlining NMFS principal responsibilities in siting review and permitting-licensing process.
7/25/77	DSP	Comments from USFWS to DSP on Ten Year Site Plan for SECI.
7/28/77	NMFS	Transmittal of draft, consolidated federal-state contents for Environmental Assessment Statement/Site Certification Application.
8/1/77	NMFS	Acknowledgement of receipt of "Table of Contents" for the "Environmental Assessment Statement/Site Certification Application" and determination of NMFS interests in power plant siting.
8/2/77	NEFRPC	Meeting with Executive Director to introduce the SECI power plant project, to solicit council's participation, and to determine the council's role in waste treatment management, coastal zone planning, and local comprehensive planning.
8/5/77	EPA	Determination that proposed generating facility will be "new source" and will be subject to NEPA of 1969.
8/17/77	REA, DER, EPA, USFWS, DST, SJRWMD, JAPB	Transmittal of draft PLAN OF STUDY for proposed project.
8/23/77	DER	Comments on Dames & Moore PLAN OF STUDY.
8/25/77	REA	Comments from USFWS to REA on request for technical assistance on proposal to construct power plant.
8/26/77	USFWS	Comments from USFWS on Dames & Moore Environmental Analysis Plant Study.
9/7/77	NMFS	Response to request for comments on PLAN OF STUDY.
9/9/77	SJRWMD	Response to request for comments on PLAN OF STUDY.
9/13/77	REA	Meeting with REA in Washington to review comments of draft Site Certification Application/Environmental Analysis, PLAN OF STUDY and establish direction of continuing efforts of SECI, REA, and Dames & Moore to satisfy requirements of REA.

Table 12-1 (Continued)

DATE	AGENCY*	NATURE OF COORDINATION
9/20/77	REA, NEFRPC, NMFS, SJRWMD, DSP, USFWS, EPA, DER, JAPB	Extension of period for comments on Dames & Moore Site Certification Application/Environmental Analysis PLAN OF STUDY.
9/21/77	REA	Telephone conversation to clarify applicable public notice requirements.
9/23/77	DAH&R	Letter to State Historic Preservation Officer to determine if archaeological study is necessary on preferred site.
9/26/77	USFWS	Response to request for comments on the Site Specific Sampling Plan, Aquatic Ecology.
9/26/77	REA	Letter to REA requesting determination of responsibilities of REA as lead agency under NEPA and clarification of role of applicant in preparation of environmental analysis.
10/13/77	DSP	Meeting of (1) Review SECI's Site Certification activities, (2) Review DSP process for evaluation of Ten Year Site Plan, (3) Review energy element of State Comprehensive Plan.
10/20/77	DAH&R	Request for DAH&R comments on archaeological survey to be conducted on preferred site.
10/20/77	REA, NEFRPC, NMFS, SJRWMD, USFWS, DSP, EPA, DER, COE, GFWFC, JAPB.	Transmittal of revised "Site Certification Application and Environmental Analysis PLAN OF STUDY," 10/14/77.
11/14/77	REA, EPA, DER	Invitation to agencies to discuss compliance with 1977 amendments to Clean Air Act.
11/18/77	EPA, DER	Meeting in Atlanta to determine procedures for compliance with the 1977 amendments to the Clean Air Act in the licensing of the preferred site.
12/7/77	USFWS	Request for comments on location evaluation for intake/discharge structure at preferred site.
12/15/77	USFWS	Response to comments on intake/discharge structure.
12/30/77	DER	Request for DER clarification on PSD permit application requirements.
1/16/78	USFWS	Response to correspondence of 12/7 and 12/15 with USFWS. Restatement of SECI's philosophy of cooperation and open communications.
1/19/78	REA	Invitation to REA to participate in 2/9-10 meeting to visit alternative power plant sites, discuss status of project, and discuss federal agency coordination process.
1/24/78	COE	Transmittal of copy "Site Certification Application and Environmental Analysis Seminole Plant Putnam County PLAN OF STUDY."
1/24/78	GFWFC	Letter concerning tentative selection of pipeline corridor.
1/27/78	GFWFC	Confirmation of meeting with SECI's representatives to discuss plans for proposed plant.
2/1/78	FAA	Application for construction of tall structure filed.
2/22/78	EPA	Meeting in Atlanta to identify information to support PSD permit application and review licensing and equipment procurement schedule.
3/1/78	REA	Letter to confirm documentation of site study.
3/2/78	REA, USFWS	Meeting with USFWS in Atlanta to discuss (1) recent correspondence between Dames & Moore, USFWS, and SECI, (2) USFWS procedures for coordination of correspondence with SECI, (3) REA position on site alternatives selection process, and (4) status of proposed SECI power plant project and effects of proposed CEQ regulations on licensing.
3/7/78	GFWFC	Meeting to discuss status of SECI's licensing activities and the relationship between USFWS and GFWFC.
3/8/78	GFWFC	Transmittal of a copy of PLAN OF STUDY.
3/14/78	DER (St. Johns River Subdistrict)	Meeting to discuss suitability of existing ambient air quality data.
3/14/78	DER, Duval County Pollution Control Dept.	Meeting in Jacksonville to discuss application for prevention of significant deterioration.
3/15/78	DER	Transmittal of comments on preferred site study plan.
3/24/78	DER (St. Johns River Subdistrict)	Request of DER for endorsement of comments and available ambient air quality data.
3/24/78	Putnam County Comm.	Application for rezoning of preferred site filed.

Table 12-1 (Continued)

DATE	AGENCY*	NATURE OF COORDINATION
3/31/78	DSP	Transmittal of "Ten-Year Site Plan" discussing electrical need forecasts and forecast for new facilities.
4/3/78	Putnam County Comm.	Private water well construction permit application filed.
4/4-5/78	REA, SJRWMD, DSP, SWFWMD, GFWFC, USFWS, EPA, DER	Interagency Coordination meeting to (1) allow participants to visit "preferred" and alternate sites, and (2) review and discuss engineering and licensing activities, interagency coordination, and results of site investigations.
4/10/78	Putnam County Comm.	Private water well construction permit issued.
4/19/78	REA, NEFRPC, NMFS, SJRWMD, DSP, EPA, DER, COE, GFWFC, JAPB, USFWS	Transmittal of "Interim Report" to (1) coordinate environmental licensing activities and engineering design, (2) ensure regulatory compliance requirements are incorporated early in engineering design process, and (3) assure adequate and orderly opportunity for participation of state and federal agencies in decision making.
4/20/78	DER	Letter responding to 3/15/78 DER comments on aquatic sampling program.
4/20/78	SJRWMD	Water well construction permit issued.
5/2/78	FAA	Permit to construct tall structure issued.
5/2/78	EPA	Conversation regarding Seminole's and Jacksonville Electric Authority's plans for proposed plants and the proper sequence for PSD and FPSD permits.
5/8/78	Putnam County Planning Commission.	Public information workshop on proposed power plant project.
5/10/78	SCWAB	Meeting to discuss Sumter site as an alternative location for a coal-fired power plant. Discussion of sludge disposal, ash disposal, disposal of cooling water, and treated waste water into surrounding area.
5/10/78	Putnam County Planning Commission	Public hearing before Planning Commission.
5/10/78	NMFS	Comments from NMFS on INTERIM REPORT: Environmental Input to Power Plant Engineering Design process.
5/18/78	EPA, (copies to REA, DER)	Transmittal of Prevention of Significant Deterioration (PSD) Permit Application for Seminole Plant Units No. 1 and No. 2.
5/22/78	DER	Comments from DER on INTERIM REPORT: Environmental Input to Power Plant Engineering Design Process.
5/23/78	Putnam County Comm.	Approval of land use zoning change.
5/24/78	COE, EPA	Meeting in Jacksonville to discuss requirements for COE permit applications.
6/2/78	COE	Letter to COE requesting review of alternative sites and a determination of jurisdiction over use of wetlands on the sites and activities in navigable waters adjacent to the sites.
6/5/78	EPA, GFWFC, USFWS	Invitation to meet to discuss alternative cooling water intake/discharge facilities and locations for use at the proposed site.
6/7/77	COE	Visit preferred site to review condition of wetlands.
6/8/78	DOT	Tall structure permit issued.
6/8/78	GFWFC	Receipt from GFWFC of comments on INTERIM REPORT and "Appendix E of PLAN OF STUDY."
6/9/78	DER	Comments on and findings of acceptability of Prevention of Significant Deterioration Application.
6/14/78	EPA	Meeting in Atlanta to discuss 316(b) compliance criteria applicable to the design and operation of a cooling water intake structure to achieve "best available technology."
6/14/78	USFWS	Meeting in Atlanta to discuss proposed "best available technology" design for cooling water intake structure.
6/16/78	GFWFC	Meeting to discuss the proposed cooling water intake structure design as "best available technology" to minimize adverse environmental impact.
6/16/78	NMFS	Transmittal of the results of the 6/14/78 meetings with EPA and USFWS on §316(b) compliance and request for review and comments.
6/16/78	DER	Transmittal of the results of the 6/14/78 meetings with EPA and USFWS on §316(b) compliance and request for review and comments.

Table 12-1 (Continued)

<u>DATE</u>	<u>AGENCY*</u>	<u>NATURE OF COORDINATION</u>
6/22/78	COE	Letter reporting on field trip of COE to the preferred Putnam County Site and determination that COE jurisdiction does not extend to wetlands on this site.

*ABBREVIATIONS:

Federal

COE	Corps of Engineers
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
NMFS	National Marine Fisheries Services
REA	Rural Electrification Administration
USFWS	U. S. Fish and Wildlife Service

State

DAH&R	Division of Archives, History and Records Management
DER	Department of Environmental Regulation
DNR	Department of Natural Resources
DOT	Department of Transportation
DSP	Division of State Planning
FWFC	Florida Game and Fresh Water Fish Commission
PSC	Public Service Commission
SJRWMD	St. Johns River Water Management District

Local

JAPB	Jacksonville Area Planning Board
NEFRPC	Northeast Florida Regional Planning Council

Table 12-1a

COORDINATION WITH GOVERNMENTAL AGENCIES
(Additions from August, 1978 to January, 1979)

<u>DATE</u>	<u>AGENCY*</u>	<u>NATURE OF COORDINATION</u>
8/7/78	COE, EPA, DOA, DOCA, DAH&R DNR, DHRS, DOT, GFWFC, DOC, DA&CS, PSC, SIERRA, WIRPC, NEFRPC	Transmittal by DER to agencies of copies of <u>SECI Site Certification Application and Environmental Analysis</u> .
8/4/78	DER, REA	SECI files <u>Site Certification Application and Environmental Analysis</u> with DER and REA.
8/14/78	DER	Determination that <u>Site Certification</u> is "complete".
8/24/78	Sumter County Water Authority	Comments on report on groundwater conditions at Sumter site alternate.
8/31/78	EPA, DOI, COE	Letter from REA to other federal agencies proposing REA be designated as federal "lead agency" on Seminole project.
9/1/78	WIRPC, NEFRPC, NCFRPC	Letter from SECI to planning councils requesting certification that proposed transmission corridors are consistent with applicable land use plans and zoning ordinances.
9/7/78	NEFRPC	Confirmation from NEFRPC that proposed site is consistent with regional land use plan and Putnam County Comprehen- sive Plan.
9/7/78	EPA	SECI transmittal of draft NPDES appli- cation to EPA.
9/7/78	COE	SECI transmittal of application for activities in navigable waters to COE.

Table 12-1a (Continued)

<u>DATE</u>	<u>AGENCY*</u>	<u>NATURE OF COORDINATION</u>
9/8/78	EPA	Letter from EPA to REA concurring with REA as lead federal agency and agreeing to work to coordinate activities and provide a draft NPDES permit for inclusion in Draft EIS.
9/13/78	DER, COE, EPA, REA	Meeting of agencies with SECI to eliminate duplication among procedures as directed by proposed Council on Environmental Quality regulations.
9/15/78	EPA	Meeting with SECI to discuss draft NPDES application.
9/20/78	WIRPC	SECI request for certification that transission corridors are consistent with regional and local land use plans.
9/20/78	NCFRPC	NCFRPC transmittal of land use plan to SECI.
9/22/78	NCFRPC	Letter to SECI acknowledging consistency of transmission corridor with regional land use plan.
9/27/78	Putnam County Board of County Commission	Transmittal to SECI of Board resolution providing for rezoning of land to allow use as a proposed power plant site.
9/29/78	COE	Letter from COE to REA agreeing with REA as lead agency.
9/29/78	NEFRPC	Transmittal regional land use plan to SECI.
10/4/78	Marion County Zoning and Building Department	Confirmation that transmission corridors would not violate zoning regulations.
10/5/78	DNR	Comments to DER on <u>Site Certification Application</u> .
10/5/78	SJRWMD	Comments to DER on preliminary review of <u>Site Certification Application</u> .

Table 12-1a (Continued)

<u>DATE</u>	<u>AGENCY*</u>	<u>NATURE OF COORDINATION</u>
10/6/78	DNR	SECI submittal to DNR of application for easement across state owned bottomlands.
10/9/78	Columbia County Board of County Commissioners	Transmittal to SECI of Columbia County Comprehensive Plan.
10/9/78	Bradford County Zoning Commission	Transmittal to SECI of Bradford County zoning codes and land use plan.
10/10/78	EPA	Letter from EPA to SECI requesting that the PSD Application be amended and confirming May 19, 1978 as the official date of application.
10/12/78	DOI	Letter concurring with role of REA as lead agency.
10/13/78	DER, COE, EPA, REA	SECI transmittal of minutes of state/federal review coordination meeting held 9/13/78.
10/16/78	DER	Transmittal to SECI of DER questions on the <u>Site Certification Application</u> .
10/23/78	DAH&R	Letter from State Historic Preservation Officer stating compliance with 36 CFR 800.
10/23/78	NCFRPC	NCFRPC comments on consistency of proposed transmission corridor with local and regional plans.
10/30/78	NCFRPC	Comments on transmission line corridor through Lake Butler.
10/31/78	EPA	SECI transmittal of NPDES Application and request for 316(b) determination.
11/1/78	DER	Request by REA for DER to cooperate and coordinate with REA during the NEPA process.

Table 12-1a (Continued)

<u>DATE</u>	<u>AGENCY*</u>	<u>NATURE OF COORDINATION</u>
11/1/78	NMFS	Letter to REA accepting REA as "lead agency" and identifying NMFS responsibilities.
11/6/78	DNR	Letter from DNR to SECI determining requirement for easement across state owned lands.
11/8/78	NCFRPC	Request for NCFRPC to be party to Seminole Site Certification proceedings.
11/9/78	EPA	Meeting of SECI with EPA to discuss PSD Application.
11/13/78	Marion County	Meeting with SECI regarding transmission line routing through county.
11/14/78	Marion County	Transmittal of comments on transmission line routing.
11/28/78	Marion County	Stipulation stating that no zoning ordinance exist which apply to transmission corridor.
12/6/78	NMFS	Letter to REA identifying NMFS interests in environmental impact statement process and permit process.
12/7/78	COE	Meeting of SECI with COE to discuss COE permit application for activities in navigable waters at proposed Putnam County Site.
12/7/78	DER	Meeting with SECI with DER to discuss estuarine modeling of water effluents.
12/12/78	USFWS, EPA, DER, GFWFC	Transmittal by SECI of "Plan of Study Aquatic Biological Program to Monitor <u>In Situ</u> Intake Screen Testing for Seminole Units No. 1 and 2" and request for comments.
12/12/78	COE	Letter from COE determining applicability of COE requirements for alternate power plant sites.

Table 12-1a (Continued)

<u>DATE</u>	<u>AGENCY*</u>	<u>NATURE OF COORDINATION</u>
12/14/78	USFWS	Meeting of SECI with FWS to discuss proposed aquatic biological testing in compliance with Section 316(b) of the Clean Water Act.
12/15/78	EPA	Meeting of SECI with EPA to submit and discuss PSD Application Amendments.
12/19/78	DNR	DNR notification to SECI of Board of Trustees of the Internal Improvement Trust Fund approval of utility easement across state owned bottomlands.
12/21/79	USFWS	Transmittal of USFWS comments on bio-fouling and aquatic biological testing program for 316(b) compliance.
1/3/79	DER	Letter from DER to SECI acknowledging review of <u>In situ</u> screen testing plan and offering comments.
1/3/79	PSC	Meeting of SECI and PSC to discuss SECI expansion plans.
1/4/79	USFWS (Area Office)	Meeting with SECI to discuss proposed project status.
1/4/79	SJRWMD	SECI transmittal to SJRWMD of responses to questions raised by SJRWMD on <u>Site Certification Application</u> .
1/8/79	USFWS	REA request of USFWS for USFWS comments for inclusion in Draft EIS.
1/8/79	USFWS	Letter to REA transmitting USFWS comments on intake screen testing program.
1/8/79	NMFS	Transittal by SECI to NMFS of copy of <u>Site Certification Application</u> .
1/8/79	NMFS	REA request of NMFS for NMFS comments to be included in Draft EIS.
1/8/79	PSD	Transmittal by PSC to DER of PSC final report of Seminole's <u>Site Certification Application</u> .

Table 12-1a (Continued)

<u>DATE</u>	<u>AGENCY*</u>	<u>NATURE OF COORDINATION</u>
1/11/79	USFWS	Letter from REA requesting Section 7 Consultation with USFWS and determination of effects of proposed project on manatee.
1/12/79	DER	Transmittal of SECI responses to DER questions dated 10/16/78.
1/16/79	USFWS (Field Office)	Meeting of SECI with USFWS to discuss NEPA responsibilities and progress of proposed project.
1/17/79	REA	Transmittal by SECI of amended copy of PSD application to REA.
1/18/79	GWFC	GWFC recommendations to SECI on intake screen study design.
1/25/79	SJRWMD	Meeting with SECI to discuss <u>Site Certification Application</u> .
1/25/79	DER, SJRWMD	Transmittal by SJRWMD to DER of District comments on <u>Site Certification Application</u> .
1/26/79	GWFC	SECI response to GWFC comments on "Aquatic Biological Program to Monitor <u>In Situ</u> Intake Screen Testing".
1/26/79	DER	Transmittal to DER of Seminole Plant Units No. 1 and 2 Mixing Zone Assessment Report.
1/31/79	EPA	Letter from EPA (Athens) acknowledging review and acceptance of plan of study for <u>In Situ</u> intake screen testing program.
1/31/79	REA, PSC	Transmittal of PSC's final evaluation of SECI <u>Site Certification Application</u> to REA.

Table 12-1b

COORDINATION WITH GOVERNMENTAL AGENCIES
(Additions to Table 12-1)

<u>DATE</u>	<u>AGENCY*</u>	<u>NATURE OF COORDINATION</u>
6/1/77	Department of Navy	Letter cancelling use of Naval restricted bombing site area near Bostwick, Florida, effective 7/1/77.
7/29/77	Putnam County Port Authority	Letter to SECI describing citizen's concerns over property adjacent to proposed plant.
8/15/77	USFWS	Letter to REA concerning potential for threatened or endangered species on proposed site near Bostwick.
8/17/77	NEFRPC	Transmittal by SECI to NEFRPC of Plan of Study and request for comments on Plan.
8/31/77	USFWS	Transmittal to SECI by USFWS of USFWS comments on Plan of Study.
9/28/77	SJRWMD	Transmittal to SECI SJRWMD comments on Plan of Study.
11/18/77	EPA	Meeting of SECI with EPA to discuss air quality issues and requirements for compliance with new source performance standards and prevention of significant deterioration regulations.
3/3/78	DNR	SECI request for determination of existence of state owned bottomlands.
4/11/78	DSP	Transmittal of "Power Requirements Study, Florida 41, Seminole, for Seminole Electric Cooperative, Inc." from SECI to DSP.
5/9/78	Sumter County Water Authority Board	Meeting with SECI to discuss alternative site Sumter.

Table 12-1b (Continued)

<u>DATE</u>	<u>AGENCY*</u>	<u>NATURE OF COORDINATION</u>
6/6/78	SJRWMD	SECI transmittal to SJRWMD of report: "Floridan Aquifer Study, Boiler Feedwater, Putnam Site."
6/16/78	EPA	Meeting with SECI to discuss procedures for compliance with 316(b) requirements.
6/16/78	USFWS	Meeting with SECI to discuss procedures for compliance with 316(b) requirements.
6/21/78	DOT	Issuance of tall structure permit.
6/22/78	COE	Letter to SECI establishing need for COE permit for intake/discharge facilities and determining that the COE does not have jurisdiction over "wetlands" on the proposed Putnam County site.

*LIST OF ABBREVIATIONS FOR TABLES 12-1a and 12-1b
(Coordination with Governmental Agencies)

Federal

COE	Corps of Engineers
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
NMFS	National Marine Fisheries Service
REA	Rural Electrification Administration
USFWS	U.S. Fish and Wildlife Service
DOI	Department of the Interior

State

DA&CS	Department of Agriculture and Consumer Services
DAH&R	Division of Archives, History and Records Management
DER	Department of Environmental Regulation
DNR	Department of Natural Resources
DOC	Department of Commerce
DOCA	Department of Community Assistance
DOT	Department of Transportation
DSP	Division of State Planning
GFWFC	Florida Game and Fresh Water Fish Commission
PSD	Public Service Commission
SJRWMD	St. Johns River Water Management District

Local

JAPB	Jacksonville Area Planning Board
NCFRPC	North Central Florida Regional Planning Council
NEFRPC	Northeast Florida Regional Planning Council
WRPC	Withlacoochee Regional Planning Council

Table 12-2

Coordination with the Public

<u>Date</u>	<u>Organization/Individual</u>	<u>No. of Participants</u>	<u>Nature of Coordination</u>
5/3/77	Mr. R. E. Hudson, Putnam County Chamber of Commerce		Letter of support from the Industrial Development Team of local businessmen.
7/20/77	Putnam County Chamber of Commerce	125	General presentation of project.
7/26/77	Mr. Prime F. Osborn, The Family Lines System Railroad		Offer of assistance and letter of sup- port for Palatka plant site.
7/27/77	Mr. A. H. "Gus" Craig, The Florida House of Representatives		Offer of personal support and assistance for Putnam County plant.
8/9/77	Palatka Rotary	75	General presentation of project.
8/16/77	Kiwanis (Azalea City)	85	General presentation of project.
8/17/77	Mr. Sherrill "Pete" Skinner, The Florida Senate		Letter of support for Putnam County plant and expression of concern for expeditious handling of permitting process.
9/1/77	Kiwanis (Downtown, Palatka)	80	General presentation of project.
9/17/77	Putnam County Democratic Women	25	General presentation of project.
9/17/77	Tri-County Electric Coopera- tive Annual Meeting	800	General presentation of project.
9/21/77	Crescent City Rotary	50	General presentation of project.
10/3/77	Palatka Lions Club	70	General presentation of project.
10/12/77	St. Mark's Parish	25	General presentation of project.
11/7/77	Men's Fellowship Group, (Christ Independent Methodist Church, Palatka)	30	General presentation of project.
1/26/78	Friends of the St. Johns	10	General discussion of proposed project.
1/26/78	National Rural Electric Association		Award recognition to Seminole as winner in 1977 member services contest for public information program on the proposed new power station.
3/11/78	Consulting Engineers' Council of Georgia, Inc.		1977 Engineering Award of Merit for Plant Location Study.
5/23/78	Public Meeting	80	REA sponsored public coordination meeting in Sumterville.
5/24/78	Public Meeting	40	REA sponsored public coordination meeting in Palatka.

Table 12-2a

COORDINATION WITH PUBLIC
(Additions)

<u>DATE</u>	<u>ORGANIZATION/INDIVIDUAL</u>	<u>NATURE OF COORDINATION</u>
	Putnam County Commission	Resolution declaring support for proposed plant.
2/13/78	Friends of the St. Johns River	Meeting with SECI to inform of proposed power plant site.
9/18/78	Putnam County Chamber of Commerce	Resolution declaring support for proposed plant.
10/12/78	City of Palatka Commission	Resolution declaring support for proposed plant.
10/19/78	Board of Directors, Atlanta National Bank of Palatka	Resolution declaring support for proposed plant.
10/25/78	Bill Chappell, Congressman	Letter of support for project.
10/26/78	Putnam County School Board	Resolution declaring support for proposed plant.
11/16/78	Sierra Club	Meeting of Sierra Club to discuss comments on Environmental Analysis.
11/21/78	Sierra Club	Transmittal of copy of NPDES Permit Application by SECI to Sierra Club.
11/27/78	Sierra Club	Transmittal of Sierra Club comments to DSP on DSP Preliminary Report to DER.
12/15/78	Sierra Club	Sierra Club review of the Preliminary Report on the Seminole Site Application by the Sierra Club.
1/17/79	Sierra Club	Transmittal of copy of PSD Application by SECI to Sierra Club.
2/1/79	Sierra Club	Transmittal of SECI responses to questions raised by Sierra Club in review of Environmental Analysis.

Table 12-3

Articles and Notices of Proposed Project

<u>Date</u>	<u>Publication</u>	<u>Nature of Article/Notice</u>
7/20/77	Florida Times Union	Announcement of proposed plant site selection.
7/20/77	Palatka Daily News	Announcement of proposed plant site selection.
7/21/77	Tampa Tribune	Announcement of proposal to construct plant.
7/21/77	Palatka Daily News	Announcement of proposed plant site selection.
7/21/77	Florida Times Union	Announcement of proposed plant site selection.
7/25/77	Palatka Daily News	Adoption of Resolution by Putnam County Commission Board supporting Seminole Electric Cooperative, Inc. plans.
7/26/77	Palatka Daily News	Editorial supporting proposed plant site.
8/15/77	Palatka Daily News	Report of presentation by H. Wright of SECI on results of preliminary site studies.
8/23/77	Tampa Tribune	"Roy Bertke on Business" reports on progress of environmental studies and Seminole's plans for new plant.
8/23/77	Palatka Daily News	Seminole announcement of request for bids from architectural/engineering firms on proposed plant.
9/77	Development News (Florida Div. of Economics)	Announcement of plans to construct electric generating plant in Putnam County.
9/6/77	Federal Register	Notice of anticipation of preparation of Environmental Impact Statement for Seminole Electric Cooperative, Inc.
9/16/77	Palatka Daily News	Notice of speech by Mr. Verne Eveland, president, Seminole Electric Cooperative, on proposed project before the Democratic Women's Club.
10/4/77	Palatka Daily News	Report of speech by Mr. R. Claussen to Lions Club of Palatka.
5/8/78	Ocala Star-Banner	Announcement of potential generating station to be constructed near Sumter and of hearing scheduled for May 24, 7 p.m.
5/17/78	Herald Express	Public Forum Editorial raising questions about proposed plant in Sumter County.
5/19/78	Florida Administrative Weekly (Vol. 4, No. 20)	Department of Environmental Regulation announcement of public information meeting regarding potential power plant site, May 23, 7:30.
5/19/78	Sumter County Times	Public notice of public information meetings and opportunity to provide input to REA by mail.
5/22/78	Palatka Daily News	Announcement of two meetings regarding SECI proposed plant: Putnam County Commissioners and public information meeting, May 23.
5/23/78	Palatka Daily News	Drawing of planned Seminole Electric Plant and announcement of public information hearing May 23, 1978.
5/19, 22, 23/78	Palatka Daily News	Public Notice of public information meeting May 23, 1978.
5/24/78	Florida Times Union	Report of public information meeting and public concern over low water table.
5/24/78	Palatka Daily News	Report of public information meeting and public concern over water problems in the area and the proposed plant burning coal.
5/20, 22, 23, 24/78	Leesburg Commercial	Notice of public information meeting.
5/26/78	Sumter County Times	Report of public forum convened by Rural Electrification Administration and support of local people for power plant.
5/29/78	Ocala Star-Banner	Report of public forum conducted by Rural Electrification Administration to find out public opinion in Sumter County on Seminole Electric Cooperative's plans to construct a power generating plant.
5/29/78	Ocala Star-Banner	U. S. Rep. Richard Kelly expressed support for Seminole Electric Cooperative's plans to construct a power generating plant in Sumter County.

Table 12-3a

ARTICLES AND NOTICES OF PROPOSED PROJECT
(Additions)

<u>DATE</u>	<u>PUBLICATION</u>	<u>NATURE OF ARTICLE/NOTICE</u>
3/24/78	Palatka Daily News	Notice of public hearing to consider changes in zoning ordinances in Putnam County.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

P. O. Box 520, Palatka, Florida 32077

February 26, 1979

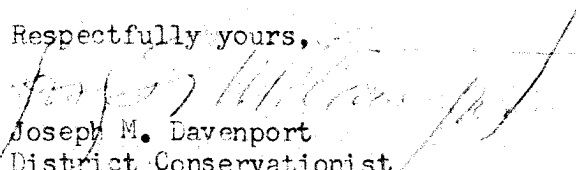
Mr. Marvin Smith, Staff Geographer
Dames & Moore, Consultants
Suite 200, 455 East Paces Ferry Road
Atlanta, Georgia, 30305

Dear Sir:

We have made an intensive soil survey of the property acquired by
Seminole Electric Cooperative, Inc. in Putnam County, Florida.

There is no prime agricultural land within the boundaries delineated.

Respectfully yours,


Joseph M. Davenport
District Conservationist





STATE OF FLORIDA
Department of State

THE CAPITOL
TALLAHASSEE 32304

OCT 30 1978

DAMES & MOORE
1036/PM-102 (2.5.1)

SECRETARY OF STATE

JESSE J. McCRARY, JR.

October 23, 1978

L. ROSS MORRELL, ACTING DIRECTOR
DIVISION OF ARCHIVES, HISTORY, AND
RECORDS MANAGEMENT

(904) 488-1480

IN REPLY REFER TO:

Mr. Louis Tesar
Historic Sites Specialist
(904) 487-2333

Mr. Tim Doyle
Dames and Moore
455 East Paces Ferry Road
Suite 200
Atlanta, Georgia 30305

Re: Cultural Resource Assessment of
Seminole Electric Cooperative
Proposed Generating Facility
Putnam County, Florida

Dear Sir:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Procedures for the Protection of Historic and Cultural Properties"), we have reviewed the above referenced project for possible impact to archaeological and historical sites or properties listed, or eligible for listing, in the National Register of Historic Places. The authorities for these procedures are the National Historic Preservation Act of 1966 (Public Law 89-665) as amended by P.L. 91-243, P.L. 93-54, P.L. 94-422, and P.L. 94-458, and Presidential Executive Order 11593 ("Protection and Enhancement of the Cultural Environment").

We have reviewed the Florida Master Site File and the results of the recent archaeological and historical survey of the project area by Cultural Resource Management, Inc. Two previously unrecorded prehistoric shell midden sites were found on the St. Johns River in the general area of outfall corridor B, Fryman, Griffin and Miller (1978) report:

These sites contain intact stratigraphy and, being likely to yield information important in prehistory, must be considered eligible for inclusion in the National Register of Historic Places. Avoidance of impact is recommended by rejection of alternate corridor B.

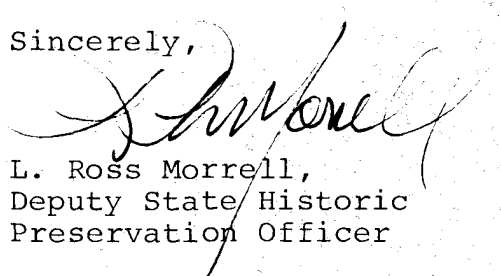
Mr. Tim Doyle
October 23, 1978
Page Two

No other archaeological or historical sites are recorded for the proposed project area. Therefore, it is our opinion that if alternate corridor B is not utilized, then no archaeological or historical sites listed, or eligible for listing, on the National Register of Historic Places, or otherwise of national, state or local significance, and the project may proceed without further involvement with this agency. If alternate corridor B is utilized, it is our recommendation that two identified sites be mitigated through archaeological salvage excavation by a professionally competent agency.

If you have any questions about our comments, or about federal historic preservation regulations, please feel free to contact us.

Your interest and cooperation in preserving Florida's historic resources are appreciated.

Sincerely,



L. Ross Morrell,
Deputy State Historic
Preservation Officer

LRM:Teh

cc: James J. Miller



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32201

REC'D JUN 26 1978

SAJOD-RP

22 June 1978

Mr. David L. Lester
Environmental Engineer
Seminole Electric Cooperative Inc.
Suite 108
2410 East Busch Blvd.
Tampa, Florida 33612

FILE IDENTIFIER	SUBJECT
A	173-E.1

Dear Mr. Lester:

This letter is in followup to our trip to the site contemplated by Seminole Electric Cooperative Inc., for an electric generating station south of Bostwick, Florida, near the St. Johns River just north of the intersection of the St. Johns River and Rice Creek.

The purpose of this letter is to let you know of our determination of the need for a Department of the Army permit for the work you contemplate.

The wetland areas found on the north end of the property are an isolated wetlands not connected to navigable waters by a surface tributary system and we have determined that the degradation of that area would not adversely impact on interstate commerce. Therefore, they are not subject to the Corps of Engineers jurisdiction pursuant to Section 404 of the Federal Water Pollution Control Act Amendments of 1972 since they are not wetlands which fall under the category of waters of the United States. Therefore, a Department of the Army permit would not be required for placing fill in that wetland area.

The connection of the intake and discharge structures to the St. Johns River will require a Department of the Army permit since we have made an administrative determination that the St. Johns River is a navigable water of the United States, in that reach. Thus, any work in that area would be subject to a permit pursuant to Section 10 of the River and Harbor Act of 1899, and, in addition, the placement of any fill in the river would also be subject to a permit pursuant to Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500).