TAMPA ELECTRIC COMPANY

POLK POWER STATION
Polk County, Florida

SITE CERTIFICATION APPLICATION

VOLUME 1

TAMPA ELECTRIC
A TECO ENERGY COMPANY

July 1992

APPLICANT INFORMATION

Applicant's Official Name: Tampa Electric Company

Address: Post Office Box 111, Tampa, Florida 33601-0111

Address of Official Headquarters: 702 North Franklin Street, Tampa, Florida 33602

Business Entity (corporation, partnership, cooperative): Corporation

Names, Owners, etc.: Tampa Electric Company

Name and Title of Chief Executive Officer: G.F. Anderson, President

Name, Address, and Phone Number of Official Representative Responsible for Obtaining Certification: A. Spencer Autry, Director, Environmental, Tampa Electric Company, P.O. Box 111, Tampa, Florida 33601-0111 813/228-4111

Site Location (County): Polk County, Florida

Nearest Incorporated City: Bowling Green

Latitude and Longitude: Latitude 27° 43' 43", Longitude 81° 59' 23"

UTMs Northerly: 3067.35

UTMs Easterly: 402.45

Section, Township, Range: All or portions of Sections 1 through 4 and 7 through 12, Township 32 South, Range 23 East and Sections 34 and 35, Township 31 South, Range 23 East

Location of Any Directly Associated Transmission Facilities (Counties): Polk County

Name Plate Generating Capacity: 1,150 megawatts (nominal net)

Capacity of Proposed Additions and Ultimate Site Capacity (where applicable): 1,150 megawatts (nominal net)

SITE CERTIFICATION APPLICATION

FOR

TAMPA ELECTRIC COMPANY

POLK POWER STATION PROJECT

Environmental Consulting &
Technology, Inc.
5200 Newberry Road, Suite E-1
Gainesville, Florida 32607

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7/25/92

Thomas W. Davis, P.E.
Florida No. 36777

United Engineers & Constructors, Inc.
30 South 17th Street
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7-24-92

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Tampa Electric Company
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G-TECPPSSCA.15/SIGN.1–072392

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LIST OF ACRONYMS

7Q10	7-day, 10-year flow rate
AADT	average annual daily trips
AAQS	ambient air quality standard
ACSR	aluminum conductor steel reinforced
Agrico	Agrico Chemical Company
AM	amplitude modulation
A/RR	Agricultural/Residential Rural
ASTM	American Society for Testing and Materials
BACT	best available control technology
BEBR	Bureau of Economic and Business Research
BLIS	BACT/LAER information system
BOCC	Board of County Commissioners
BOD	biochemical oxygen demand
Btu	British thermal unit
Btu/ft^3	British thermal units per cubic foot
Btu/gal	British thermal units per gallon
Btu/lb	British thermal units per pound
°C	degree Celsius
$CaCO_3$	calcium carbonate
CC	combined cycle
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CFRPC	Central Florida Regional Planning Council
cfs	cubic foot per second
CG	coal gasification
CGCU	cold gas cleanup
CITES	Convention on International Trade in Endangered Species
cm	centimeter
cm/sec	centimeter per second

CO	carbon monoxide
CO_2	carbon dioxide
COD	chemical oxygen demand
COS	carbonyl sulfide
CPT	cone penetration test
CR	County Road
CS_2	carbon disulfide
CSM	cubic foot per second per square mile
CT	combustion turbine
CUP	Conditional Use Permit
CWA	Clean Water Act
°	degree
d	Shannon Weaver diversity index
dBA	A-weighted decibel
dbh	diameter at breast height
DO	dissolved oxygen
DOE	U.S. Department of Energy
DSM	demand-side management
ECT	Environmental Consulting & Technology, Inc.
EEI	Edison Electric Institute
EIS	environmental impact statement
EIV	Volume of Environmental Information
EMF	electromagnetic field
EMS	emergency medical services
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
°F	degree Fahrenheit
F.A.C.	Florida Administrative Code
FCC	Federal Communications Commission

FCG	Florida Electric Power Coordinating Group
FCREPA	Florida Committee on Rare and Endangered Plants and Animals
FDACS	Florida Department of Agriculture and Consumer Services
FDCA	Florida Department of Community Affairs
FDER	Florida Department of Environmental Regulation
FDER/PSES	FDER Point Source Evaluation Section
FDHR	Florida Division of Historical Resources
FDLES	Florida Department of Labor and Employment Security
FDNR	Florida Department of Natural Resources
FDOT	Florida Department of Transportation
FEECA	Florida Energy Efficiency and Conservation Act
FEMA	Federal Emergency Management Agency
FEPPSA	Florida Electrical Power Plant Siting Act
FGD	flue gas desulfurization
FGFWFC	Florida Game and Fresh Water Fish Commission
FGS	Florida Geological Survey
FGT	Florida Gas Transmission Company
FLUCCS	Florida Land Use and Cover Classification System
FLUCFS	FDOT Land Use, Cover, and Forms Classification System
FM	frequency modulation
FNAI	Florida Natural Areas Inventory
FPC	Florida Power Corporation
FPSC	Florida Public Service Commission
FR	Federal Register
F.S.	Florida Statutes
FSRI	Florida Sinkhole Research Institute
ft	foot
ft bls	foot below land surface
ft/day	foot per day

ft^2/day	square foot per day
ft^3/day	cubic foot per day
ft^3/day/ft^3	cubic foot per day per cubic foot
ft/ft	foot per foot
ft^3/hr	cubic foot per hour
ft-msl	foot above mean sea level
ft-NGVD	foot national geodetic vertical datum
FTE	full-time equivalent
GE	General Electric Company
GEESI	General Electric Environmental Systems, Inc.
gpd	gallon per day
gpm	gallon per minute
gpm/ft	gallon per minute per foot
gpm/ft^2	gallon per minute per square foot
gr/scf	grains per standard cubic foot
gr/100 scf	grains per 100 standard cubic feet
H_2S	hydrogen sulfide
H_2SO_4	sulfuric acid
HGCU	hot gas cleanup
HHV	higher heating value
HRSG	heat recovery steam generator
HUD	Housing Urban Development
IGCC	integrated coal gasification combined cycle
IWTP	industrial wastewater treatment plant
kg	kilogram
km	kilometer
kV	kilovolt
kV/m	kilovolt per meter
kw	kilowatt

kwh	kilowatt hour
LAER	lowest achievable emission rate
lb/day	pound per day
lb/ft^3	pound per cubic foot
lb/hr	pound per hour
lb/MMBtu	pound per million British thermal units
L_{dn}	day-night sound level
L_{eq}	equivalent noise level
$L_{eq}(24)$	equivalent sound level for 24-hour periods
LHV	lower heating value
LOLP	loss of load probability
LOS	level of service
LRU	logical reclamation unit
m	meter
m^2	square meter
MCR	maximum current rating
mG	milligauss
mg/L	milligram per liter
MGD	million gallons per day
mi^2	square mile
mL	milliliter
mph	miles per hour
MVA	megavolt amperes
MW	megawatt
NAS	National Audubon Society
NEPA	National Environmental Policy Act of 1969
NESC	National Electrical Safety Code
NESHAPS	National Emission Standard for Hazardous Air Pollutants
NGVD	National Geodetic Vertical Datum

NH_3	ammonia
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NSCR	non-selective catalytic reduction
NSPS	new source performance standards
NSR	New Source Review
NTU	nephelometric turbidity unit
NWS	National Weather Service
O_3	ozone
OAQPS	Office of Air Quality Planning and Standards
organisms/m^2	organisms per square meter
PCB	polychlorinated biphenyl
pCi/L	picoCurie per liter
persons/mi_2	persons per square mile
PHX	primary heat exchanger
PM	particulate matter
PM_{10}	particulate matter less than or equal to 10 micrometers aerodynamic diameter
POS	plan of study
POTW	publicly owned treatment works
ppb	part per billion
ppm	part per million
ppmv	part per million volumetric
ppmvd	dry volume parts per million
PRECO	Peace River Electric Cooperative
PSD	prevention of significant deterioration
psia	pound per square inch absolute
psig	pound per square inch gauge

Pt-Co	platinum-cobalt
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
R-1	Residence
RC	Rural Conservation
RCC	Rural-Cluster Center
R.O.	reverse osmosis
RCRA	Resource Conservation and Recovery Act
RMD	Rural Mixed-Use Development
rpm	revolutions per minute
RRD	Rural Residential
RV	recreational vehicle
SARA	Superfund Amendment and Reauthorization Act
SCA	Site Certification Application
scf	standard cubic foot
SCR	selective catalytic reduction
SCS	Soil Conservation Services
SF-1M	Single Family-Mixed
SIC	Standard Industrial Classification
SMSA	Standard Metropolitan Statistical Area
SNCR	selective non-catalytic reduction
SO_2	sulfur dioxide
SO_3	sulfur trioxide
SOP	standard operating procedure
SPCC	Spill Prevention, Control, and Countermeasure
SPT	standard penetration test
SR	State Road
ST	steam turbine
stpd	short-tons per day

SUS	Saybolt Universal seconds
SWFWMD	Southwest Florida Water Management District
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
Texaco	Texaco, Inc.
tpd	ton per day
tpy	ton per year
TSP	total suspended particulate
TSS	total suspended solids
UE&C	United Engineers & Constructors
μg/L	microgram per liter
μg/m^3	microgram per cubic meter
μmhos/cm	micromhos per centimeter
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
VOC	volatile organic compound
WUP	water use permit

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CHAPTER 1.0
NEED FOR POWER AND THE PROPOSED FACILITIES

1.1 INTRODUCTION

Tampa Electric Company is an investor-owned electric utility which serves west-central Florida, primarily Hillsborough County and portions of Polk, Pasco, Pinellas, and Highlands Counties (see Figure 1.1.0-1). Currently, Tampa Electric Company serves more than 467,000 residential, commercial, industrial, and governmental Customers within its service area. Tampa Electric Company's system has an installed net electric generating capacity of 3,281 megawatts (MW) from 24 generating units located at five different sites--Big Bend, Gannon, Hookers Point, Phillips, and Dinner Lake stations.

As a public utility, Tampa Electric Company has the obligation to provide reliable and economical electric power service to its existing and future Customers. To meet this obligation, Tampa Electric Company conducts ongoing, long-range power resource planning and load (i.e., demand) forecasting programs to predict its future power supply needs and to evaluate available options to meet these needs. These programs also consider Tampa Electric Company's extensive efforts to encourage conservation, load management programs, and cogeneration projects to reduce future power needs. As a result of these programs, Tampa Electric Company has determined the need for approximately 1,150 MW of new electric generating capacity (i.e., new power plant facilities) to meet its Customer power demands beginning in the mid-1990s and continuing into the early 21st century. These additional power supply needs are primarily based on future electricity demands created by ongoing and projected population growth within its service area.

Tampa Electric Company is proposing to license/permit, construct, and operate the needed, new power plant and associated facilities on an approximately 4,348-acre site in southwest Polk County, Florida. Figure 1.1.0-2 shows the location of the site within the State of Florida. The proposed facilities will be known as the Tampa

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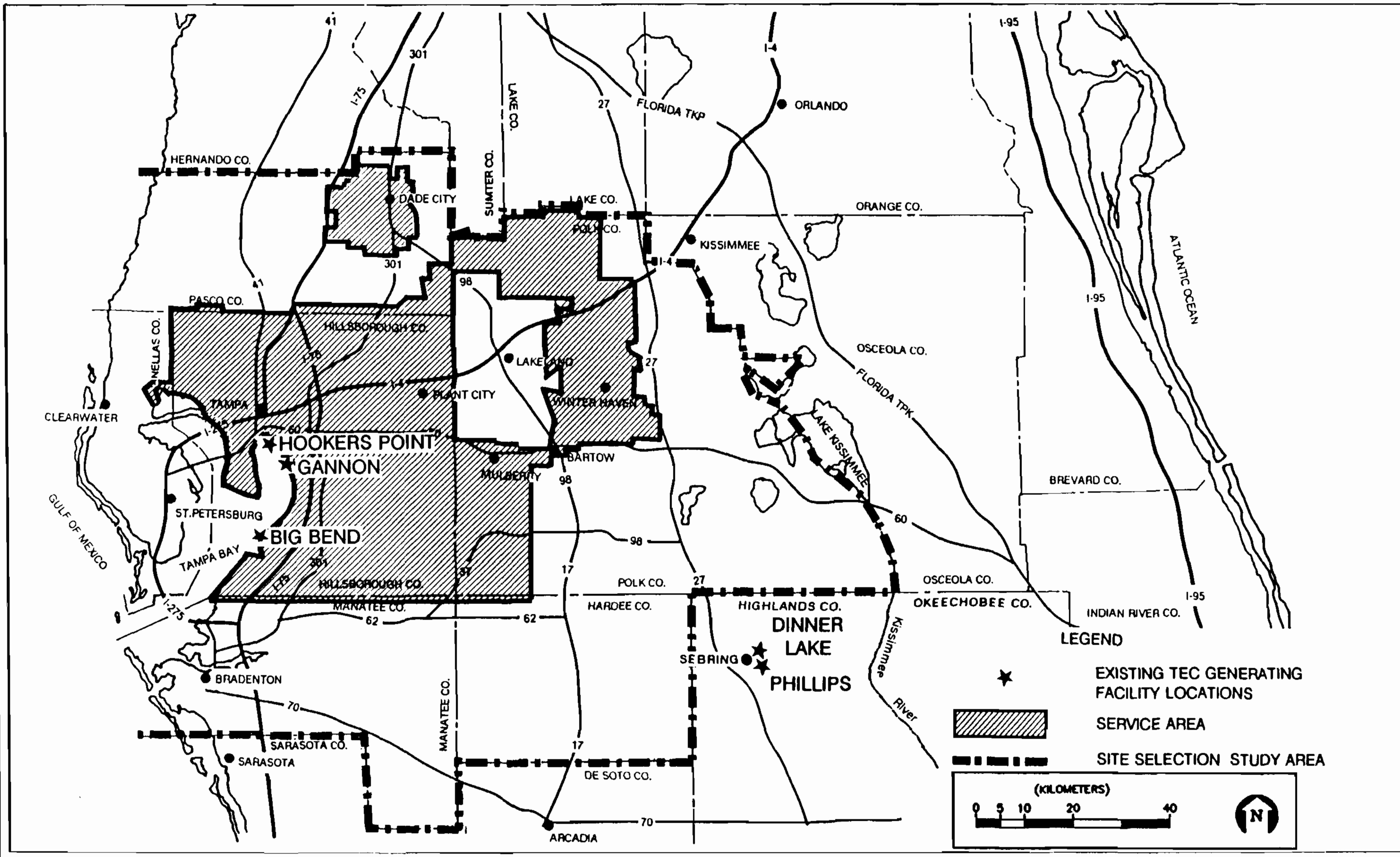

FIGURE 1.1.0-1.

TAMPA ELECTRIC COMPANY SERVICE AREA AND EXISTING GENERATING FACILITY LOCATIONS AND SITE SELECTION STUDY AREA

Source: Tampa Electric Company, 1992. ECT, 1992.

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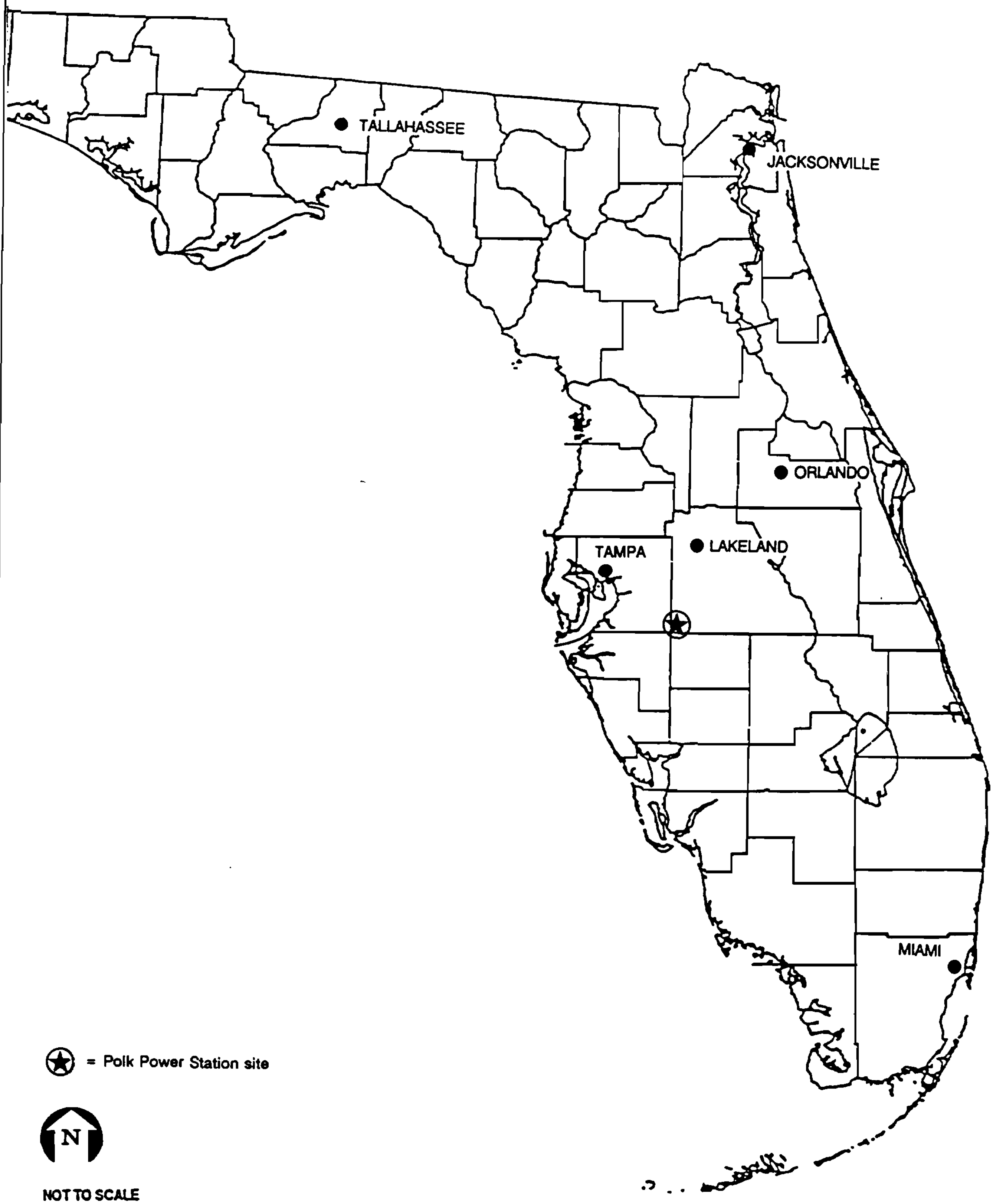

FIGURE 1.1.0-2.

LOCATION OF THE POLK POWER STATION WITHIN THE STATE OF FLORIDA
Source: ECT, 1992.

TAMPA ELECTRIC
A TECO ENERGY COMPANY

POLK POWER STATION

Electric Company Polk Power Station. The total generating capacity of the units at the site will be approximately 1,150 MW. The generating units planned for the Polk Power Station will be developed at the site according to a phased schedule which matches Tampa Electric Company's forecasted growth in electricity demands beginning in 1995 and continuing into the year 2010. The first generating facilities at the Polk Power Station site will be an integrated coal gasification combined cycle (IGCC) demonstration project developed by Tampa Electric Company and supported in part through funding from the U.S. Department of Energy (DOE) under the Clean Coal Technology Demonstration program. The coal-fueled IGCC unit will consist of a nominal net 150-MW advanced combustion turbine (CT), fueled by low sulfur No. 2 fuel oil during the first year of operation in 1995. Heat recovery steam generator (HRSG), steam turbine (ST), and coal gasification (CG) facilities will be added and integrated with the advanced CT a year later to complete the nominal net 260-MW IGCC unit. After integration of these facilities, the IGCC unit will be fueled by coal-derived gas (i.e., called coal gas or syngas) which is produced in the CG facilities, with low sulfur No. 2 fuel oil as a backup fuel. This IGCC unit will be known as Polk Unit 1. Tampa Electric Company's current Power Resource Plan indicates that later facilities will consist of two combined cycle (CC) generating units and six simple-cycle CTs fueled by natural gas with low sulfur No. 2 fuel oil as the backup fuel.

Tampa Electric Company is proposing to license the Polk Power Station site for all the currently planned electric generating units (i.e., total nominal net generating capacity of 1,150 MW) and associated facilities. Therefore, all generating units and associated facilities planned for the ultimate site capacity are the subject of this Site Certification Application (SCA).

1.2 PURPOSE OF THE SITE CERTIFICATION APPLICATION

The licensing or permitting of power plants and associated transmission lines and facilities in Florida requires compliance with applicable federal, state, and local laws, regulations, and ordinances. The two most comprehensive laws governing the licensing of the Tampa Electric Company Polk Power Station project are the Florida Electrical Power Plant Siting Act (FEPPSA), Section 403.501-403.519, Florida Statutes (F.S.), and the National Environmental Policy Act of 1969 (NEPA), 42 United States Code (U.S.C.) 4321 *et seq.*

FEPPSA establishes the policy of the state to balance the need for new power plant facilities with the potential effects of the facility construction and operation on human health, welfare, and environmental resources of the state in conjunction with state and local agency permit decisions and recommendations regarding the proposed facilities. To implement this policy, FEPPSA established a centrally coordinated permit application, agency review, and approval process known as the site certification process. Within the site certification process, the Florida Public Service Commission (FPSC) is the exclusive forum for the determination of need for the proposed plant based on electric system reliability and integrity considerations and whether the proposed plant is the most cost-effective alternative to provide the needed power. The certification proceedings are initiated by the applicant filing an SCA with the Florida Department of Environmental Regulation (FDER) which administers and centrally coordinates the process with affected agencies, governmental entities, other parties, and the applicant. The process concludes with the approval or certification of the power plant and associated facilities by the Governor and Cabinet, sitting as the Siting Board. The FDER procedures for implementing FEPPSA are contained in Chapter 17-17, Florida Administrative Code (F.A.C.).

In accordance with FEPPSA, FDER is required to notify all affected or other agencies of the filing of the SCA, ensure the timely distribution of copies of the SCA and any amendments to the application by the applicant to the affected agencies, and establish a schedule of dates for submission of inputs and reports from affected agencies during the certification process. Inputs requested by FDER from affected agencies include statements of issues, reports on the sufficiency of the SCA, requests for supplemental information, and reports on the consistency or compliance of the proposed project with applicable policies and regulatory requirements within their jurisdictions. Under FEPPSA, the affected agencies are also statutory parties to the certification hearing to be held on the SCA. For the Tampa Electric Company Polk Power Station project, the affected agencies in the certification process designated under FEPPSA requirements include:

- FDER,
- FPSC,
- Florida Department of Community Affairs (FDCA),
- Florida Department of Natural Resources (FDNR),
- Florida Game and Fresh Water Fish Commission (FGFWFC),
- Southwest Florida Water Management District (SWFWMD),
- Central Florida Regional Planning Council (CFRPC), and
- Polk County.

NEPA provides the basic national charter for protection of the environment. NEPA establishes national policy, sets goals, and provides means for carrying out the policy. Under NEPA provisions, federal agencies have the responsibility to consider the environmental consequences of actions or decisions which may significantly affect the quality of the human environment. The Council on Environmental Quality (CEQ) has promulgated regulations for implementing the provisions of NEPA by establishing uniform procedures that must be followed by all federal agencies [Code of Federal Regulations (CFR), Chapter 40, Parts 1500 through 1508]. DOE has also promulgated regulations and guidelines for the implementation of NEPA under NEPA and CEQ requirements [10 CFR 1021 and 52 Federal Register (FR) 47662, December 15, 1987]. In accordance with these regulations, DOE has determined that certain decisions to fund or share in costs for projects under programs which it administers are major federal actions subject to NEPA regulations.

DOE has committed to provide a portion of the funding for the IGCC generating facilities at the Polk Power Station through the Clean Coal Technology Demonstration program under a cooperative agreement with Tampa Electric Company. Further, DOE has determined that the decision to provide partial funding for the Tampa Electric Company project is an action subject to NEPA regulations. To fulfill its responsibilities under NEPA, DOE is required to prepare an Environmental Impact Statement (EIS) for the Tampa Electric Company Polk Power Station project. DOE will be the lead federal agency, while other federal agencies such as the U.S. Environmental Protection Agency (EPA) will participate with DOE in the EIS preparation as cooperating agencies. In implementing its NEPA responsibilities and procedures, DOE publishes a Notice of Intent to prepare an EIS for the Polk Power Station project and to conduct a public scoping meeting. The purposes of the public scoping meeting are to receive public and affected agency comments on significant environmental issues and concerns associated with the proposed project and the scope of the EIS.

Typically, the DOE EIS is based on information provided by the project sponsor in a document called a Volume of Environmental Information (EIV) prior to the public scoping meeting for the project. Tampa Electric Company submitted the EIV for the project to DOE in early June 1992 (Tampa Electric Company, 1992a). However, some of the detailed engineering, design, and environmental studies for the Polk Power Station project were still in progress when the EIV was submitted to DOE by Tampa Electric Company. Therefore, the final results of these detailed studies which are included in this SCA, as well as the EIV, will be used by DOE to fully assess the environmental consequences of and potential alternatives to the Polk Power Station project in preparation of the EIS.

It is expected that EPA, Region IV will determine that the three ST electric generating units proposed for the Polk Power Station project will be "new sources," as defined by Section 306 of the Clean Water Act (CWA), as amended (33 U.S.C. 1251 *et seq.*). The ST electric generating units are components of the IGCC unit and the two CC units planned for the project. In addition, it is expected that EPA will determine that the CG facilities associated with the IGCC unit are not new sources since there are no new source performance standards (NSPS) applicable to CG facilities. As new sources, the construction and operation of the ST electric generating units which are components of the overall project will require a National Pollutant Discharge Elimination System (NPDES) permit from EPA. Tampa Electric Company has submitted an NPDES permit application for the project to EPA. This NPDES permit application is provided in Appendix 11.1.1 of this SCA.

The issuance of an NPDES permit would be a major federal action which is also subject to the provisions of NEPA and would require preparation of an EIS under the requirements of EPA. To fulfill both of their responsibilities under NEPA, DOE and EPA entered into a memorandum of understanding whereby DOE, as lead federal agency, will prepare the EIS in cooperation with EPA. Other federal agencies which may also participate with DOE as cooperating agencies in the EIS preparation for the proposed Polk Power Station project include the U.S. Army Corps of Engineers (USACE) pursuant to Section 404 of the CWA which requires permits for dredge-and-fill activities in Waters of the United States, and the U.S. Fish and Wildlife Service (USFWS) pursuant to its consultation requirements under Section 7 of the Fish and Wildlife Coordination Act of 1934, as amended, and the Endangered Species Act of 1973, as amended.

Thus, the purpose of this SCA is to provide a single, comprehensive environmental document for the Tampa Electric Company Polk Power Station project which will be submitted to FDER, other state and local agencies, and to DOE and EPA to fulfill the requirements of FEPPSA and NEPA as well as other applicable laws and regulatory requirements. This SCA provides the most currently available and detailed engineering and environmental information regarding the Tampa Electric Company Polk Power Station project. Information in the SCA includes descriptions of the existing environmental conditions on the proposed site and its vicinity and of the proposed power plant and associated facilities, assessments of the expected effects of the facility construction and operation, and discussions of alternatives considered for the proposed project and site. The SCA has been prepared and complies with the regulatory, procedural, and informational requirements for the application under FEPPSA and FDER implementation procedures and instruction guide for certification applications [FDER Form 17-1.211(1), F.A.C.]. In addition, the SCA and supporting data have been developed in accordance with the scope, quantity, and specificity of information presented in the Environmental Licensing Plan of Study for the Polk Power Station project [Environmental Consulting & Technology, Inc. (ECT), 1991]. This plan of study (POS) was reviewed and approved by various federal, state, regional, and local agencies.

Prior to submission of the SCA, Tampa Electric Company has had numerous meetings, presentations, and discussions with federal, state, and local agencies and the public regarding potential concerns and issues associated with the Polk Power Station project. A listing of these agency and public coordination efforts is provided in Chapter 10.0 of this SCA. The information and impact evaluations contained in the SCA address these issues and demonstrate that the project fulfills and complies with applicable laws, regulations, and standards for the proposed project.

1.3 NEED FOR THE PROJECT

1.3.1 NEED DETERMINATION BY FLORIDA PUBLIC SERVICE COMMISSION

As discussed in Section 1.2, the FPSC has the statutory responsibility for determining and approving the need for construction of new power plants in Florida. According to Section 403.519, F.S., the FPSC must consider four specific items in determining the need for a new power plant:

- Need for electric system reliability and integrity,
- Need for adequate electricity at a reasonable cost,
- Cost-effectiveness of the proposed power plant versus available alternatives, and
- Conservation measures which might mitigate the need for the proposed power plant.

The FPSC must evaluate these specific items in relation not only to the system needs of the applicant proposing the new power plant, but also to the power supply and Customer needs of peninsular Florida. The FPSC evaluation must consider compliance of the proposed project with the mandates of the Florida Energy Efficiency and Conservation Act (FEECA) to ensure the most economical use of natural gas and oil. Finally, in accordance with state regulations, a formal determination of need must be made by the FPSC and a report provided to FDER prior to final certification of a proposed power plant under FEPPSA.

During the decision-making process, the FPSC reviews information provided by the applicant, conducts its own evaluations, and holds a formal public hearing to obtain additional inputs from the applicant, the FPSC staff, and other parties regarding the need for the new power plant. Key considerations in this process are the identification and evaluation of reasonable alternatives to the construction of the proposed power plant while maintaining electric system reliability and minimizing the cost of electric power to Customers. The alternatives considered by the FPSC include available means to mitigate or avoid the need to construct a new power plant such as conservation, load management, and power purchases from other generators, as well as alternative generation technologies and fuels, to ensure that the proposed project represents the most cost-effective means of supplying reliable electric power.

On September 5, 1991, Tampa Electric Company filed a "Petition to Determine Need for Electrical Power Plant and Related Facilities" with the FPSC pursuant to Section 403.519, F.S., and designated Docket No. 910883-EI. A copy of this petition is provided in Appendix 11.14. In conjunction with this filing, Tampa Electric Company submitted to the FPSC a document entitled "Polk Unit One Need Determination Study" to support the petition and provide the information required under the FPSC rule Chapter 25-22.081, F.A.C. Copies of this document are available for inspection at the FPSC, Division of Records and Reporting, 101 East Gaines Street, Tallahassee, Florida.

In the petition to determine need and the supporting study, Tampa Electric Company provided the FPSC with information from its Power Resource Plan which demonstrated the need for an additional 440 MW of new generating capacity during the period of 1995 through 2000. The information also showed that the company's total resource needs to meet Customer demands for the 5-year period were almost 800 MW and that more than 40 percent of these needs would be met through the company's extensive programs to promote conservation and load management and by power purchases from cogenerators. According to its Power Resource Plan, the remaining resource needs would be most cost-effectively and reliably met by the construction of the proposed IGCC unit with a commercial operation date of July 1996 and a phased 220-MW CC unit with an in-service date of 2001.

A public hearing on Tampa Electric Company's petition to determine need for electrical power plant was held by the FPSC on December 10 and 11, 1991, in Tallahassee, Florida. Prior notice of this hearing was published in the Florida Administrative Weekly and local newspapers according to the requirements of Section 403.519, F.S. Subsequent to these proceedings, Tampa Electric Company submitted to the FPSC a document entitled "Post-Hearing Statement and Brief," which provided additional information on the specific issues addressed at the public hearing. This document is also available for inspection at the FPSC office in Tallahassee, Florida.

The FPSC held a Special Commission Conference on January 31, 1992, to consider and make a final decision regarding the Tampa Electric Company petition for determination of need for a proposed electrical power plant and related facilities. At these proceedings, the FPSC voted to approve and issue a certification of need order for the IGCC power plant, Polk Unit 1. The order determining the need for Polk Unit 1 was issued on March 2, 1992, and is provided in Appendix 11.14.

In its order, the FPSC determined that Polk Unit 1 was needed to maintain electric system reliability and integrity. Tampa Electric Company used a combination of planning criteria in assessing the need for additional generating capacity, including a minimum of 20 percent winter reserve margin and an assisted loss of load probability (LOLP) of 0.1 days per year. These criteria were considered reasonable by the FPSC for planning purposes. Based on the power resource planning information provided by Tampa Electric Company in support of the petition to determine need and its own evaluations, the FPSC concluded in its order that:

> "Tampa Electric Company's reliability criteria of 0.1 days per year LOLP and minimum winter reserve margin of 20 percent would be violated with a delay in the in-service date of the proposed unit. If no capacity is added to Tampa Electric Company's system in 1995, Tampa Electric Company's LOLP is estimated to be 0.140 days per year and its winter reserve margin will be 19.1 percent. If no capacity is added in 1996, the net LOLP will deteriorate to 0.199 days per year and the winter reserve margin will drop to 16.2 percent. Thus, the addition of capacity from the proposed IGCC unit is needed for Tampa Electric Company to maintain acceptable reliability criteria." (FPSC, 1992)

Further, the FPSC concluded that the proposed IGCC unit is also needed to contribute to the reliability and integrity of the electric system of the state as a whole.

Next, in its order determining need, the FPSC concluded that the proposed IGCC unit is the most cost-effective alternative to provide the additional needed capacity for Tampa Electric Company and peninsular Florida. Based on information provided by Tampa Electric Company to support the petition to determine need, the proposed IGCC unit is estimated to save Tampa Electric Company's ratepayers up to $195 million over the life of the unit compared to the next best option. These savings are primarily attributable to fuel savings resulting from the use of coal and the $120 million DOE contribution for construction of the unit and the first 2 years of operation and maintenance.

Finally, in the order determining the need for Polk Unit 1, the FPSC concluded that Tampa Electric Company's residential conservation programs were reasonable in saturating the eligible market and that no additional conservation measures were reasonably available to Tampa Electric Company to avoid the need for the proposed IGCC unit. The FPSC also evaluated alternatives available to Tampa Electric Company to purchase power from cogenerators and other utilities in order to avoid the need for the proposed unit and concluded that Tampa Electric Company had adequately explored these alternatives. As discussed previously, Tampa Electric Company's total resource needs to meet Customer demands in the 1995 through 2000 period are almost 800 MW and that more than 40 percent of these needs will be met through the company's conservation and load management programs and power purchases from cogenerators.

Based on these findings, the FPSC approved and granted Tampa Electric Company's Petition to Determine Need for the proposed electrical power plant and related facilities at the Polk Power Station site.

Although the FPSC need order is specifically for Polk Unit 1, the IGCC unit which is planned to be phased into service in 1995 and 1996, Tampa Electric Company's ongoing, long-range power resource planning studies have determined the need for an additional 220 MW of new generating capacity in the 1999 to 2001 timeframe and another approximately 670 MW of new generating capacity by the year 2010. Therefore, at the present time, Tampa Electric Company's total new electric generating capacity needs, including the proposed nominal net 260-MW IGCC unit, are approximately 1,150 MW in order to meet its projected Customer demands over the 1995 through 2010 timeframe. The need for this new generating capacity remains after the implementation by Tampa Electric Company of all reasonably available, cost-effective alternatives to construction of new generating facilities. These non-construction alternatives consider both demand and supply side alternatives including:

- Conservation,
- Load management,
- Interruptible load,
- Qualifying cogeneration power purchases, and
- Other purchased power.

Tampa Electric Company's analyses show that the implementation of all of these non-construction alternatives will reduce the need for future generating capacity by approximately 1,000 MW or by almost 50 percent compared to its total projected resource needs in the 1995 through 2010 period.

The following section provides a summary of Tampa Electric Company's ongoing, long-range power resource planning process. Additional descriptions of the power resource planning studies and results are provided in Chapter 8.0 of this SCA which addresses the wide range of alternatives considered by Tampa Electric Company for the proposed Polk Power Station project. It should be noted that some of the numerical estimates and projections presented in the following and elsewhere in this SCA may vary from figures presented in other published documents and information since such projections are continually under revision and updating as part of the ongoing power resource planning process.

1.3.2 POWER RESOURCE PLAN SUMMARY

Tampa Electric Company conducts ongoing power resource planning studies to ensure that the future demands of Customers for reliable and economical electric power are met. In general, this complex planning process consists of two major components: (1) forecasts of Customer demands and energy needs, fuel prices, and economic and financial conditions; and (2) evaluations and optimization of the timing and options to supply the future electricity requirements. These options include demand- and supply-side power resources. The demand-side options include Tampa Electric Company's continuing programs in energy conservation, load management, and cogeneration. The supply-side options include different types of power generating unit additions. The results of these efforts form the basis for Tampa Electric Company's future power resource plan which provides the best mix of demand-side and supply-side alternatives for Tampa Electric Company's Customers in terms of reliability and the cost of future electric energy, while meeting applicable environmental regulations and standards. Tampa Electric Company's overall power resource planning process is illustrated in Figure 1.3.2-1.

1.3.2.1 Future Energy and Demand Forecasts

Tampa Electric Company's Customer demand and energy forecasts are the foundation from which the power resource plan is developed. Because of their critical importance, Tampa Electric Company combines state-of-the-art methodologies and proven statistical techniques with practical experience to develop forecasts with the highest probability of occurrence. The complex process results in forecasts of both Tampa Electric Company's peak monthly electricity usage (i.e., demand) and its total monthly electricity usage (i.e., energy). Since many factors can influence future demand and energy forecasts (e.g., weather, economic conditions, population growth, fuel prices), Tampa Electric Company continuously evaluates potential changes in these factors and, in turn, potential changes in its long-range forecasts.

In practice, the Tampa Electric Company demand and energy forecasting process involves five separate models or analyses:

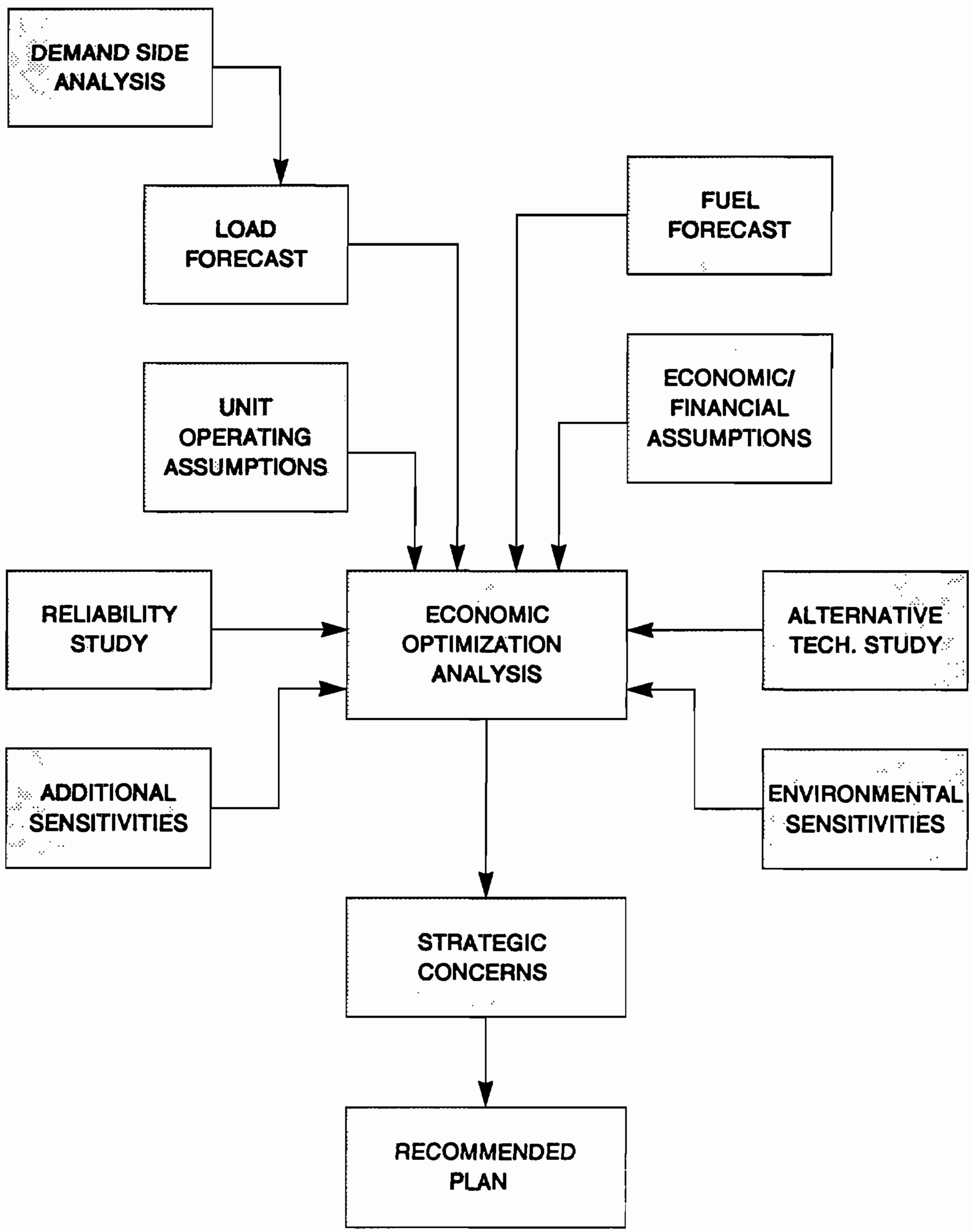

FIGURE 1.3.2-1.

POWER RESOURCE PLANNING PROCESS

Source: Tampa Electric Company, 1992.

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1. Detailed end-use model,
2. Multiregression model,
3. Trend analysis,
4. Phosphate method, and
5. Conservation program analysis.

Figure 1.3.2-2 shows the general flow of the Customer demand and energy forecasting process. The first three techniques are combined to develop a demand and energy projection, excluding the phosphate industry electricity needs. The phosphate demand and energy requirements are forecasted separately and then combined in the final forecast. The effects of Tampa Electric Company's conservation, load management, and cogeneration programs are incorporated into the process by subtracting their expected reduction in demand and energy from the forecast. The final energy and demand forecast is established by combining the results of the five forecasting methods. In its order determining the need for Polk Unit 1, the FPSC concluded that the forecasting methodology used by Tampa Electric Company produced a reasonable prediction of the company's future energy demands (i.e., load).

According to the demand and energy forecasts presented in its petition to determine need, Tampa Electric Company's firm summer and winter peak loads are projected to grow at an average annual rate of 2.7 and 2.6 percent, respectively, during the 1991 through 2000 period.

1.3.2.2 Forecast of Power Resource Requirements

Based on the forecasted energy demands, the second major component of the power resource planning process involves evaluations of future demand- and supply-side options to meet future Customer power needs. The objective of the power resource expansion planning process is to determine the long-range mix of power resource options which represents the best plan to provide economical and reliable electric service to Tampa Electric Company's Customers. As shown in Figure 1.3.2-1, the expansion planning process incorporates a reliability analysis to determine the timing

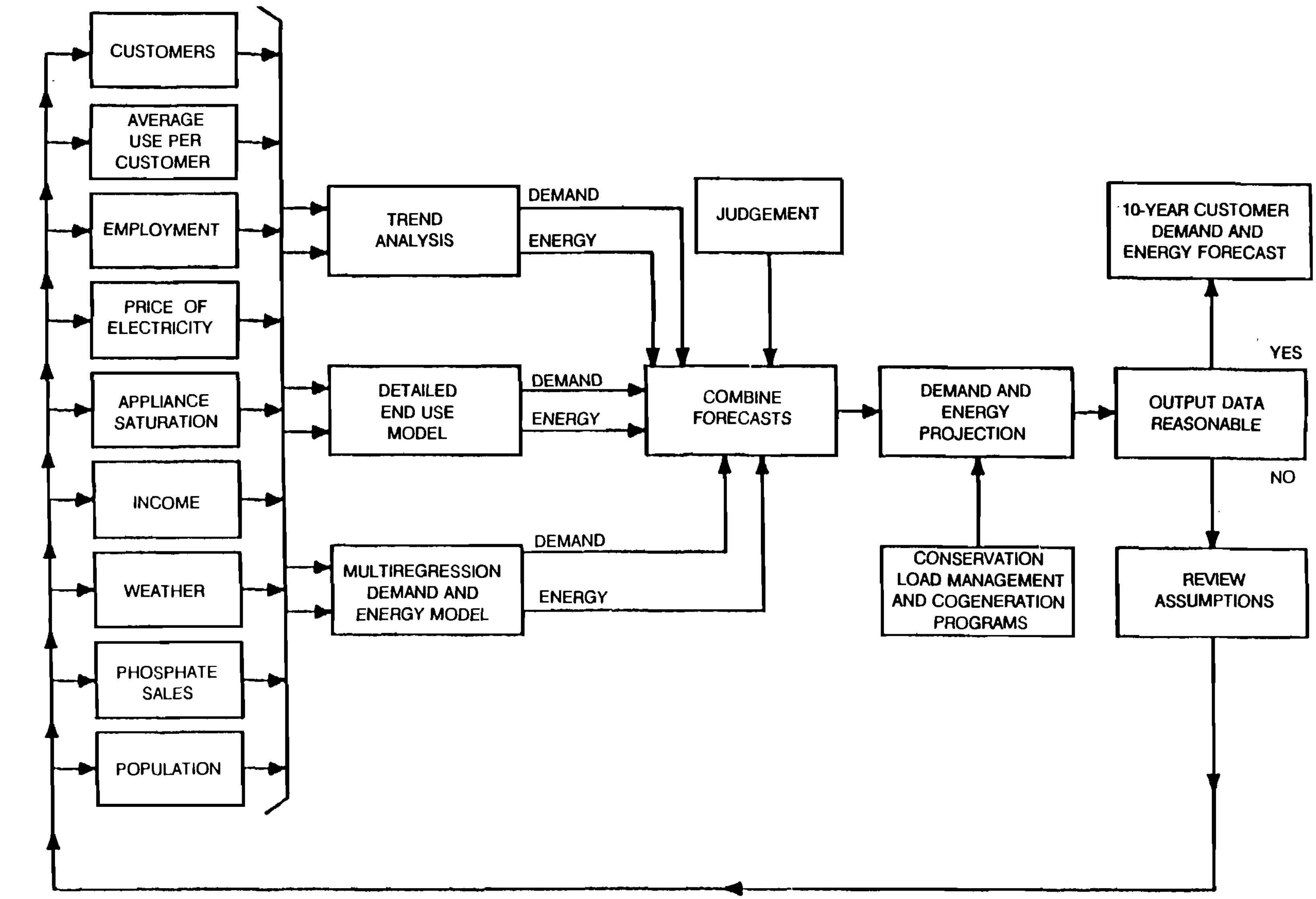

FIGURE 1.3.2-2.

CUSTOMER DEMAND AND ENERGY FORECAST PROCESS

Source: Tampa Electric Company, 1992.

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of future need, alternative technology screening to select options to meet future needs, and a supply-side analysis and optimization evaluation to determine what alternatives best meet future needs. Finally, a sensitivity/strategic concerns analysis is conducted to ensure that the best plan is chosen under various changes in the planning assumptions. The following subsections summarize the results of these analyses.

System Reliability and Integrity Analysis

As discussed previously, Tampa Electric Company used a combination of criteria to determine the need for additional generating capacity in the 1995 through 2000 timeframe, including a minimum 20-percent winter reserve margin and assisted LOLP of 0.1 day per year. These criteria are considered to be reasonably adequate for planning purposes by the FPSC. The 0.1-day-per-year LOLP criterion is consistent with the LOLP criteria used by the Florida Electric Power Coordinating Group (FCG), and the winter reserve margin is considered to be reasonable for a utility of Tampa Electric Company's size. These planning criteria were applied to Tampa Electric Company's load forecast and existing power supply resources to determine whether the company needed additional capacity in 1995 and beyond.

To meet the established reliability criteria, the analysis showed a need for a series of generating capacity additions:

Year	Generating Capacity Addition
1993	Met by purchase agreement
1994	--
1995	65 MW
1996	66 MW
1997	43 MW
1998	47 MW
1999	61 MW
2000	65 MW

Based on the results of this analysis, if additional capacity is not placed into service, Tampa Electric Company's winter reserve margin will fall below 20 percent and its

LOLP is projected to rise above the 0.1 day per year in 1995, which exceed the established system reliability criteria (see Table 1.3.2-1).

The FPSC concurred with the results that Tampa Electric Company's reliability criteria of 0.1-day-per-year LOLP and minimum winter reserve margin of 20 percent would be violated with a delay in the in-service date of the proposed Polk Unit 1. Thus, additional generating capacity is needed for Tampa Electric Company to maintain acceptable reliability criteria in the future.

Alternative Technology Study

An integral step in Tampa Electric Company's power resource planning process is the identification and consideration of alternative generation technologies which could be constructed to meet future Customer demands. The objective of the alternative generation technology study is to identify the most reliable, feasible, environmentally acceptable, and cost-effective generating facilities for consideration in a comprehensive power resource plan.

The alternative technology study conducted by Tampa Electric Company involved a systematic review and assessment of a wide variety of conventional and nonconventional energy generation technologies. Initially, 46 technologies were identified for evaluation. These alternative technologies were screened in a two-step process: preliminary and economic screening analyses. In step one, a preliminary screening analysis was conducted to eliminate those technologies which could not be utilized because regional geography and/or weather are not suitable for a technology, costs were higher when compared to similar type technology alternatives, proven demonstration of the technology has not been performed, public opposition to technology exists, and/or questions exist regarding the technology safety.

In step two of the screening analysis, the economics of the technologies which were selected in the preliminary screening were compared using economic screening curves which reflect levelized annual/lifecycle costs of the technologies at different capacity

Table 1.3.2-1. Tampa Electric Company System Reliability Excluding New Unit Additions

Year	Net LOLP (days per year)	Winter Reserve Margin (percent)
1993	0.045	25.2
1994	0.067	22.2
1995	0.140	19.1
1996	0.199	16.2
1997	0.259	13.4
1998	0.361	10.8
1999	0.526	8.3
2000	0.770	5.9

Note: Figures include Tampa Electric Company's capacity from TECO Power Services Purchase Agreement in 1993.

Source: Tampa Electric Company, 1991.

factors. Based on this screening analysis, a final group of technologies was selected for the detailed economic optimization analysis. These screening analyses of the alternative technologies are described in Section 8.2 of this SCA.

Based on these analyses, the technologies selected for the economic optimization analysis included:

<u>Baseload Technologies</u>

- Conventional pulverized coal with flue gas desulfurization (FGD), and
- IGCC,

<u>Intermediate Load Technologies</u>

- IGCC,
- CC,
- Phosphoric acid fuel cell,
- Photovoltaic solar cell, and
- Solar thermal, and

<u>Peaking Technologies</u>

- CT.

The baseload conventional coal and IGCC technologies were maintained because of their relatively lower levelized costs compared to other baseload technologies and because of the favorable environmental performance of IGCC units compared to conventional coal units. The CC technology had the best economics of all of the intermediate technologies, but the fuel cells and solar technologies were advanced into the economic analysis because of their exceptional environmental performance (very low noise, extremely low or no emissions, and possibility of siting in or close to load centers).

Economic Optimization Analysis

The goal of the economic optimization analysis was to identify the best supply side plan for serving the forecasted energy requirements. The development of the supply side plan involved the use of dynamic programming to optimize the mix of generating capacity on the system. The objective function of the optimization analysis was to minimize present worth revenue requirements for the Tampa Electric Company system.

First, in the analysis, various power resource scenarios, comprised of a mixture of generating technologies, joint participation and purchased power generation, and demand-side management (DSM) programs were developed. Next, these alternatives were analyzed, along with future system demand and energy requirements, future DSM programs, and existing generating capabilities, to arrive at a number of viable generating expansion alternatives. Each alternative satisfied the established reliability criteria.

The capital expenditures associated with each capacity addition were determined based on the types of generating unit, fuel type, and in-service year. The fixed charges resulting from the capital expenditures were expressed in *present-worth* dollars for comparison purposes.

The fuel and the operation and maintenance costs associated with each scenario were projected based on estimated unit dispatch. The projections, also expressed in present-worth dollars, were combined with the fixed charges to obtain the total present worth of revenue requirements for each alternative power resource plan.

The expansion plan which was initially identified by this analysis as having the lowest revenue requirements was then compared to other generation plans which may be strategically superior for Tampa Electric Company and its Customers. These various expansion plans were again compared to one another on an economic basis, including an analysis of the sensitivity of the revenue requirement projections to changes in base case assumptions regarding fuel availability and costs.

Strategic Considerations

The final step in the power resource planning process was a strategic issues/risk analysis which was conducted to compare the overall performance of each individual generation expansion plan alternative under additional factors that were not easily quantified. These strategic issues may affect the type, capacity, and/or timing of Tampa Electric Company's future generation resource requirements. These issues, such as high and low fuel prices, natural gas availability, environmental legislation, and potential joint ownership projects, were evaluated in the process of determining the optimal expansion plan. In this way, an economically sound expansion plan was selected which has the flexibility to respond to future technological and economical changes.

1.3.2.3 Selection of Optimum Power Resource Plan

The results of Tampa Electric Company's power resource planning efforts demonstrated that the best series of generating capacity additions to meet its Customer needs during the 1995 through 2001 period is as follows:

Year In Service	Nominal Generating Capacity Addition	Ultimate Unit Configuration
1995	150/190 MW advanced CT*	260 MW IGCC (Polk Unit 1)
1996	70 MW HRSG/ST/CG	
1997	--	
1998	--	
1999	75 MW CT	220 MW CC
2000	75 MW CT	
2001	70 MW HRSG/ST	

* 150 MW when operated in simple-cycle or CC mode and fired on fuel oil. 190 MW when operated in IGCC mode with gasifier and air separation unit.

1.3.3 PLANNED ULTIMATE SITE CAPACITY

Tampa Electric Company's power resource planning efforts have also analyzed its new generating capacity needs beyond the typical 10-year planning timeframe. Such long-range analyses are important in planning efforts to meet the future Customer electricity demands due to the long lead-time needed to license/permit, design, and construct new electric generating facilities. Tampa Electric Company's site selection program, which resulted in the selection of the Polk Power Station site, also considered its generating capacity needs into the early 21st century. Tampa Electric Company recognizes that its long-range power resource plans may change based on such factors as changes in planning assumptions (e.g., the rate of projected population growth in its service area and costs of alternative fuels), the availability of power supplies from other sources (i.e., cogeneration and power supply purchase agreements with other generators), the relative success of DSM programs (i.e., conservation and load management), and advances in electric generation technologies.

Tampa Electric Company's current long-range power resource plans show that its Customer demands will continue to grow beyond the year 2001. These plans project the need for additional resources of more than 1,300 MW from 2002 through 2010. These plans also project that more than 650 MW of these additional resource needs will be met through non-construction alternatives, including conservation, load management, and power purchases from cogenerators. Thus, over the total 15-year period of 1995 through 2010, Tampa Electric Company's need for new generating capacity will be reduced by almost 50 percent through the effective implementation of these non-construction alternatives.

In addition to the 480 MW of generating capacity in the 1995 to 2001 timeframe, Tampa Electric Company's long-range power resource plan demonstrates the need for approximately 670 MW in new generating capacity in the 2002 through 2010 period. These generating capacity additions are again needed to meet projected increases in Customer electricity demands primarily due to forecasted population growth in west-central Florida. Thus, Tampa Electric Company currently has the need for a total of approximately 1,150 MW in new generating capacity from 1995 through 2010.

Based on these long-range planning studies, the phased schedule for operation of all needed electric generating units at the Polk Power Station site is presented in Table 1.3.3-1. This long-range generating capacity plan reflects the future power supply needs of Tampa Electric Company beyond the needs addressed by the need determination petition filed with the FPSC for Polk Unit 1 and the supporting power resource planning information showing the need for an additional 220-MW CC unit.

In this SCA, Tampa Electric Company is seeking certification of the planned ultimate electric generating capacity (i.e., approximately 1,150 MW) at the Polk Power Station site as presented in Table 1.3.3-1. Tampa Electric Company recognizes that certain changes in these ultimate capacity plans may require the filing of supplemental applications pursuant to the requirements and procedures of Section 403.517, F.S., and Chapter 17-17.231, F.A.C.

Table 1.3.3-1. Phased Schedule for Ultimate Electric Generating Capacity at the Polk Power Station Site

Year In Service	Nominal Generating Capacity Addition	Ultimate Unit Configuration
1995	150/190 MW advanced CT*	260 MW IGCC
1996	70 MW HRSG/ST/CG	(Polk Unit 1)
1997	--	
1998	--	
1999	75 MW CT	220 MW
2000	75 MW CT	CC
2001	70 MW HRSG/ST	
2002	75 MW CT	
2003	220 MW CC	
2004	--	
2005	--	
2006	75 MW CT	
2007	75 MW CT	
2008	75 MW CT	
2009	75 MW CT	
2010	75 MW CT	

* 150 MW when operated in simple-cycle or CC mode and fired on fuel oil. 190 MW when operated in IGCC mode with gasifier and air separation unit.

Source: Tampa Electric Company, 1992.

1.4 OVERVIEW OF THE POLK POWER STATION PROJECT

The following provides an overview of the comprehensive efforts conducted by Tampa Electric Company to select the Polk Power Station site, the general site location, and the planned power plant and directly associated facilities at the site. A summary description of the DOE Clean Coal Technology Demonstration program is also provided. More detailed information regarding the project site and the planned facilities is provided in Chapters 2.0 and 3.0, respectively, of this SCA.

1.4.1 POWER PLANT SITE SELECTION AND SITING TASK FORCE

In order to identify a suitable site for the needed power plant facilities, Tampa Electric Company conducted a Power Plant Site Selection Assessment program between September 1989 and November 1990. The overall objective of this site selection program was to select a site or sites which were considered the most suitable for developing the needed power plant based on a combination of environmental, socioeconomic, land use, and engineering/economic factors. The six-county study area for the siting program in west-central Florida is shown on Figure 1.1.0-1. An integral aspect of this program was the formation by Tampa Electric Company of a public Siting Task Force which actively participated in the site selection efforts. The Siting Task Force was comprised of 17 private citizens from environmental groups, businesses, and universities in the Tampa Electric Company service area and throughout Florida. Tampa Electric Company's objective for involving the Siting Task Force in the site selection process was to ensure that local and statewide public issues and environmental concerns relative to new power plant development were adequately and accurately considered in selecting a suitable site for the new power plants. Appendix 11.15 provides a listing of the Siting Task Force members and a brief description of their backgrounds. Descriptions of the Power Plant Site Selection Assessment program approach, evaluation methodologies, and findings are provided in Section 8.1.

Based on the results of detailed environmental and engineering/economic evaluations, the Siting Task Force recommended three adjacent areas located in southwest

Polk County as the most suitable or *preferred sites* for locating the planned power plant facilities. The three preferred sites had similar environmental characteristics in that each had been disturbed by previous and ongoing phosphate mining activities. The Task Force recommended that Tampa Electric Company pursue acquisition and environmental licensing efforts for any one of the three preferred sites. Tampa Electric Company concurred with the recommendations of the Siting Task Force and selected one of the preferred sites in southwest Polk County as the location for the planned power plant which is the proposed Tampa Electric Company Polk Power Station site. This site is the subject of this SCA.

1.4.2 GENERAL SITE LOCATION AND DESCRIPTION

The Tampa Electric Company Polk Power Station site is located approximately 17 miles south of the City of Lakeland, approximately 11 miles south of the City of Mulberry, and 13 miles southwest of the City of Bartow in southwest Polk County, Florida. Figure 1.4.2-1 shows the general location of the site in west-central Florida, and Figure 1.4.2-2 provides a vicinity location map and approximate boundaries of the site. The site consists of approximately 4,348 acres and is bordered by the Hillsborough County line along the western boundary; Fort Green Road [County Road (CR) 663] on the east; CR 630, Bethlehem and Albritton Roads along the north; and State Road (SR) 674 and several phosphate clay settling ponds on the south. SR 37 bisects the property, running in a southwest to northeast direction. The portion of the property to the east of SR 37 consists primarily of mined-out lands with water-filled mine cuts between spoil piles surrounding an unmined parcel of land and old mined and unreclaimed lands. The area to the west of SR 37 is currently being mined for phosphate matrix and these operations are scheduled to continue into 1994. In general, lands surrounding the site and in the region have also been impacted by previous and ongoing phosphate mining operations.

The majority of the site has been mined by Agrico Chemical Company (Agrico), a division of Freeport MacMoRan, Ltd., as part of Agrico's Fort Green Mine. The remaining acreage, approximately 775 acres, located south of CR 630, is property of American Cyanamid Company. A portion of American Cyanamid property has been leased, re-mined, and recently reclaimed by IMC Fertilizer, Inc. Tampa Electric Company intends to acquire all of these lands prior to commencement of construction for the Polk Power Station.

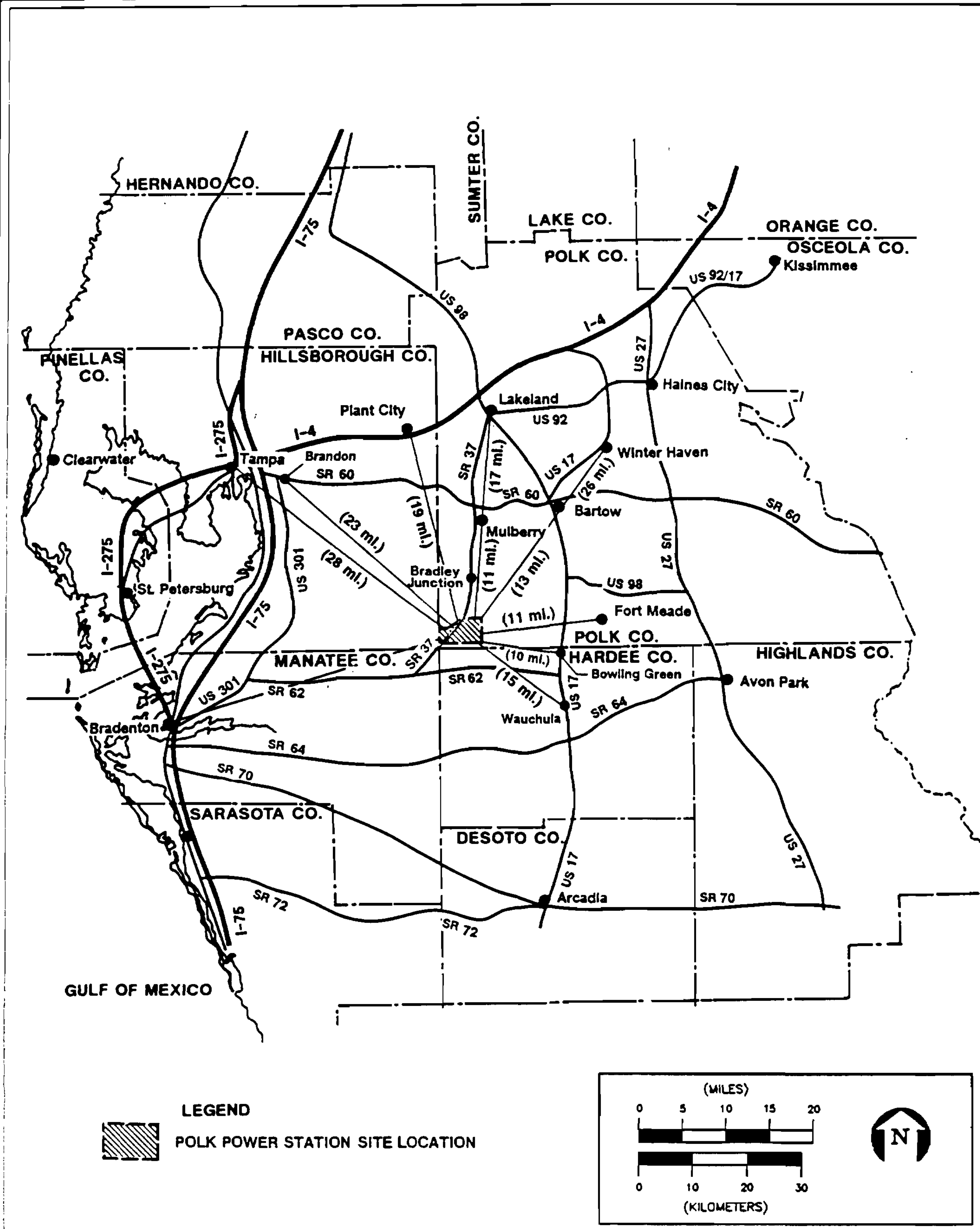

FIGURE 1.4.2-1.

REGIONAL LOCATION OF THE POLK POWER STATION SITE

Source: ECT, 1992.

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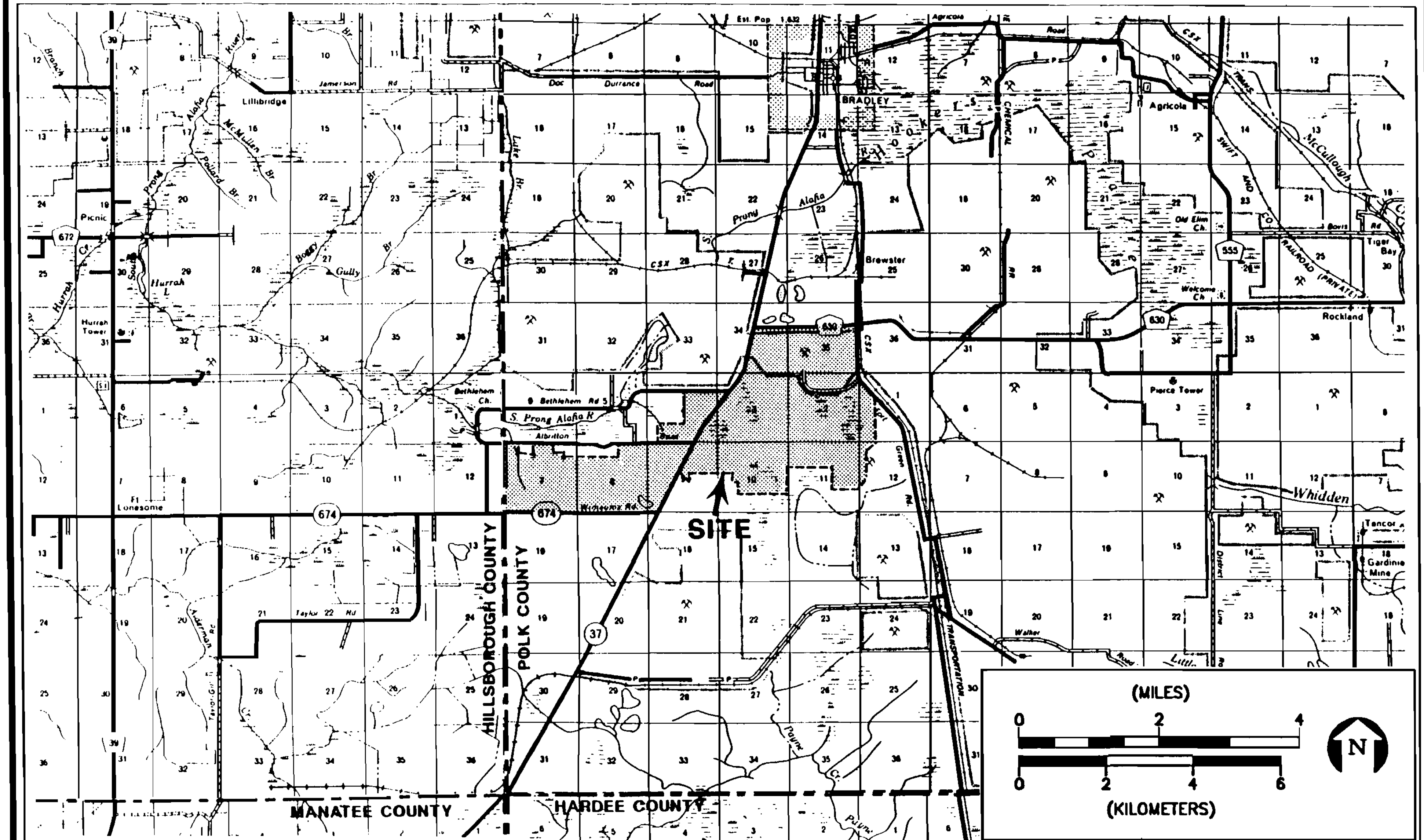

FIGURE 1.4.2-2.

VICINITY MAP AND BOUNDARIES OF POLK POWER STATION SITE

Sources: FDOT Map, FL. ECT, 1992.

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POLK POWER STATION

1.4.3 GENERAL PROJECT DESCRIPTION

Tampa Electric Company is planning to construct and operate new electric generating units at the Polk Power Station site with units added according to a phased schedule designed to match the projected growth of Tampa Electric Company's Customer power demands, and subject to obtaining need for power certifications from the FPSC. The total nominal generating capacity of the units at the site will be approximately 1,150 MW. The first generating facilities at the Polk Power Station site will be an IGCC unit developed by Tampa Electric Company supported in part through funding from DOE under the Clean Coal Technology Demonstration program. The coal-fueled facilities will consist of a nominal net 150-MW advanced CT, initially fueled by low sulfur No. 2 fuel oil, with HRSG, ST, and CG facilities added 1 year later to complete the nominal net 260-MW IGCC unit. Tampa Electric Company's current long-range power resource planning efforts indicate that later facilities will consist of two nominal net 220-MW CC generating units and six stand-alone nominal net 75-MW CTs fueled primarily by natural gas with low sulfur No. 2 fuel oil as the backup fuel.

The IGCC facilities will consist of an oxygen-blown entrained flow gasification system to produce syngas fuel for the CT. The planned CG system is based on the Texaco, Inc. (Texaco) commercially available technology. The CC power block facilities are based on a General Electric Company (GE) advanced nominal net 150-MW 7F CT and nominal net 70-MW HRSG/ST configuration. The GE 7F CT is expected to be capable of a nominal net 190-MW capacity when operating with the coal gasifier and air separation unit. The other two CC units are based on a configuration of two nominal net 75-MW CTs with a nominal net 70-MW HRSG/ST facilities. The six stand-alone CTs are currently assumed to be nominal net 75-MW units.

The primary power plant facilities (i.e., power block and fuel storage) will be located on unmined land on the east side of SR 37. The surrounding mined-out land to the east and south of the plant facilities will be developed as a primarily below-grade cooling reservoir surrounded by a low-profile earthen berm with a top elevation of

145 feet National Geodetic Vertical Datum (ft-NGVD). Potable and process water will be provided by onsite wells. Stormwater runoff on the plant site will be collected, detained, recycled, and treated, as appropriate, in accordance with applicable regulations. The current designs for the plant systems are based on criteria to maximize plant water recycling and re-use, and to minimize groundwater withdrawals and offsite discharges. Discharges from the cooling reservoir will be routed to the Little Payne Creek drainage system.

Tampa Electric Company will be its own provider for most utilities at the Polk Power Station. Electricity, potable water, and sanitary sewerage treatment services will be provided by onsite facilities. Therefore, no interconnection to or demands on public utilities for these services will be created by the operation of the project. Domestic, construction, and certain industrial solid waste disposal services will be provided by licensed waste carriers/disposal contractors serving the region.

Four 230-kilovolt (kV) electric transmission circuits will be needed to connect the Polk Power Station with the Tampa Electric Company and Florida transmission grid. Two of the circuits will run northeast from the onsite Polk Power Station Substation to interconnect with Tampa Electric Company's existing Hardee Power Station-Pebbledale 230-kV transmission line adjacent to the Polk Power Station site along Fort Green Road. Thus, the corridor for these two circuits will be located within the site boundaries. The other two circuits will run west from the onsite substation to SR 37, then north along SR 37 approximately 5 miles to interconnect with Tampa Electric Company's existing Mines-Pebbledale 230-kV transmission line at a point to the west of the community of Bradley Junction. These two circuits will be located within a new transmission line corridor adjacent to SR 37.

As part of the development activities for the Polk Power Station, reclamation of lands disturbed by phosphate mining will occur in accordance with the requirements of Section 211, F.S., and Chapter 16C-16, F.A.C., and the Polk County Phosphate Mining Ordinance 88-19. The state reclamation requirements are administered by

FDNR. Tampa Electric Company will submit to FDNR and Polk County appropriate modifications to the currently-approved mine reclamation plans for the site which integrate the planned power plants and associated facilities while complying with FDNR and Polk County reclamation requirements. Chapter 9.0 of this SCA presents a summary of Tampa Electric Company's proposed plans to comply with the FDNR and Polk County mined land reclamation requirements. A separate document entitled Conceptual Reclamation Plan Application has also been submitted to FDNR and Polk County which includes more detailed information on the proposed reclamation plans and appropriate forms to modify existing, approved reclamation plans for the site under FDNR requirements.

1.4.4 CLEAN COAL TECHNOLOGY DEMONSTRATION PROGRAM

The DOE Clean Coal Technology Demonstration program is a government- and industry-cofunded technology development effort to demonstrate a new generation of innovative coal utilization processes in a series of large-scale *showcase* facilities built across the country. The program takes the most promising advanced coal-based technologies and moves them into the commercial marketplace through demonstration. These demonstrations are on a scale large enough to generate all the data, from design, construction and operation, that are necessary for the private sector to judge commercial potential and make informed, confident decisions on commercial readiness. The projects in the program are demonstrating technologies capable of being applied to the United States coal resource base and encompass advanced electric power generation systems, high-performance pollution control devices, and coal processing for clean fuels and industrial applications.

The innovative clean coal technologies being demonstrated offer tremendous potential as part of the solution to many complex problems that face the nation--and the world--in a rapidly changing arena dominated by energy, economic, and environmental issues. These issues include the following:

- Air quality,
- Acid rain,
- Global climate change,
- Power production,
- Energy security,
- Technology awareness, and
- International competitiveness.

The dependence of the electricity-producing industry on coal is especially strong, and the burning of coal to provide industrial heat and power is critical to the economy. In 1989, 86 percent of coal consumption went into the generation of electricity. By 2010, coal use in the electricity production industry will increase by at least

50 percent and double by 2030 even with optimistic estimates of contributions from conservation, renewable resources, and nuclear energy.

Currently available technologies will have difficulty in satisfying the rapidly changing environmental, economic, and technical performance requirements being imposed on power plants. The coal-fueled power plant of the future must be capable of meeting stringent siting and environmental demands while producing power efficiently and with a high level of reliability. Further, the ability to rapidly add generation capacity in modules which closely match load growth will be an important factor in keeping reasonable electricity costs to the consumer. Therefore, over the next 10 years, it will be critical to bring new technology options into the marketplace to satisfy not only the requirements of the traditional utility industry but also the requirements of independent power producers and cogenerators which are producing an increasing share of power in the United States. As a result of the Clean Coal Technology Demonstration program, new power production systems using technologies demonstrated in the program will have the potential to gain a major share of the market for replacement and new capacity through 2010, thereby providing a clean, efficient, reliable source of affordable energy.

The commercially-proven IGCC process basically has the following four steps:

1. A fuel gas is formed by reacting coal with air or oxygen;
2. The coal-derived syngas is cooled and purified;
3. The clean gas is burned, and the hot exhaust is routed through a CT to generate electricity; and
4. The residual heat in the exhaust is recovered in a HRSG to form steam for a conventional ST generator to produce additional electricity.

IGCC systems are among the cleanest and most efficient of the emerging clean coal technologies. Sulfur, nitrogen compounds, and particulates are removed before the fuel is burned in the CT.

Tampa Electric Company will demonstrate an oxygen-blown entrained-flow IGCC technology. Such a demonstration is expected to show that an oxygen-blown entrained-flow IGCC unit can achieve significant reductions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) emissions when compared to existing and future coal-burning power plants using available, conventional pulverized coal technologies. The integrated performance to be demonstrated will include all major subsystems in the IGCC system entailing coal feeding; a pressurized, oxygen-blown entrained-flow gasifier capable of using caking coal; an air separation unit to provide oxygen to the gasifier as an oxidant and also to provide nitrogen to the CT for NO_x control and power augmentation; a commercially-proven cold gas cleanup (CGCU) system capable of treatment of 100 percent of the syngas flow in parallel with a demonstration hot gas cleanup (HGCU) system capable of a nominal 50-percent syngas flow treatment for removing sulfur compounds, particulates, and other contaminants as necessary to meet environmental and CT fuel requirements; an advanced CT appropriately modified to use low-British-thermal-unit (Btu) syngas as fuel; the HRSG system; the system cycle; all control systems; and associated facilities.

In a coventional IGCC system, the syngas is cooled prior to sulfur removal and then reheated prior to firing in the CT. These cooling and reheating processes result in a less efficient power generation system. Part of the reason Tampa Electric Company was awarded this Clean Coal Technology Demonstration program project is due to the demonstration of a HGCU system. By using a bed of metal oxide particles, the syngas can be cleaned without first cooling it down. This will result in a more efficient system.

Under its agreement with DOE, Tampa Electric Company will demonstrate the HGCU system for a 2-year period. The demonstration period will involve significant testing and optimization to determine the cost and performance of the HGCU system as well as the overall integration of the CG and CC technologies. Successful operation will enable future IGCC systems to operate more efficiently, providing more opportunities to meet the goals of the Clean Coal Technology Demonstration program.

1.5 GENERAL DESCRIPTION OF GENERATING TECHNOLOGIES

The proposed Polk Power Station will consist of three types of electric generating technologies or units: CT units, CC units, and an IGCC unit. While many of the main electric generating components of these units are relatively similar, each type of unit has certain differences in its operational requirements and its emissions and wastes/by-products, which in turn may involve different potential environmental effects. To provide the reader of this SCA with an initial, basic understanding of the generating technologies, the following presents a general description of each type of the generating unit planned for the Polk Power Station. More detailed, technical descriptions of these units and their major systems, designs, and operations are provided in Chapter 3.0.

1.5.1 COMBUSTION TURBINE GENERATING TECHNOLOGY

The CT generating technology is the simplest of the three types of technologies planned for the Polk Power Station. When operated as a separate, distinct generating technology (i.e., not combined with HRSG/ST facilities as in a CC unit), CT units are often referred to as simple-cycle or stand-alone CTs. A basic CT electric generating unit consists of a compressor, a combustor, a turbine, and an electric generator in series and operating similar to a jet aircraft engine. In an aircraft engine, jet fuel is burned to produce hot gases which are used to spin a turbine, which in turn creates the thrust for the aircraft. For power generation, air is compressed in a compressor and delivered along with gaseous or liquid fuel to a high-pressure combustion chamber where the fuel is burned to produce hot gases. These high temperature, high pressure gases then pass and expand through a turbine causing the turbine to spin. The turbine drives a generator which produces electricity. Again, similar to jet aircraft engine operation, the hot combustion gases are released to the atmosphere after passing through the turbine. Figure 1.5.1-1 provides a simplified flow diagram of a CT power system.

Stand-alone CT units are generally used only as peaking units to supply electricity for those days of the year when demand is the highest or peaks. In this role, the

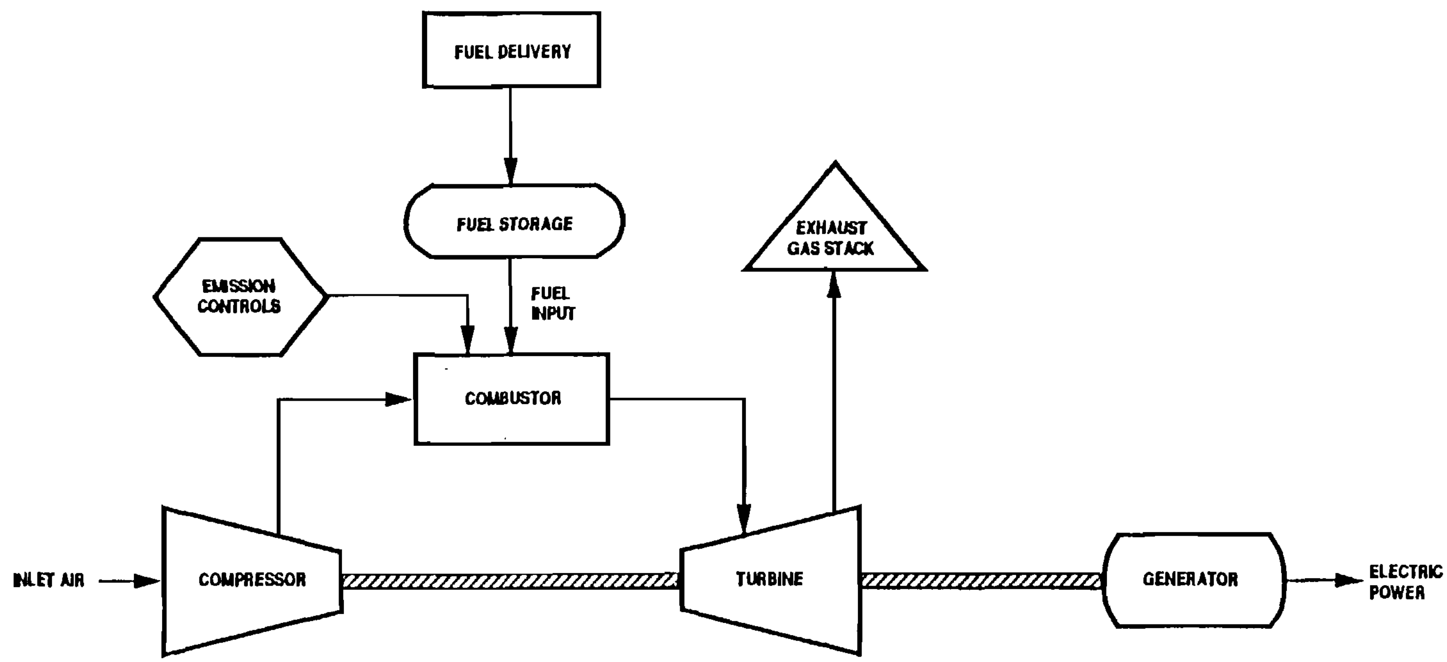

FIGURE 1.5.1-1.

SIMPLIFIED FLOW DIAGRAM OF COMBUSTION TURBINE POWER SYSTEM

Source: ECT, 1992.

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advantage of CTs is that a unit can start and stop generating electricity quickly. This rapid response makes the units effective in providing extra capacity during the periods of peak demand. Other advantages of CTs are that the units are relatively less expensive to build than other types of generating plants and require less time to build and be operational than other types of plants. Also, from an environmental standpoint, stand-alone CT units do not require water for cooling purposes and do not produce solid wastes or by-products.

The disadvantage of CT technology is that it is relatively less efficient in the conversion of energy created by the fuel combustion to electricity than many other available technologies. Thus, the cost of electricity generated by CT units is relatively more expensive than electricity generated by many other technologies. Also, until recently, CT units were generally limited in size with a maximum power-producing capacity of less than 100 MW. However, recent technological advances have allowed development of larger units (e.g., up to 150 MW). These larger CT units are often referred to as advanced CTs.

According to the ultimate site capacity plan shown in Table 1.3.3-1, a total of 11 CT units will be located on the Polk Power Station site; however, only six of the units are planned for long-term operation as stand-alone CTs. One of the units will be an advanced CT (i.e., GE 7F) with a nominal net capacity of 150 MW which will be operated in a stand-alone mode using No. 2 fuel oil only during the first year of operation. After the first year, this advanced CT will be integrated with HRSG, ST, and CG facilities to form the IGCC unit.

Currently, each of the remaining CTs are planned to have a nominal net capacity of 75 MW. Two of these CTs will be operated in a stand-alone mode for 1 to 2 years prior to being integrated to form a CC unit, while two other CTs will be only operated as a CC unit.

The remaining six CTs will be operated as stand-alone units to provide electric power during periods of peak demands. These CT units will use natural gas as primary fuel and No. 2 fuel oil as backup fuel.

Air pollution emission controls for the stand-alone CT units and CTs integrated for CC units will consist of a combination of measures. SO_2 emissions will be controlled by the use of fuels with low sulfur contents (i.e., natural gas with only trace sulfur content and fuel oil with a maximum sulfur content of 0.05 percent). NO_x emissions will be controlled by the use of efficiently designed and operated combustors called dry low-NO_x combustors when the units are fired by natural gas, and water injection when fired on the backup fuel oil. Other potential air pollutants [i.e., carbon monoxide (CO), volatile organic compounds (VOCs), particulate matter less than or equal to 10 micrometers aerodynamic diameter (PM_{10}), and trace elements] will also be primarily controlled by the fuel characteristics and the efficient design and operation of the CT units.

1.5.2 COMBINED CYCLE GENERATING TECHNOLOGY

In general, a CC electric generating unit consists of one or two CT units configured with HRSG and ST facilities and a second electric generator. The efficiency of electric generation is improved when CT units are combined in a CC unit arrangement compared to CT units operated as stand-alone facilities. When CT units are used as stand-alone units, the hot combustion gases are released to the atmosphere after passing through the turbine. In a CC unit, the hot combustion gases from the CT are reused. The hot gases are ducted into an HRSG, where water in boiler tubes is heated to produce steam. The steam is then used to spin an ST which drives a second generator to produce electricity. Therefore, by reusing the waste heat from the CT units, additional electricity is efficiently produced by the ST and generator without additional fuel input.

Due to their improved efficiency, CC units are used to serve intermediate electricity demands or the portion of the utility load that varies daily. For example, intermediate plants may start up every morning and may stop every night when the demand diminishes.

Two CC generating units will be located at the Polk Power Station site. The IGCC generating unit also includes a CC unit, which will be configured slightly different than the two other units. Figure 1.5.2-1 presents a simplified flow diagram of a CC unit.

Each of the two CC units will have a nominal net generating capacity of 220 MW. As currently planned, each CC facility will be comprised of two 75-MW CT units, two HRSGs, and a 70-MW ST. The first CC unit will be developed under a phased schedule with one of the 75-MW CT units placed in service in early 1999, the second unit in service in early 2000, and the HRSG and ST facilities to complete the nominal net 220-MW CC unit scheduled for operation in early 2001. The phased CT units will be operated as stand-alone generating facilities until combined into the CC facility in order to meet Tampa Electric Company's projected peak power demands

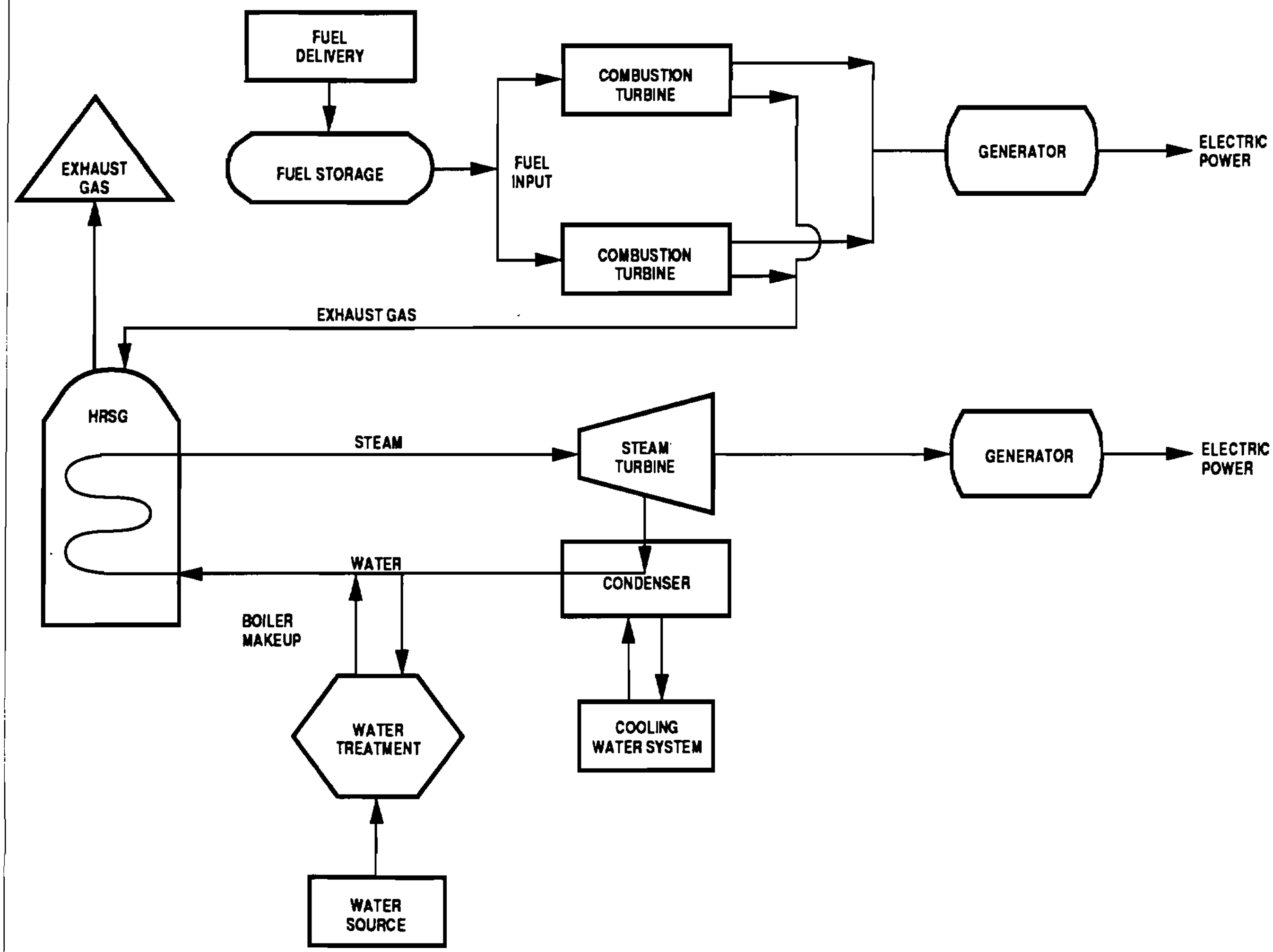

FIGURE 1.5.2-1.

SIMPLIFIED FLOW DIAGRAM OF COMBINED CYCLE POWER SYSTEM

Source: ECT, 1992.

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in the 1999 to 2001 timeframe. The components of the second CC unit are expected to be constructed concurrently beginning in early 2001 with the total nominal net 220-MW unit operational in early 2003.

Similar to the stand-alone CT units, the two CC units will use natural gas as primary fuel and No. 2 fuel oil as backup.

The proposed air pollutant emission controls for the CC units will also be similar to those for the stand-alone CT units (i.e., dry low-NO_x combustors when fired on natural gas and water injection when fired on the backup fuel oil).

Unlike the stand-alone CT units, the CC units will require water for the steam generating cycle as well as for air pollution control and other plant uses. Makeup water for the boiler steam cycle will be provided from the Floridan aquifer by wells on the site. Also, as discussed previously, an 860-acre cooling reservoir, including the area of the surrounding berm, will be constructed to provide circulating water for condenser cooling and system heat dissipation purposes.

1.5.3 INTEGRATED COAL GASIFICATION COMBINED CYCLE TECHNOLOGY

The IGCC generating technology involves the integration of CG facilities with a CC unit. As discussed previously, the initial electric generating facilities at the Polk Power Station site will be an IGCC unit with a nominal net generating capacity of 260 MW. The IGCC unit will be known as Polk Unit 1. The IGCC generating facilities will consist of a nominal net 150-MW advanced CT and nominal net 70-MW HRSG/ST and CG facilities. When the IGCC unit is operated on the syngas and with the associated air separation unit, the nominal net generating capacity of the advanced CT is expected to increase to 190 MW. The CC components (i.e., CT and HRSG/ST) of the unit produce electricity in a similar manner and have similar process and cooling water requirements as described previously for the two CC units at the site. However, instead of using two 75-MW CTs, the IGCC unit will use a single, larger advanced CT (i.e., GE 7F). Construction of the IGCC facilities will begin in early 1994 and the nominal net 150-MW advanced CT will be placed in service in mid-1995. The CT unit will be fueled initially by No. 2 fuel oil. The HRSG/ST and CG facilities will be placed in service 1 year later, or mid-1996, to complete the nominal net 260-MW IGCC unit. When completed, the unit will be fueled by coal gas or syngas produced from the CG facilities with No. 2 fuel oil as backup fuel.

CG involves a method of producing a clean, burnable gas from coal. Gasification is achieved by exposing coal to nearly pure oxygen in a pressurized vessel. Under these controlled conditions, the coal (i.e., the carbon in coal) is partially oxidized to form a combustible gas, consisting mainly of hydrogen and CO. When coal is burned conventionally, complete oxidation of carbon occurs with nearly all the chemical energy of the coal released as heat energy and the remaining gases will not burn. In the gasification process, by restricting the amount of oxygen available to the coal and controlling the temperature and duration of the reaction, only partial oxidation occurs and gases are formed that will burn.

The basic technology of CG has been in commercial use for many years. The first low-Btu gas gasifier for production of coal-derived gas began operation in England in 1832, and extensive use of gasifiers began in 1861. Medium-Btu gas production from coal began in 1875. By the 1920s, approximately 11,000 gasifiers were in use in the United States. The availability of low cost natural gas and oil in the mid-1900s resulted in a loss of interest in the CG process. Worldwide interest in CG renewed in 1973 because of the Arab oil embargo and ensuing drastic rise in the price of oil. The industrial need for more efficient, environmentally clean processes resulted in a number of extensive programs to develop *second generation* CG processes for the production of fuels and electric power.

The Dakota Gasification Company's Great Plains CG plant (Beulah, North Dakota) is an early example of these second generation plants. This facility used the Lurgi oxygen-blown fixed-bed CG technology.

The most prominent modern commercial-scale applications of CG in the United States are the Cool Water power plant in southern California and Tennessee Eastman plant in Kingsport, Tennessee, both of which use the Texaco gasification technology, the Dow Syngas project in Plaquemine, Louisiana, and the Shell CG Process in Deer Park, Texas. These facilities use an oxygen-blown entrained flow gasification process. The oxygen-blown CG system developed by Texaco will be used for the IGCC unit at the Polk Power Station.

As discussed previously, Tampa Electric Company will develop the IGCC unit in conjunction with a cooperative agreement with DOE under the Clean Coal Technology Demonstration program. Under this agreement, DOE will provide $120 million in funding for construction and operation of the unit to demonstrate the integration of CG and CC technologies and a new, more efficient technology for removing sulfur from the coal gas prior to its combustion. This innovative technology is called HGCU and has been developed by General Electric Environmental Systems, Inc. (GEESI). The demonstration aspects of the IGCC unit provide the opportunity to commercially demonstrate an economical and environmentally-acceptable means of generating electricity using coal which is the most abundant energy resource in the United States. Therefore, if successful, this demonstration could assist in reducing future reliance on and use of foreign energy resources (i.e., imported oil) for electricity generation in the United States.

The IGCC unit at the Polk Power Station will include both the proven CGCU system and the HGCU demonstration technology to assure the reliable production of clean syngas for the continued operation of the generating unit and compliance with applicable environmental regulations.

Figure 1.5.3-1 provides a simplified flow diagram of the IGCC unit planned for the Tampa Electric Company Polk Power Station. As shown in this figure, coal is fed to a conventional rod-type grinding mill to reduce the coal to the design particle size and mixed with water to create a coal slurry. The coal slurry is pumped to the gasifier which is a refractory-lined vessel capable of withstanding high temperatures and pressures. Pure oxygen is also provided to the gasifier from an air separation unit which separates the two major components of air, oxygen and nitrogen, through a process of cooling compressed air to liquid states, separating the oxygen and nitrogen streams, and re-warming the streams to gaseous states. In the gasifier, the coal slurry and oxygen react at high temperatures to produce syngas. The syngas consists primarily of hydrogen, CO, water vapor, and carbon dioxide (CO_2), with small amounts of hydrogen sulfide (H_2S), carbonyl sulfide (COS), methane, argon, and nitrogen. Heat created by the reaction in the gasifier is used to heat water in boiler tubes to steam which is provided to the HRSG/ST facilities.

Within the gasification process, ungasified components of the coal (primarily ash) are cooled in a pool of water at the bottom of the gasifier and form a solid by-product called slag. The slag material is a vitrified (i.e., glasslike) granular solid that is non-leachable and classified as non-hazardous. The slag has commercial applications such as sand-blasting material and as an aggregate in cement, road construction, and

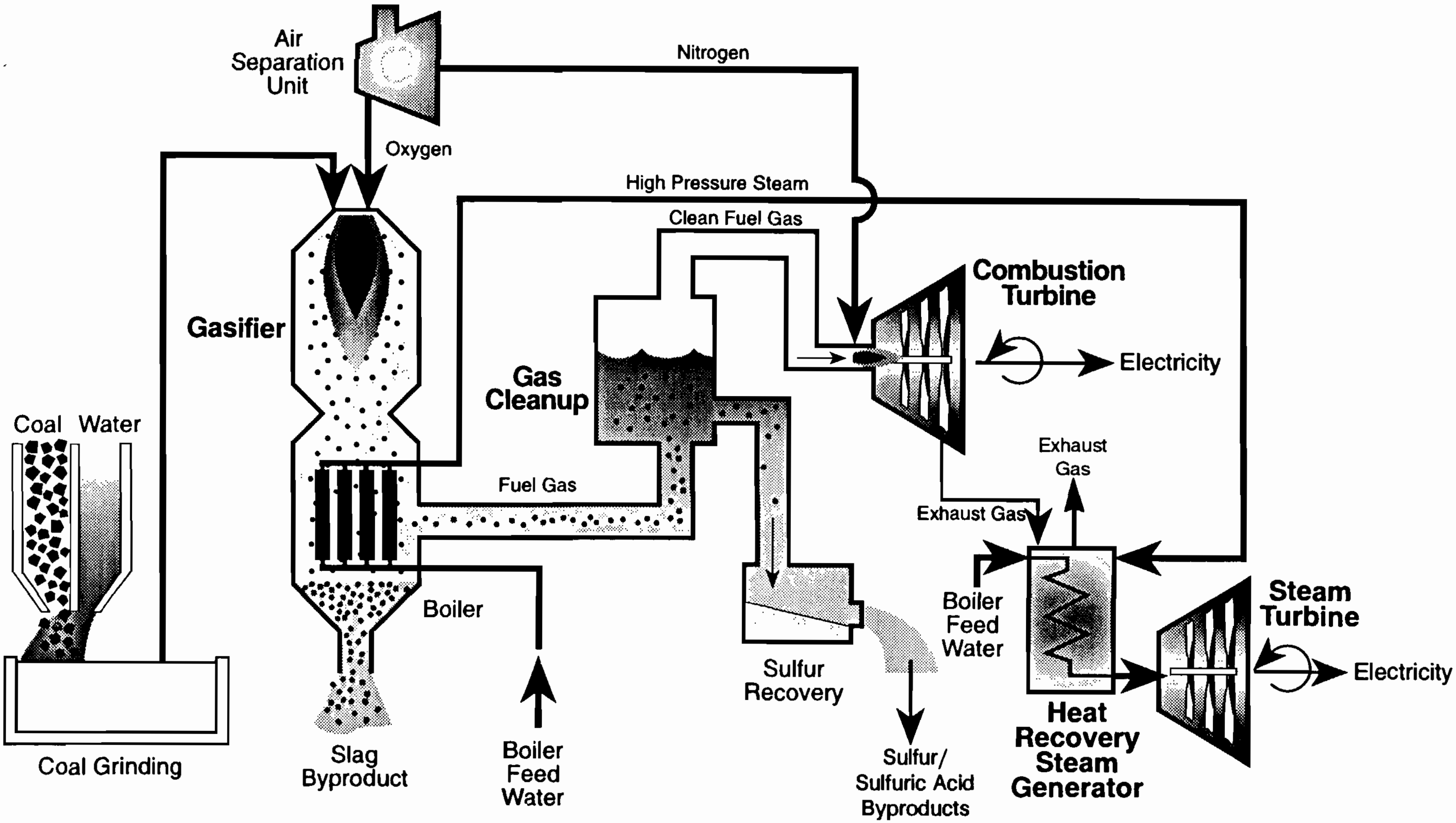

FIGURE 1.5.3-1.

SIMPLIFIED FLOW DIAGRAM OF INTEGRATED COAL GASIFICATION COMBINED CYCLE UNIT

Source: Texaco, 1992. Tampa Electric Company, 1992.

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other building materials. Although a temporary storage area for the slag will be developed onsite, the slag will be actively marketed and sold for offsite uses to minimize the onsite storage requirements. The temporary slag storage area will be lined with a synthetic material or other materials with similar low-permeability characteristics and have appropriate stormwater management control systems.

The syngas from the gasifier will be fed to the gas cleanup systems to remove entrained solids and acid gases such as CO_2 and H_2S. As discussed previously, the gas cleanup systems will include both the conventional CGCU and the demonstration HGCU methods. The CGCU system will be designed to treat 100 percent of the syngas flows for the IGCC unit, while the HGCU system will be capable of treating approximately 50 percent of the gas when the unit is operating at full capacity. Within the CGCU system, the sulfur in the syngas is primarily converted to and recovered as molten, elemental sulfur using a combination of thermal and catalytic reactors. This sulfur recovery process is used extensively in the petroleum refining industry. Elemental sulfur is also a by-product with commercial uses, particularly for the chemical fertilizer industry in central Florida. Some temporary storage for the sulfur by-product in tanks or specially designed railcars will be provided on the site prior to shipment offsite.

For the demonstration HGCU system, the sulfur in the syngas will be converted to sulfuric acid (H_2SO_4) in a skid-mounted unit. Again, H_2SO_4 produced in this cleanup process has commercial uses and will be marketed and sold for these offsite uses.

As shown in Figure 1.5.3-1, the clean syngas is then fed to the advanced CT for firing to produce electricity and the exhaust gas is routed to the HRSG/ST facilities to produce additional electricity as a CC generating unit. Nitrogen from the air separation unit is also fed to the CT unit which increases the overall efficiency of the unit in generating electricity.

Again, the previous descriptions are intended to provide an initial overview of the electric generating technologies and units planned for the Polk Power Station. More detailed descriptions of the designs and operations of these facilities are provided in Chapter 3.0.

1.6 PROJECT TERMINOLOGY

In order to provide the reader of this SCA with a consistent understanding of the Polk Power Station project, Table 1.6.0-1 presents descriptions of certain project terms and components used throughout the SCA.

Table 1.6.0-1. Polk Power Station Project Terminology

Project Term/ Component	Description
Polk Power Station project	The overall Polk Power Station project includes the proposed power plant facilities with a nominal net 1,150-MW generating capacity; fuel delivery and storage facilities; by-product storage areas; cooling reservoir; water supply and wastewater treatment facilities; and associated transmission lines.
Polk Power Station site	The overall 4,348-acre site.
Main power plant facilities site	The approximately 150-acre area to the east of SR 37 on which the main power plant facilities and structures (i.e., power blocks, fuel and by-product storage) will be constructed.
Cooling reservoir	The approximately 860-acre area, including the area of the surrounding earthen berms, within which the cooling reservoir will be constructed. The reservoir will have a maximum bottom elevation of 120 ft-NGVD and the top of the surrounding earthen berms will be at 145 ft-NGVD. The total water surface of the reservoir is approximately 727 acres at the normal operating water level of 136 ft-NGVD. Water discharges (i.e., blowdown) from the reservoir will be routed to the reclaimed lake at the eastern edge of the reservoir and flow into the Little Payne Creek system.
Wildlife corridor or wildlife/ water management area	The approximately 1,511-acre portion of the site to the west of SR 37; this area will be reclaimed in an integrated series of forested and non-forested wetlands and uplands, and will not contain power plant facilities or structures. After reclamation, the entire area will provide a wildlife corridor between the headwater areas of Payne Creek and the Little Manatee River and the South Prong Alafia River system.

Table 1.6.0-1. Polk Power Station Project Terminology (Continued, Page 2 of 3)

Project Term/ Component	Description
Eastern associated transmission line corridor	The 400-ft wide corridor area from the onsite substation to the existing Tampa Electric Company Hardee-Pebbledale 230-kV transmission line along the eastern edge of the site. This corridor is contained completely within the Polk Power Station site boundaries. Two 230-kV electric transmission circuits and structures will be constructed within the corridor.
Northern associated transmission line corridor	The corridor area from the onsite substation to to the existing Tampa Electric Company Mines-Pebbledale 230-kV transmission line at a point west of the community of Bradley Junction. The corridor area is 400-ft wide as it runs west on the site from the substation to SR 37 and widens to 0.5 mile centered on SR 37 as it runs north along SR 37. The corridor width increases to 1 mile southwest of Bradley Junction as it turns northwest to interconnect to the existing line. Two 230-kV transmission line circuits and structures will be constructed within this corridor.
IGCC generating unit	The nominal net 260-MW IGCC unit consisting of an advanced CT and HRSG/ST facilities and integrated CG facilities including air separation unit, coal grinding facilities, gas cleanup systems, tail gas treating system, and CG process wastewater treatment facilities.
Stand-alone CC generating units	Two nominal net 220-MW CC units each consisting of two nominal net 75-MW CTs and nominal net 70-MW HRSG/ST facilities.
Stand-alone CT generating units	Six CT units each with a nominal net generating capacity of 75 MW.

Table 1.6.0-1. Polk Power Station Project Terminology (Continued, Page 2 of 3)

Project Term/ Component	Description
Syngas/coal gas	Syngas and coal gas are used interchangeably in this SCA to refer to the combustible coal-derived gas produced in the gasification process and, after appropriate cleanup, used as fuel in the advanced CT in the IGCC unit.

Source: ECT, 1992.

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CHAPTER 2.0

SITE AND VICINITY CHARACTERIZATION

2.1 SITE AND ASSOCIATED FACILITIES DELINEATION

The Polk Power Station site consists of approximately 4,348 acres in southwest Polk County. The site is bordered by the Hillsborough County line along the western boundary; Fort Green Road (CR 663) on the east; CR 630 and Bethlehem and Albritton Roads along the north; and SR 674 and phosphate clay settling areas on the south. The Polk Power Station site and adjacent areas are shown on Figure 2.1.0-1 at a scale of 1 inch equals 2,000 feet (ft) based on U.S. Geological Survey (USGS) 7.5-minute quadrangle topographic maps, and a recent aerial photograph of the site and adjacent areas at the same scale is shown on Figure 2.1.0-2. A more detailed scale (1 inch equals 1,000 ft) aerial photograph of the site is provided in Appendix 11.16.8. SR 37 bisects the property running in a southwest to northeast direction. As shown on the aerial photograph, the property to the east of SR 37 consists primarily of recently mined areas with water-filled mine cuts between over-burden spoil piles, recently reclaimed areas, and old mined and unreclaimed areas. The area to the west of SR 37 is currently being mined for phosphate matrix. These operations are scheduled to continue into 1994. Except for the approximately 775-acre tract south of CR 630 (Sections 34 and 35), the site has been part of the Agrico Fort Green Mine.

Southwest Polk County is relatively flat, with elevations generally ranging between 120 and 150 feet above mean sea level (ft-msl). The prevalent land use in the area is phosphate strip mining. The Polk Power Station site itself fits this description. The elevation of the plant site is approximately 140 ft-msl. More than 94 percent (i.e., approximately 4,110 acres) of the 4,348-acre site has been or will be mined or disturbed by phosphate mining activities prior to Tampa Electric Company's use of the site. Some of the mined-out areas will be developed into a cooling reservoir.

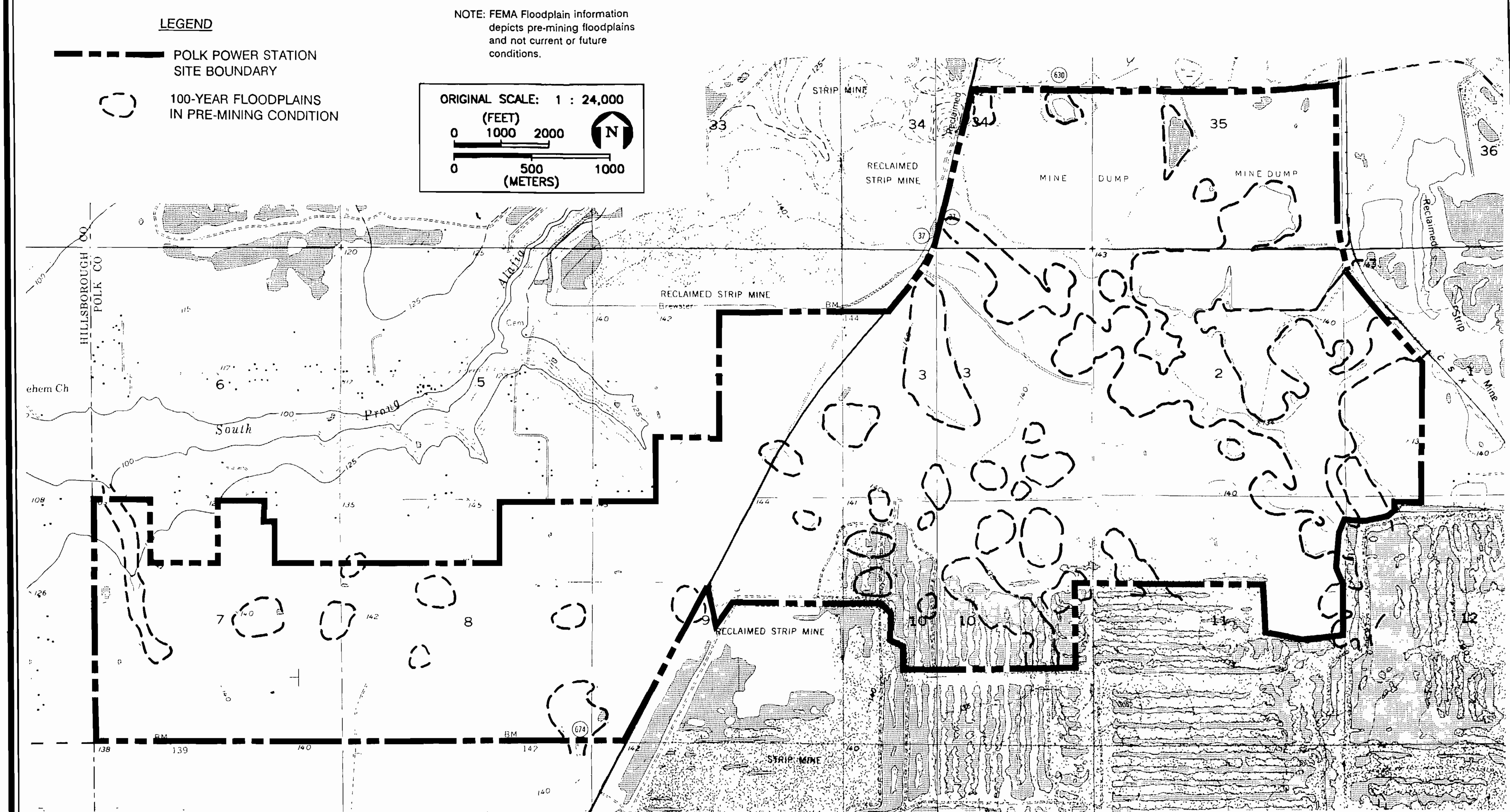

FIGURE 2.1.0-1.

POLK POWER STATION SITE WITH PRE-MINING 100-YEAR FLOODPLAINS

Source: USGS, 1987. FEMA, 1983. ECT, 1992.

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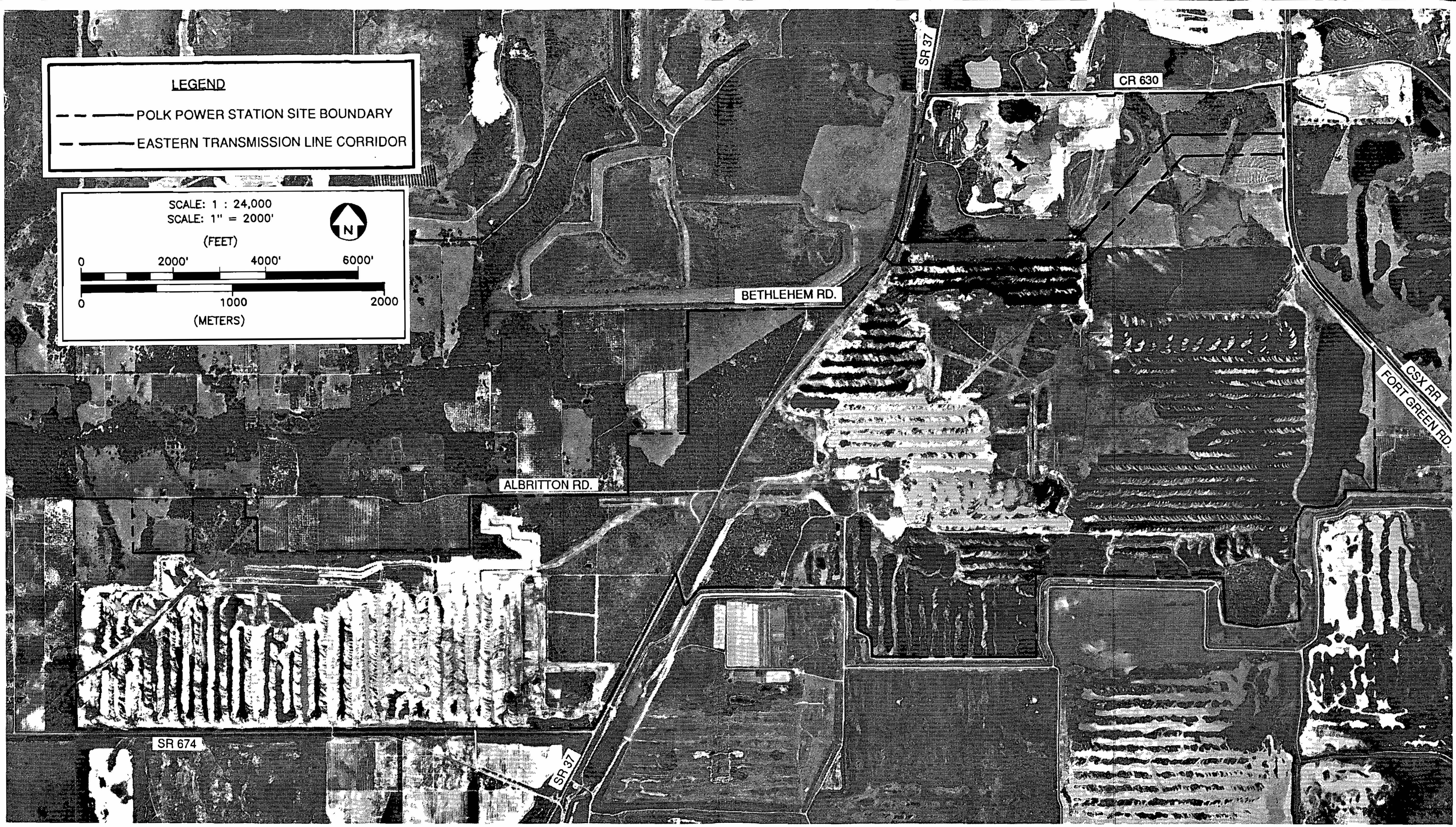

FIGURE 2.1.0-2.

POLK POWER STATION SITE AND ADJACENT LANDS

Sources: SRMC, 1992; ECT, 1992.

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The 100-year floodplains for the pre-mining conditions onsite have been documented by the Federal Emergency Management Agency (FEMA), and are shown on Figure 2.1.0-1. Only a small portion of the site area to the west of SR 37 is located within the 100-year floodplain. Under pre-mining conditions, portions of the site area to the east of SR 37 contained floodplains primarily associated with the headwaters of Little Payne Creek. As shown on the aerial photograph in Figure 2.1.0-2, the majority of these floodplains have been mined and are not currently connected to the nearby creek systems.

2.2 SOCIO-POLITICAL ENVIRONMENT

Certification of the Polk Power Station site requires the analysis of various land use and socioeconomic baseline conditions and projected impacts in accordance with guidelines established by FDER Form 17-1.211(1), F.A.C. and local government comprehensive plans, zoning ordinances, and development regulations. The various planning issues relevant to the Polk Power Station fall within the following generalized categories: existing land use, comprehensive plans and zoning ordinances, infrastructure and growth management, cultural resources, aesthetics, and socioeconomics.

Based on the preliminary evaluation of existing conditions, consistency with land development plans and ordinances, and sufficient capacity of public facilities, the Polk Power Station is a compatible development and should represent no significant negative impacts to the socio-political environment in the surrounding area.

2.2.1 SOCIOECONOMIC STUDY AREA

For purposes of this application, two study areas have been defined as being within the geographic influence of the Polk Power Station. As shown on Figure 2.2.1-1, the primary socioeconomic study area was defined to include Polk and Hillsborough Counties, based on the projected primary source of employment and commuting patterns. The secondary socioeconomic study area was defined to include Manatee and Hardee Counties, based on the location of the Polk Power Station relative to these county boundaries. Only small percentages of the workforce are expected to be drawn from Manatee and Hardee Counties, with correspondingly minimal impacts anticipated (see Sections 4.6 and 5.9). Therefore, certain socioeconomic characteristics (e.g., police protection) were described only for the primary and not the secondary study area.

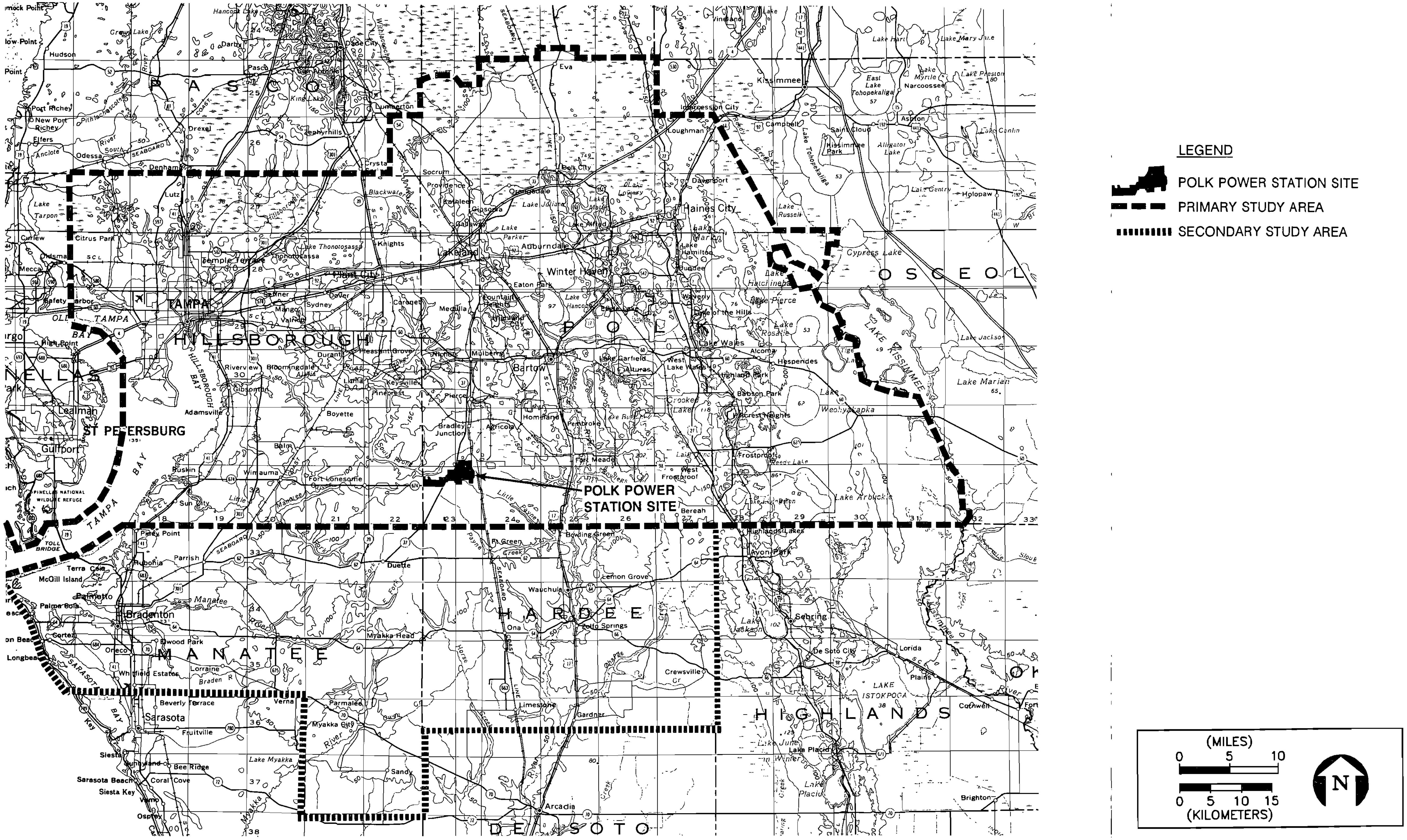

FIGURE 2.2.1-1.

PRIMARY AND SECONDARY SOCIOECONOMIC STUDY AREA

Sources: USGS, 1978; ECT, 1992.

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2.2.2 GOVERNMENTAL JURISDICTIONS

As shown on Figure 2.2.2-1, the Polk Power Station site lies entirely within Polk County, and borders the Polk/Hillsborough County line on the western property boundary. The Polk Power Station site is also within the jurisdiction of CFRPC and SWFWMD. No public lands are located directly adjacent to the Polk Power Station, or within a 5-mile radius of the site.

The nearest community is unincorporated Bradley Junction, which lies approximately 4.4 miles to the north of the power block and fuel storage area. As shown on Figure 1.4.2-1, the nearest incorporated municipality to the site is the City of Bowling Green, located approximately 10 miles to the southeast in Hardee County. The nearest incorporated areas in Polk County to the proposed site are the Cities of Fort Meade and Mulberry, which lie approximately 11 miles to the east and north of the site, respectively. Larger incorporated communities lying within a 45-minute commuting distance include: Bartow, approximately 13 miles northeast; Lakeland, approximately 17 miles north; Winter Haven, approximately 26 miles to the north-east; Plant City, approximately 19 miles to the northwest; Bradenton, approximately 35 miles to the southwest; and the Tampa urban area including Brandon, whose outer fringe is located approximately 23 miles west-northwest of the Polk Power Station site.

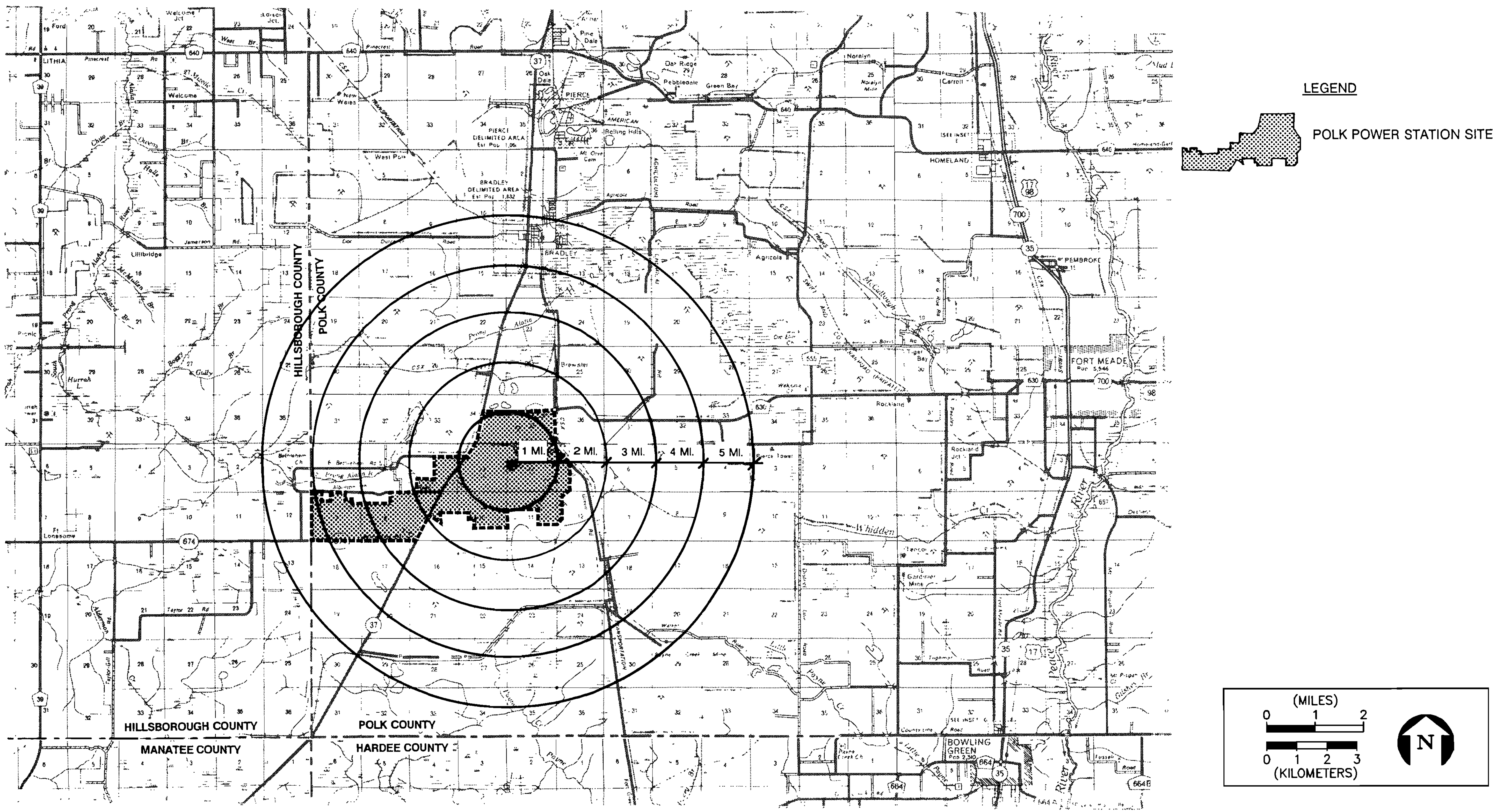

FIGURE 2.2.2-1.

GOVERNMENTAL JURISDICTIONS AND SPECIAL ENVIRONMENTAL RESOURCE AREAS WITHIN A 5-MILE RADIUS OF THE POLK POWER STATION

Sources: FDOT, 1987, 1988. ECT, 1992.

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2.2.3 ZONING AND LAND USE PLANS

Various state, regional, and local comprehensive plans and local zoning ordinances affect the Polk Power Station site. These include:

- State Comprehensive Plan,
- Central Florida Regional Policy Plan,
- Polk County Comprehensive Plan, and
- Polk County Zoning Ordinance.

A review of the compatibility of the Polk Power Station with the goals, objectives, and policies of these plans is contained in Section 4.6. A map of future land use categories found within a 5-mile radius of the Polk Power Station is shown in Figure 2.2.3-1, and a description of permitted uses within those categories is found in Table 2.2.3-1.

The entire Polk Power Station site is designated as Phosphate Mining (PM) in the Future Land Use Element of the Polk County Comprehensive Plan (1991). The construction and operation of Certified Electric Power Generating Facilities (power plants subject to certification under the FEPPSA) are permitted uses within this future land use category. County review and approval of such facilities described by the Comprehensive Plan will be implemented by a Conditional Use Permit (CUP). Site layout of the power block and fuel storage areas of Polk Power Station will satisfy locational, environmental, and development approval criteria contained in Section 2.114-C of the Comprehensive Plan.

The suitability of the Polk Power Station site within southwestern Polk County for the development of an electric generating facility is substantiated within Appendix B 2.100 of the Comprehensive Plan Future Land Use Support Document:

> "Southwest Polk County possesses several advantages *[for a power plant location]* relative to other locations:
>
> 1. This area is predominantly reclaimed phosphate mining lands that do not contain a large amount of environmentally sensitive land;

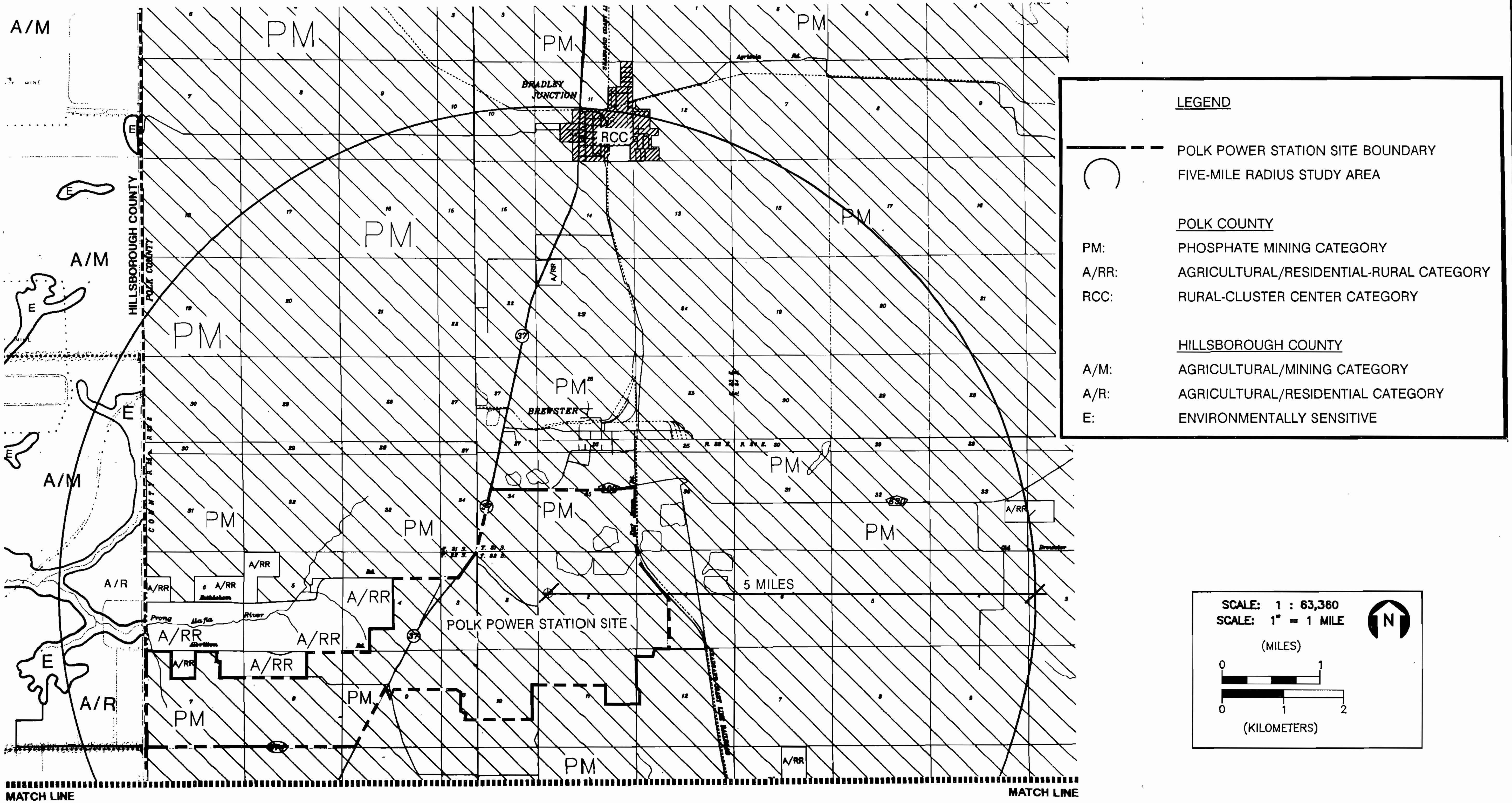

FIGURE 2.2.3-1.

FUTURE LAND USE CATEGORIES WITHIN A 5-MILE RADIUS OF THE POLK POWER STATION SITE (PAGE 1 OF 2)

Sources: Polk County, 1991. Hillsborough County, 1991. ECT, 1992.

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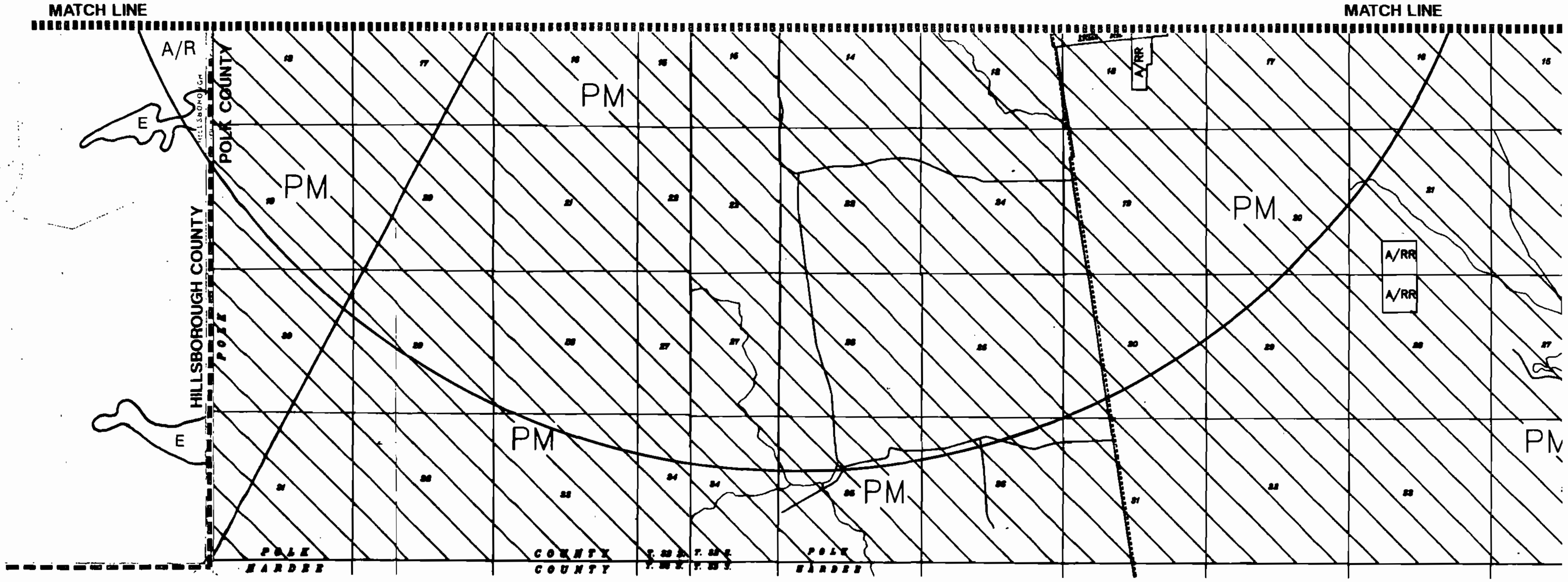

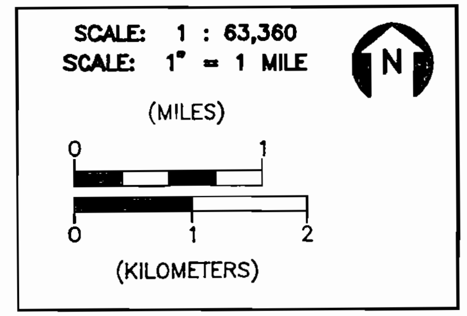

FIGURE 2.2.3-1.

FUTURE LAND USE CATEGORIES WITHIN A 5-MILE RADIUS OF THE POLK POWER STATION SITE
(PAGE 2 OF 2)
Sources: Polk County, 1991. Hillsborough County, 1991. ECT, 1992.

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Table 2.2.3-1. Future Land Use Categories and Zoning Districts Within a 5-Mile Radius of the Polk Power Station

Designation	Permitted Use
FUTURE LAND USE CATEGORIES	
Polk County	
PM	PHOSPHATE MINING--Phosphate mining and allied industries, land reclamation, agriculture, Certified Electric-Power Generating Facilities and ancillary facilities, Non-certified Electric-Power Generating Facilities and ancillary facilities, commercial hazardous waste treatment facilities, and other land uses with conditional approval that are compatible with phosphate extraction and processing
A/RR	AGRICULTURAL/RURAL RESIDENTIAL--Single-family homes at a density of one dwelling unit per 5 acres, associated farm labor residential uses, utility structures, and permitted uses within Rural Residential Development (RRD) and Rural Mixed-Use Development (RMD) categories
RCC	RURAL-CLUSTER CENTER--Single-family homes at or less than a density of two dwelling units per acre, commercial uses compatible with rural population needs for retail and personal services, non-residential uses concentrated at the center of the cluster (i.e., grocery, pharmacy, medical offices) based on location and minimum population support criteria
Hillsborough County	
A/M	AGRICULTURE/MINING--Residential units up to 0.05 dwelling units per acre, RV parks, adult congregate living facilities, rehabilitation centers, farm labor camps, rural scale neighborhood commercial uses, offices, and industrial uses related to agricultural uses, mining-related activities, agricultural uses
A/R	AGRICULTURE/RESIDENTIAL--Residential units up to 0.2 dwelling units per acre, RV parks, adult congregate living facilities, rehabilitation centers, farm labor camps, rural scale neighborhood commercial uses, offices, and industrial uses related to agricultural uses, mining-related activities, agricultural uses
E	ENVIRONMENTALLY SENSITIVE--Conservation

Table 2.2.3-1. Future Land Use Categories and Zoning Districts Within a 5-Mile Radius of the Polk Power Station (Continued, Page 2 of 3)

Designation	Permitted Use
ZONING DISTRICTS	
Polk County	
RC	RURAL CONSERVATION--Class III Agricultural Uses, parks and open space, nature preserves and wildlife refuges, single-family detached dwellings, foster homes, home occupations, Class I and II Essential Services, off-premises signs, other uses similar to or customarily accessory to those described
R-3	RESIDENCE--Residential dwellings not to exceed two stories, foster homes, customary accessory structures, parks and playgrounds, Class I and II Agricultural Uses, Class I and II Essential Services, home occupation
R-2	RESIDENCE--Single-family detached dwellings, foster homes, customary accessory structures, public parks and playgrounds, Class I and II Agricultural Services, Class I and II Essential Services, home occupations
R-1	RESIDENCE--Single-family detached dwellings, foster homes, customary accessory structures, public parks and playgrounds, Class I and II Agricultural Services, Class I and II Essential Services
SF-1M	SINGLE FAMILY-MIXED--Single-family detached dwellings, foster homes, customary accessory structures, parks and playgrounds, Class I Agricultural Uses, Class I and II Essential Services
C-2	MULTI-NEIGHBORHOOD COMMERCIAL--Retail establishments, personal service establishments, offices, clinics, home occupations, Class I and II Agricultural Uses, Class I and II Essential Services, restaurants, financial institutions, light repair services, day-care centers, multiple-family dwellings
C-3	REGIONAL COMMERCIAL--Retail establishments, personal service establishments, offices, clinics, Class I and II Agricultural Uses, Class I and II Essential Services, financial institutions, light repair services, day-care centers, multi-family structures, restaurants, transient lodging places, business services, enclosed storage and warehousing, health and service establishments, amusement and recreational services, cultural activities, radio and television stations, kennels, off-premises signs

Table 2.2.3-1. Future Land Use Categories and Zoning Districts Within a 5-Mile Radius of the Polk Power Station (Continued, Page 3 of 3)

Designation	Permitted Use
GI	GENERAL INDUSTRIAL--Manufacturing, processing, and packaging of commercial foods, textiles, furniture and fixtures, printing trades, chemically based products, ceramic goods, office equipment and machinery, electronics, light industrial products, transportation equipment, tobacco products, lumber and wood, paper and paper products, chemical processing, petroleum and rubber, stone and cement products, metal products, and offices and office parks, research, development, and testing centers, training schools, radio and television stations, repair services, Class I, II, and III Essential Services, salvage yards, stockyards, and aviation facilities
Hillsborough County	
M-1	INDUSTRIAL--Manufacturing or the operation of abrasive products, adhesives, asbestos products, blueing, boats and repairing, breweries and distilleries, brick products, calcimine, clay and stone products, commercial docks and marine facilities, concrete products, essential oils, flour, feed and grain packaging and storage, food products, fruit and vegetable processing, galvanizing and plating, glass products, inks, locomotive and railroad car building and repair, monument and architectural stone, paint and varnish products, paper and paperboard, pottery and porcelain products, radio and television stations, refractories, sand-lime products, stone products, wallboard products, and wire rope and cable
A	AGRICULTURE--Conventional single-family and mobile home residential development at a density not to exceed 1 dwelling unit per 10 acres, recreational uses, community residential home, agricultural uses
AA and AS-1*	ACREAGE AGRICULTURAL/AGRICULTURAL, SINGLE FAMILY--Conventional single-family and mobile home residential development at a density not to exceed 1 dwelling unit per acre, agricultural uses, animal hospitals, boat piers and non-commercial boat slips, youth camps, churches, congregate living facilities, country clubs, recreational uses, fish hatcheries, guest houses, libraries, mining, muck lots, sawmills, schools, radio and television stations, land preserves

Note: Permitted uses are summarized. Some uses require conformance with other applicable regulations.

* Zoning districts were promulgated in two different zoning ordinances but allow identical types of development in terms of density, intensity, and character.

Sources: Polk County, 1991, 1983.
Hillsborough County, 1989/1991, 1985/1990.
ECT, 1992.

2. This area of the county is relatively close to population centers along the west coast of the state;
3. This area of the county possesses a full complement of requisite infrastructure (rail spurs, adequate road network, plentiful water supply, etc.) for facilities such as this." (Polk County Comprehensive Plan, 1991).

Zoning districts located within a 5-mile radius of the Polk Power Station are shown in Figure 2.2.3-2, and a description of permitted uses within these districts are summarized in Table 2.2.3-1.

The Polk Power Station site is zoned Rural Conservation (RC), a district which provides for low-density, agricultural, and open space uses (Polk County Zoning Ordinance, 1983). This zoning district allows electric generating facilities as a conditional use as reviewed and approved through a CUP.

2.2.3.1 <u>Zoning</u>

The Polk Power Station is considered a Class III Essential Service by the Polk County Zoning Ordinance, and is an allowable conditional use within the Rural Conservation zoning district subject to submittal of a CUP and discretionary zoning approval by the Polk Board of County Commissioners (BOCC) upon review by the appropriate Polk County staff and subsequent recommendation made to the BOCC by the Polk County Zoning Advisory Board. The site's zoning district was previously shown in Figure 2.2.3-2, and copies of applicable portions of the Polk County Zoning Ordinance 83-2 are contained in Appendix 11.3.1.

On January 17, 1992, a Pre-Application Meeting for the CUP was held in the offices of the Polk County Planning Division between Polk County staff members and representatives of Tampa Electric Company. The CUP application was filed with Polk County Development Services on January 24, 1992, with Supplemental Information provided on February 12, 1992. This information was reviewed by Polk County staff and their comments were provided to representatives of Tampa Electric Company in an Impact Review Meeting held on March 16, 1992, at the Polk County

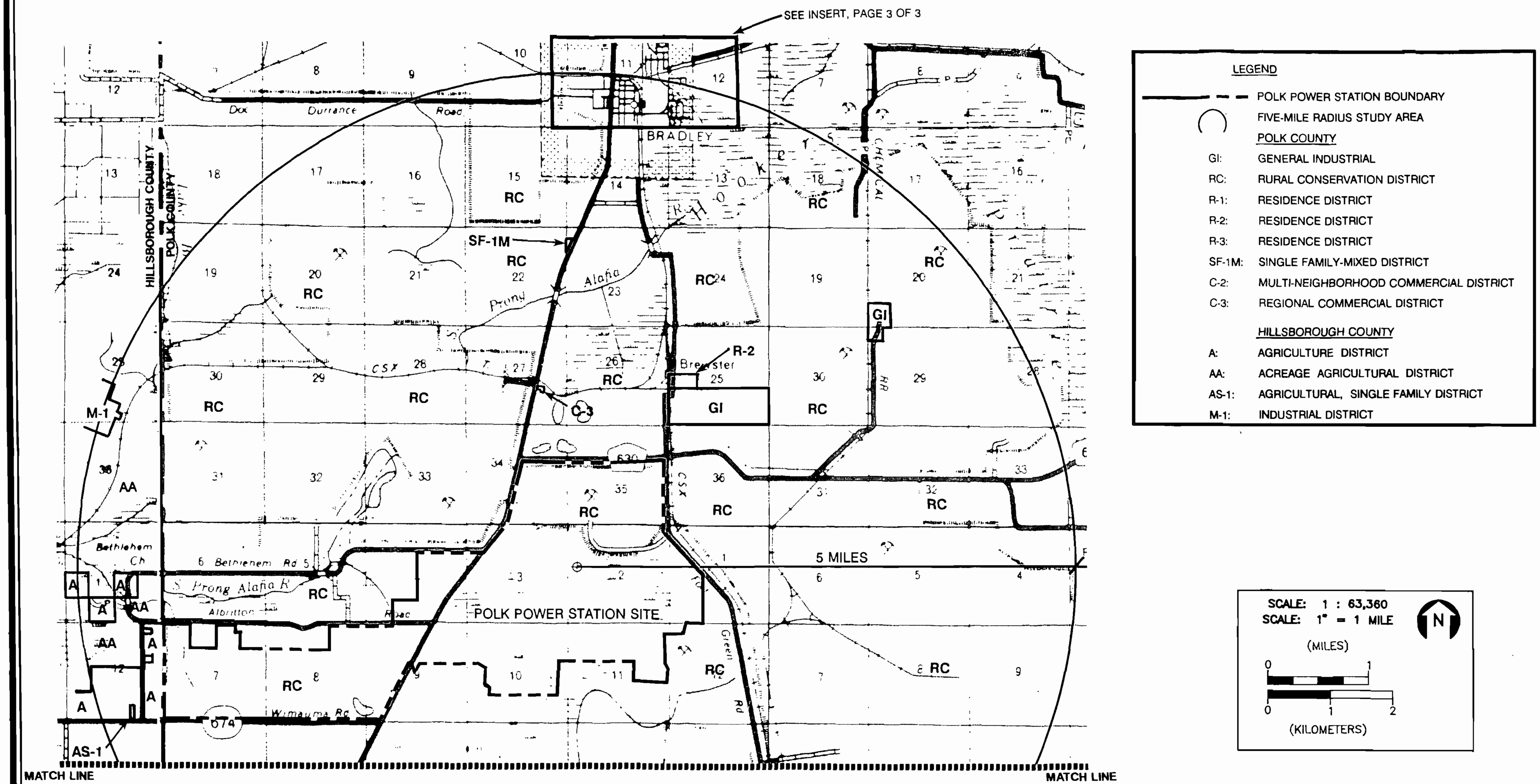

FIGURE 2.2.3-2.

ZONING DISTRICTS WITHIN A FIVE-MILE RADIUS OF THE POLK POWER STATION SITE (PAGE 1 OF 3)

Sources: FDOT, 1987, 1988. Polk County, 1991. Hillsborough County, 1989, 1991. ECT, 1992.

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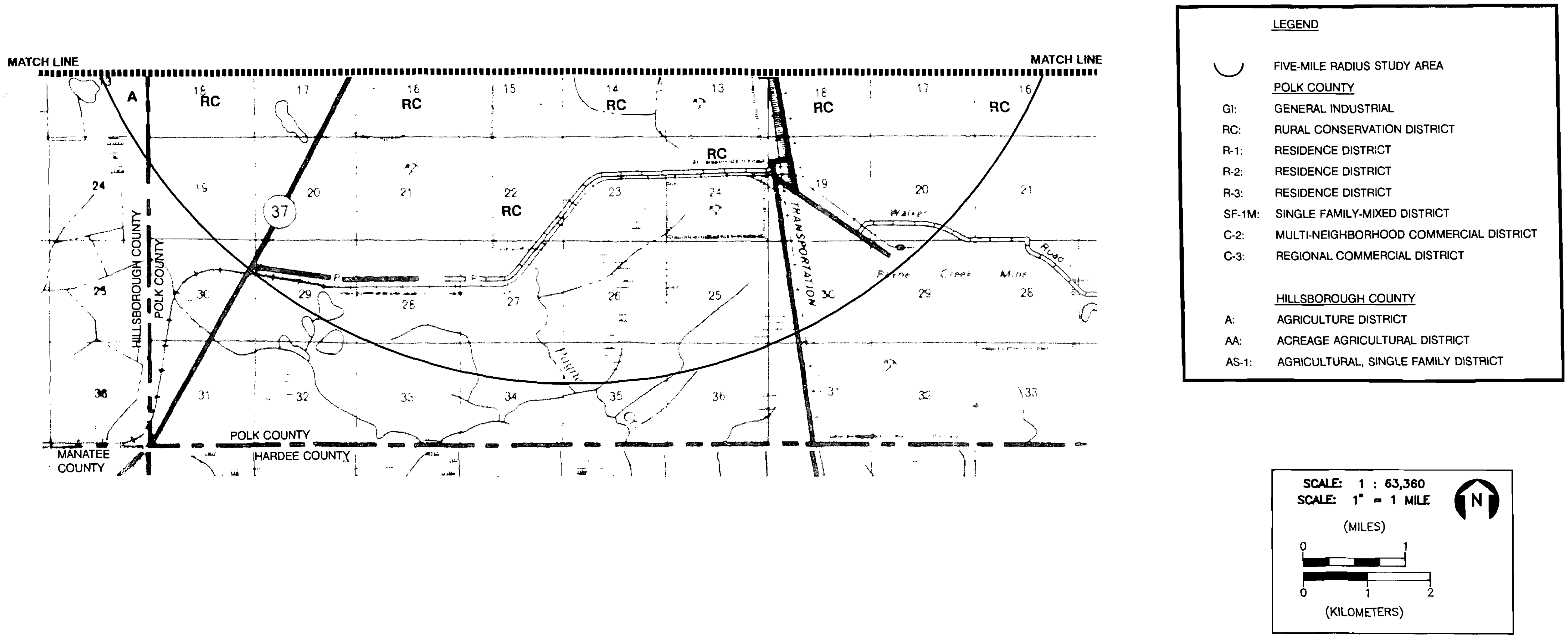

FIGURE 2.2.3-2.

ZONING DISTRICTS WITHIN A FIVE-MILE RADIUS OF THE POLK POWER STATION SITE (PAGE 2 OF 3)

Sources: FDOT, 1987, 1988. Polk County, 1991. Hillsborough County, 1989, 1991. ECT, 1992.

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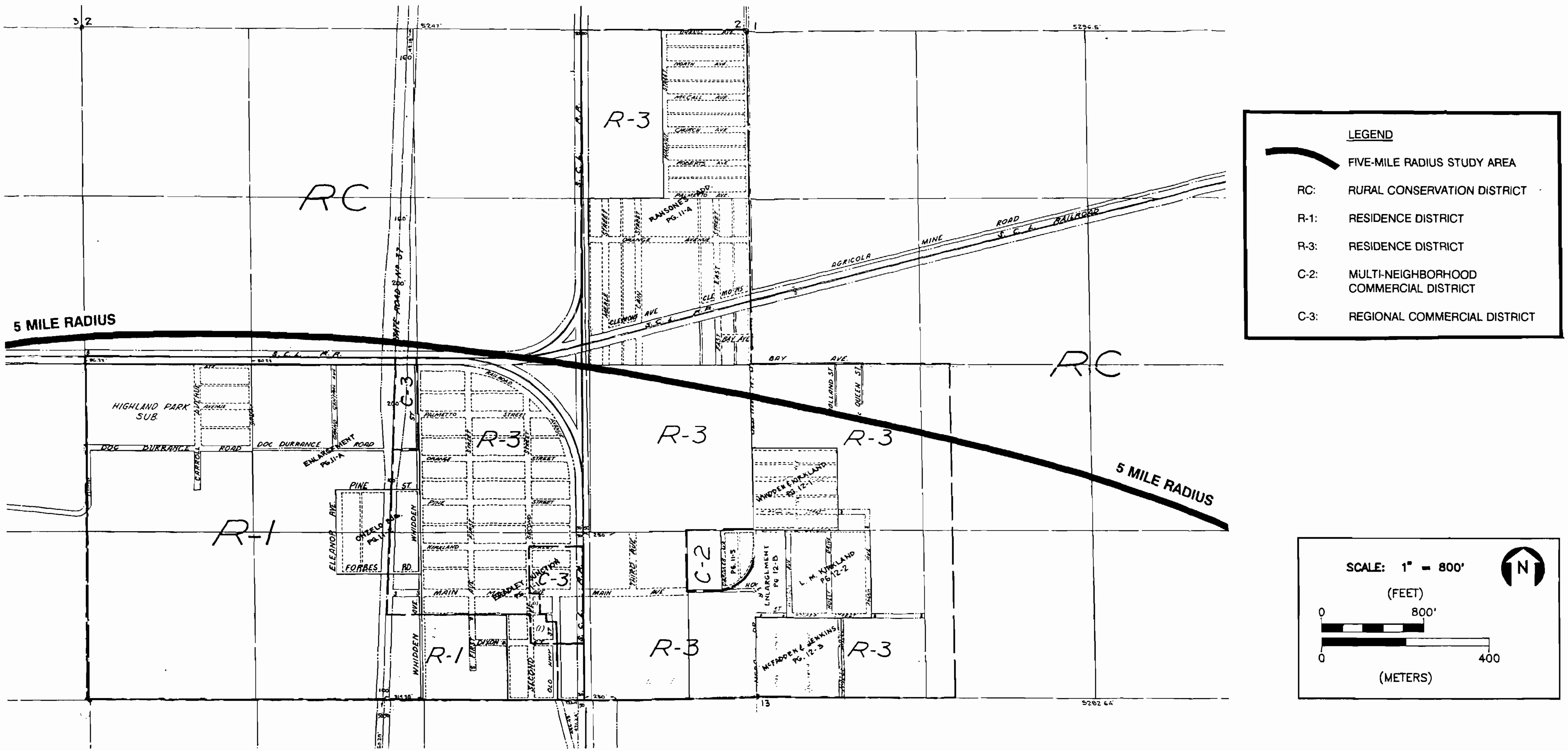

FIGURE 2.2.3-2.

ZONING DISTRICTS WITHIN A FIVE-MILE RADIUS OF THE POLK POWER STATION SITE (PAGE 3 OF 3)

Sources: FDOT, 1987, 1988. Polk County, 1991. Hillsborough County, 1989, 1991. ECT, 1992.

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Planning Division offices. Responses to comments generated during the Impact Review Meeting were submitted on March 30, 1992, and another review meeting was held on April 1, 1992. The Zoning Advisory Board recommended approval of the CUP on May 13, 1992, and the BOCC approved the CUP on June 2, 1992 (see Appendix 11.3.2).

2.2.3.2 Transportation

Based on review comments made by the Polk County Planning Division, Transportation Planning Section, regarding potential traffic impacts, the submittal of a Land Development Traffic Assessment was required. This assessment was used as the basis for the discussion of baseline traffic conditions and projected traffic impacts contained in this SCA, and a copy of the traffic assessment is contained in Appendix 11.6. A pre-application conference for the traffic assessment was held between Polk County staff and representatives of Tampa Electric Company on April 3, 1992, at the offices of the Polk County Planning Division. The traffic assessment was submitted on April 14, 1992.

2.2.3.3 Growth Management/Concurrency

The Polk Power Station is required to satisfy requirements governing adequate public infrastructure as contained in the Polk County Concurrency Management Ordinance 92-10. As this project is subject to FEPPSA (F.S., 403.501-403.519), the concurrency determination will be approved as part of the SCA process.

2.2.3.4 Land Use and Comprehensive Plan

The Polk Power Station is considered a Certified Electric-Power Generating Facility according to the Polk County Comprehensive Plan, and is a permitted use within the Phosphate Mining future land use category. The site's future land use designation, Phosphate Mining, was previously identified in Figure 2.2.3-1. Copies of applicable portions of the Polk County Comprehensive Plan, including objectives and policies cited in Section 4.6.2, are provided in Appendix 11.4.1

Since the Polk Power Station site falls within the appropriate future land use category, no additional land use or comprehensive planning permits or approvals relative to the Polk County Comprehensive Plan were required.

2.2.3.5 State and Regional Plans

The Polk Power Station furthers or is consistent with applicable goals and policies contained in the Central Florida Comprehensive Regional Policy Plan and State Comprehensive Plan, and as discussed in Section 4.6.2. Copies of these regional and state goals and policies are provided in Appendices 11.4.2 and 11.4.3, respectively.

2.2.4 DEMOGRAPHY AND ONGOING LAND USE

Based on the Polk Power Station site's location, the socioeconomic study region was determined to include Polk, Hillsborough, Manatee, and Hardee Counties. This socioeconomic study area was previously identified in Figure 2.2.1-1. Each of these counties have different socioeconomic characteristics which range from primarily urban in Hillsborough County, to primarily agricultural in Hardee County. Much of Polk County contains agricultural uses such as those surrounding the Polk Power Station; however, the Lakeland/Winter Haven Standard Metropolitan Statistical Area (SMSA) is becoming increasingly urbanized as a result of its proximity to Tampa and Orlando.

2.2.4.1 Population

The population of the State of Florida in general experienced extreme growth between 1970 and 1980, with a 43.5-percent change. This growth slowed during the decade of 1980 to 1990, to a rate of 32.8-percent change [Bureau of Economic and Business Research (BEBR), 1991]. This population growth is attributed primarily to in-migration of new residents. The population counts based on 1980 and 1990 U.S. Census data and population projections to the year 2010 are shown in Table 2.2.4-1. According to the 1990 census data, Hillsborough County is the fifth most populated county in the state with approximately 70.4 percent of the population growth between 1980 and 1990 due to net in-migration and a rate of 28.9-percent change. Polk County is the eighth most populous county in the state, according to 1990 census data, with 76.4 percent of the county's population growth between 1980 and 1990 due to net in-migration and a rate of 2.6-percent change. Manatee County is the sixteenth most populated county (based on 1990 census data), with 100 percent of the growth occurring between 1980 and 1990 due to net in-migration. Hardee County ranked fiftieth in population and experienced a decrease in population between 1980 and 1990, 100 percent of which was accounted for by out-migration (BEBR, 1991).

Another indicator of population growth and level of urbanization is the ratio of persons per square mile (persons/mi^2). For 1990, the statewide average was 239 per-

Table 2.2.4-1. Population Statistics: Census Counts and Medium Forecast Projections to 2010 (x 1,000)

	Census		Projections			
	1980	1990	1995	2000	2005	2010
State of Florida	9,746.3	12,937.9	14,451.8	15,728.4	16,946.4	18,096.6
Hardee County	20.4	19.5	19.9	20.2	20.6	21.0
Hillsborough County	646.9	834.1	917.7	987.2	1,053.6	1,116.9
Polk County	321.6	405.4	444.7	477.3	508.4	537.7
Manatee County	148.4	211.7	241.1	266.2	290.1	312.8

Sources: BEBR, 1991.
ECT, 1992.

sons/mi^2. In 1990, Hillsborough County ranked sixth highest in population density at 792 persons/mi^2, Manatee County ranked sixteenth highest at 283 persons/mi^2, Polk County ranked eighteenth highest at 222 persons/mi^2, and Hardee County ranked fiftieth highest at 31 persons/mi^2 (BEBR, 1991).

A decreasing trend in population characteristics within the state and socioeconomic study regions of the site is the average household size, which is largely attributable to single parent families and smaller family sizes. Of the four counties in the study region, Polk County experienced the largest decrease in average household size between 1980 and 1990, with a reduction from 2.70 to 2.53 persons per household, a 6.3-percent decrease. The average household size in Hillsborough County decreased from 2.66 persons to 2.51 persons, a 5.6-percent decrease. Hardee County experienced less of a decrease, from 3.05 to 2.95 persons per household, a 3.3-percent decrease. The Manatee County average household size decreased from 2.36 to 2.29 persons, a 3.0-percent decrease.

The population statistic of older persons relates directly to the state's attraction for retirees and can be expected to increase in the future. Additionally, as coastal areas are becoming built out and land prices become higher, the development of retirement centers has shifted towards the interior of the state. Based on 1980 and 1990 census figures, the percentage of population over 65 years old has increased in Polk County from 14.3 to 18.6 percent (30.1-percent change); in Hardee County from 11.4 to 15.2 percent (33.3-percent change); and increasing at a lower rate in Hillsborough County from 11.5 to 12.2 percent (6.1-percent change). In Manatee County, which has the highest percentage of persons over 65 years old of the subject four counties, showed an increase in percentage of persons over 65 years old from 27.1 to 28.1 percent (3.7-percent change) between 1980 and 1990 (BEBR, 1991). This illustrates a slowing trend in retirement aged population moving to Manatee and Hillsborough Counties relative to the other counties in the region of the Polk Power Station site.

2.2.4.2 Existing Land Use

The majority of the Polk Power Station site has been used for phosphate mining and is in a disturbed state. The existing land use features within this site include recently mined areas containing water-filled mine cuts between over-burden spoil piles, older mined, reclaimed and unreclaimed areas, and minimal areas which are undisturbed. More than 91 percent (i.e., approximately 3,970 acres) of the 4,348-acre site has been or will be impacted by mining activities.

Existing land uses found adjacent to the Polk Power Station site boundaries primarily include areas currently utilized for phosphate mining, and reclaimed and unreclaimed phosphate mining areas. From a land use perspective, those reclaimed areas currently function as agricultural land. Scattered residential areas are also found in some areas around the Polk Power Station site in addition to those lands utilized for current or past mining operations. Approximately 85 homes are located in areas west of SR 37 north of the Polk Power Station site along Albritton and Bethlehem Roads. The Alafia Bible Camp is also located along Bethlehem Road, and the Bethlehem Primitive Baptist Church and Cemetery are located at the western edge of Bethlehem Road. Approximately 14 additional homes are located 1.5 miles to the southeast of the Polk Power Station site, along Mills Road, and approximately 30 other homes are located west of the Polk Power Station site adjacent to SR 674.

The only other areas of residential and commercial development found within a 5-mile radius of the Polk Power Station are located approximately 4 miles to the north, in the unincorporated community of Bradley Junction.

Existing land use and land cover characteristics within the Polk Power Station site and the surrounding area within a 5-mile radius drawn from the IGCC unit exhaust stack are shown at a scale of 1 inch equals 2,000 ft (1:24,000 proportion scale) on Figure 2.2.4-1. The land use and land cover information was generated for SWFWMD by their consultant in late 1991, as classified according to the Florida Department of Transportation (FDOT) Land Use, Cover, and Forms Classification

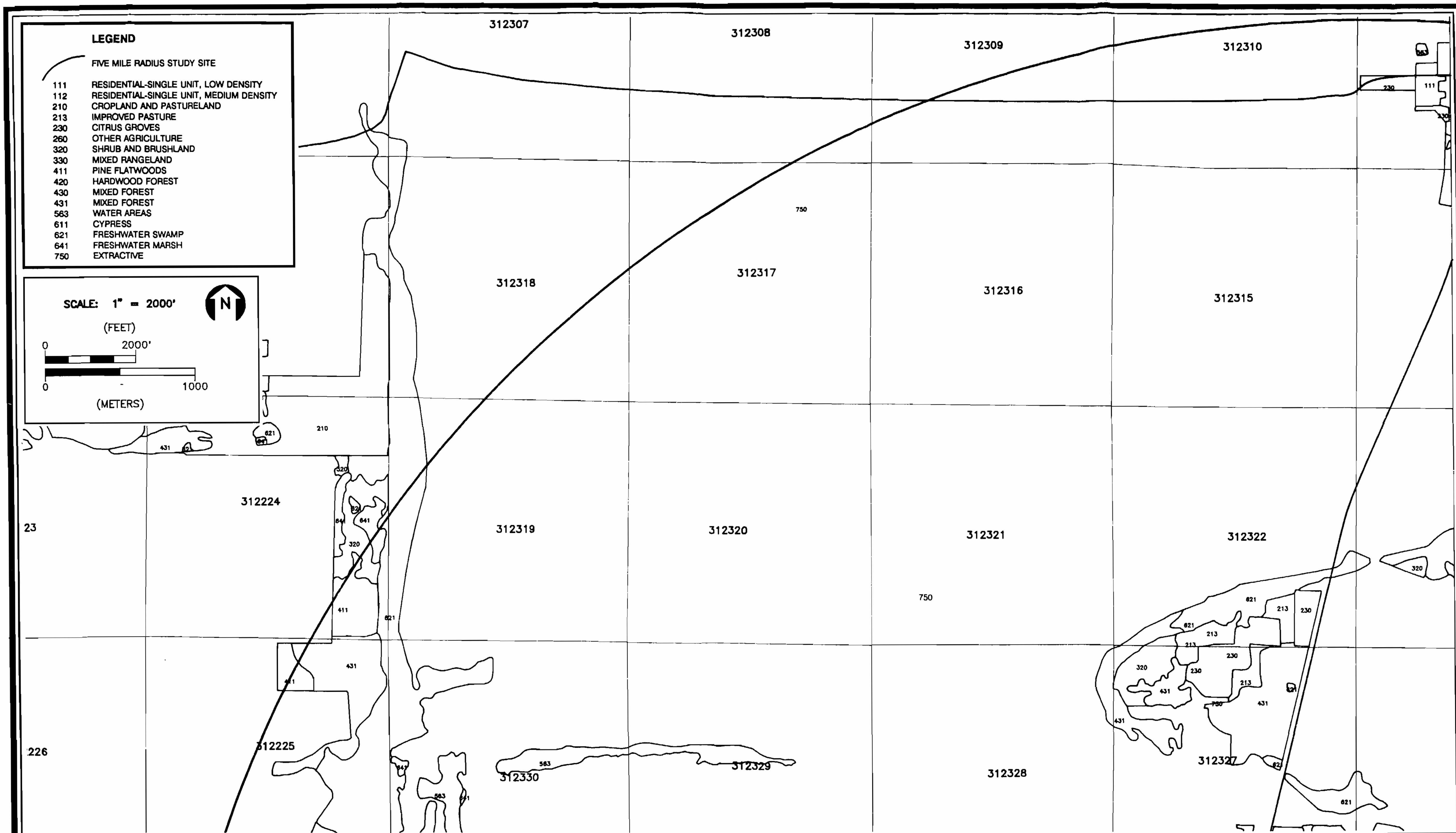

FIGURE 2.2.4-1.

LAND USE AND LAND COVER WITHIN A FIVE-MILE RADIUS OF THE POLK POWER STATION SITE (FIGURE 1 OF 6)

Sources: SWFWMD, 1991; ECT, 1992.

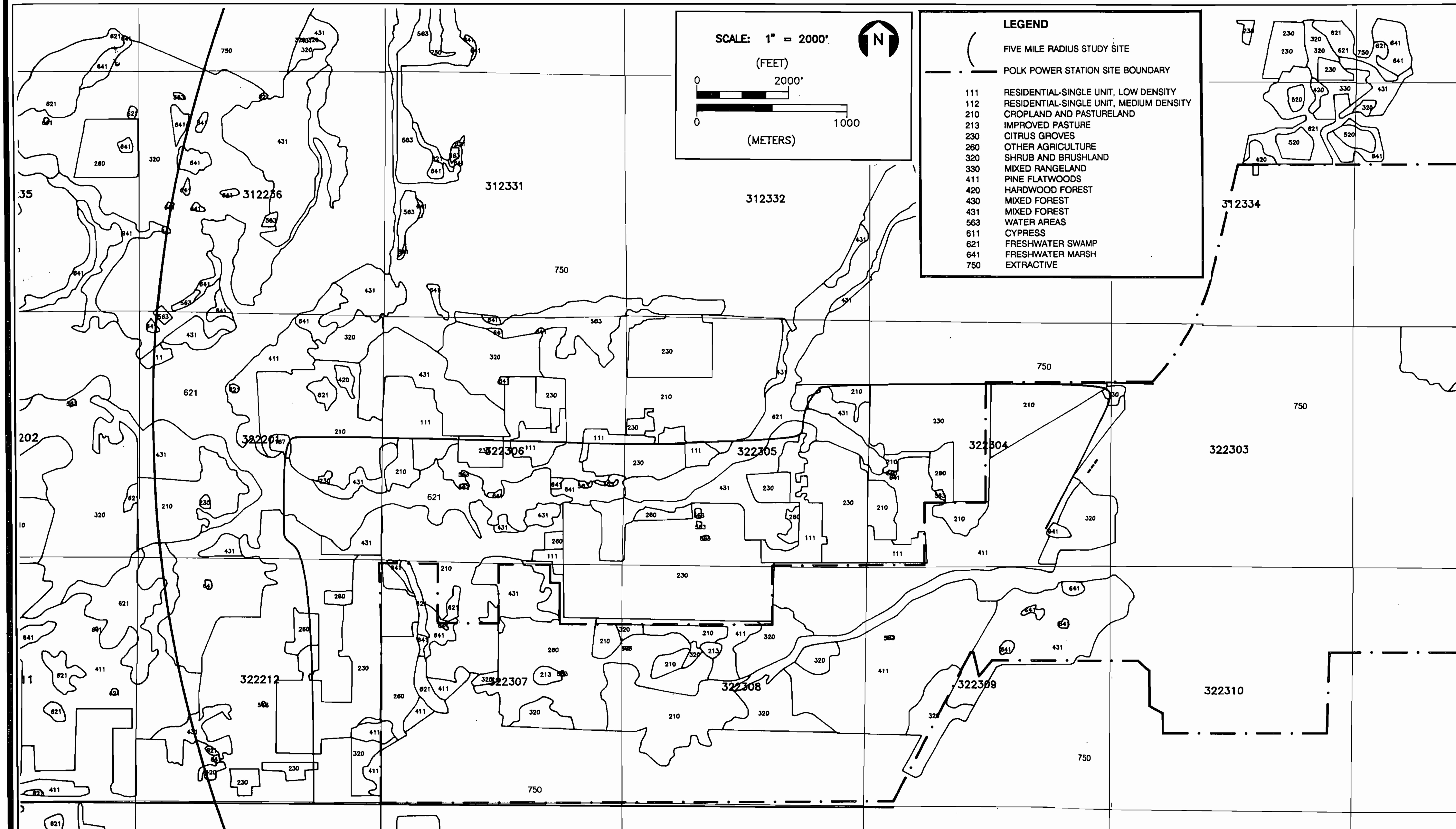

FIGURE 2.2.4-1.

LAND USE AND LAND COVER WITHIN A FIVE-MILE RADIUS OF THE POLK POWER STATION SITE (FIGURE 2 OF 6)

Sources: SWFWMD, 1991; ECT, 1992.

KEY:

1 OF 6	6 OF 6
2 OF 6	5 OF 6
3 OF 6	4 OF 6

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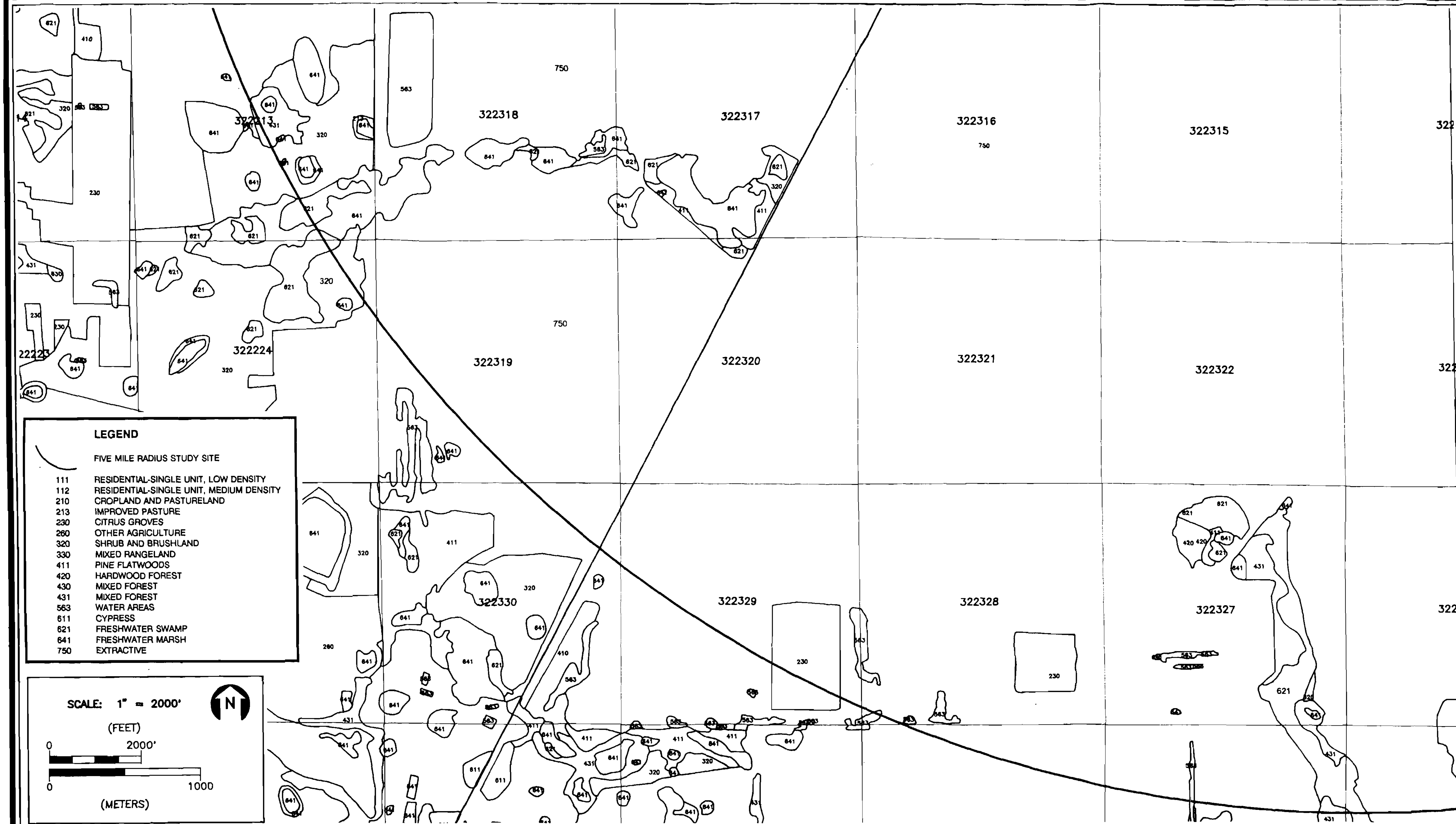

FIGURE 2.2.4-1.

LAND USE AND LAND COVER WITHIN A FIVE-MILE RADIUS OF THE POLK POWER STATION SITE (FIGURE 3 OF 6)

Sources: SWFWMD, 1991; ECT, 1992.

KEY:

1 OF 6	6 OF 6
2 OF 6	5 OF 6
3 OF 6	4 OF 6

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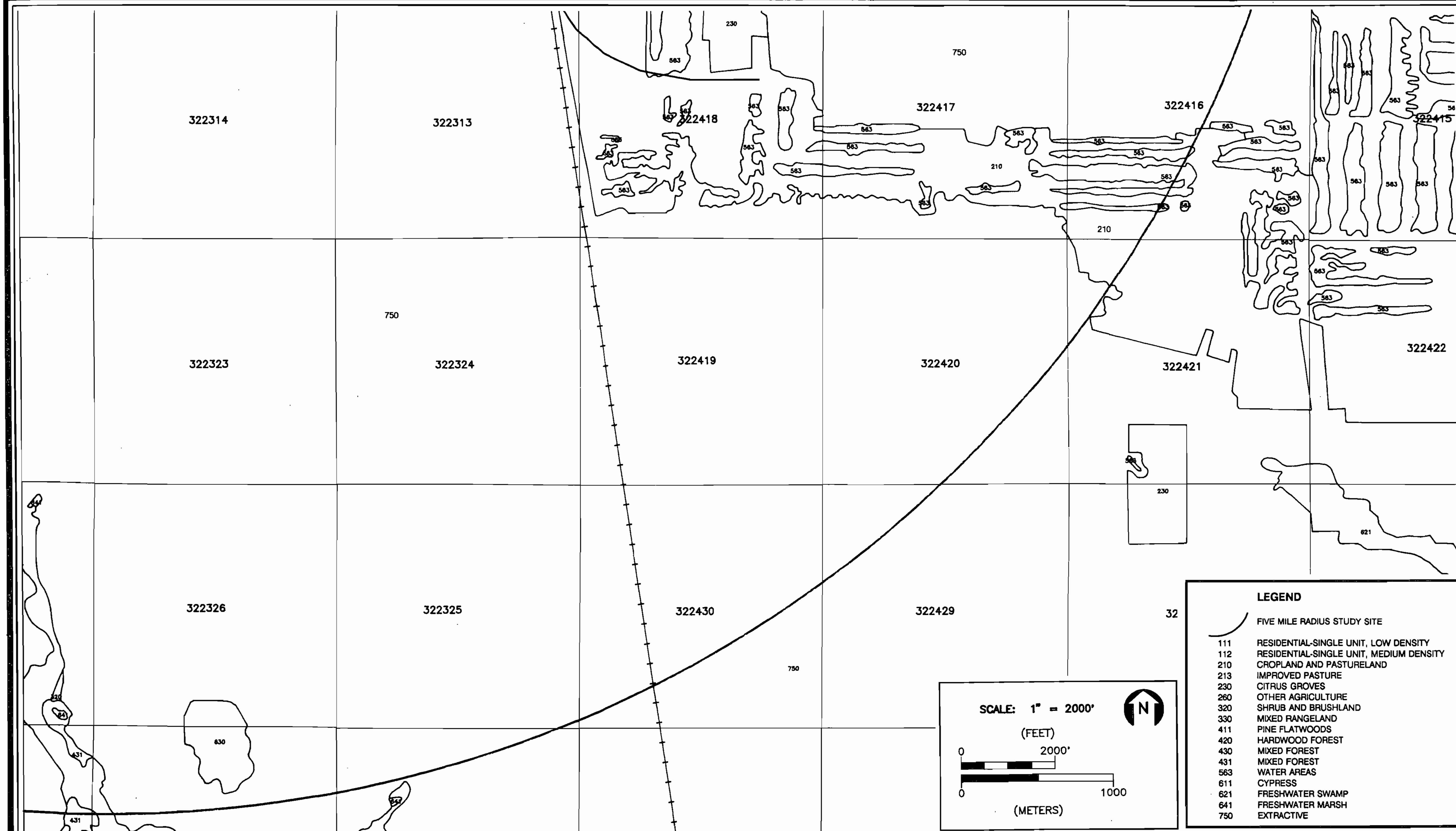

FIGURE 2.2.4-1.

LAND USE AND LAND COVER WITHIN A FIVE-MILE RADIUS OF THE POLK POWER STATION SITE (FIGURE 4 OF 6)

Sources: SWFWMD, 1991; ECT, 1992.

KEY:

1 OF 6	6 OF 6
2 OF 6	5 OF 6
3 OF 6	4 OF 6

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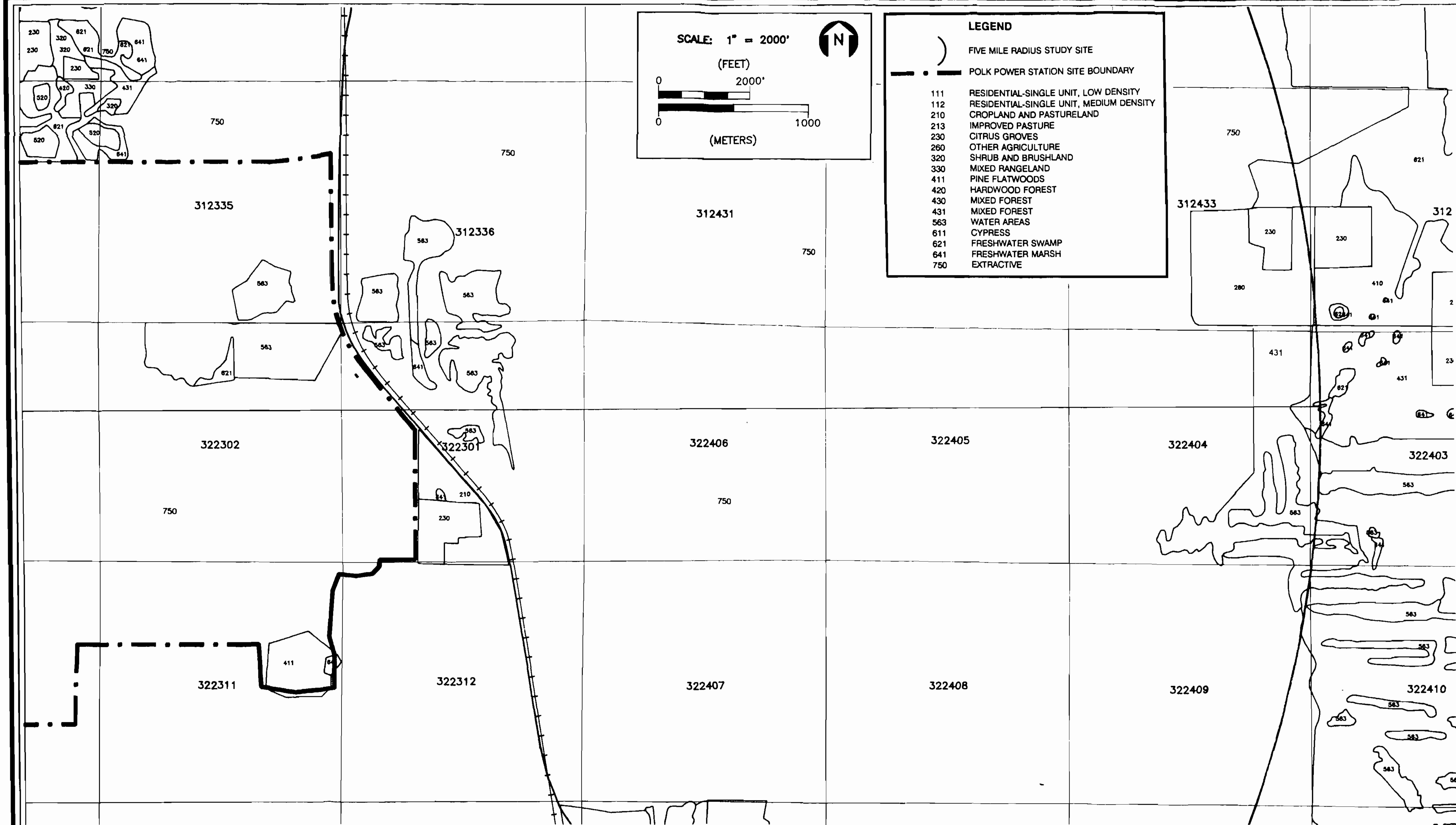

FIGURE 2.2.4-1.

LAND USE AND LAND COVER WITHIN A FIVE-MILE RADIUS OF THE POLK POWER STATION SITE (FIGURE 5 OF 6)

Sources: SWFWMD, 1991; ECT, 1992.

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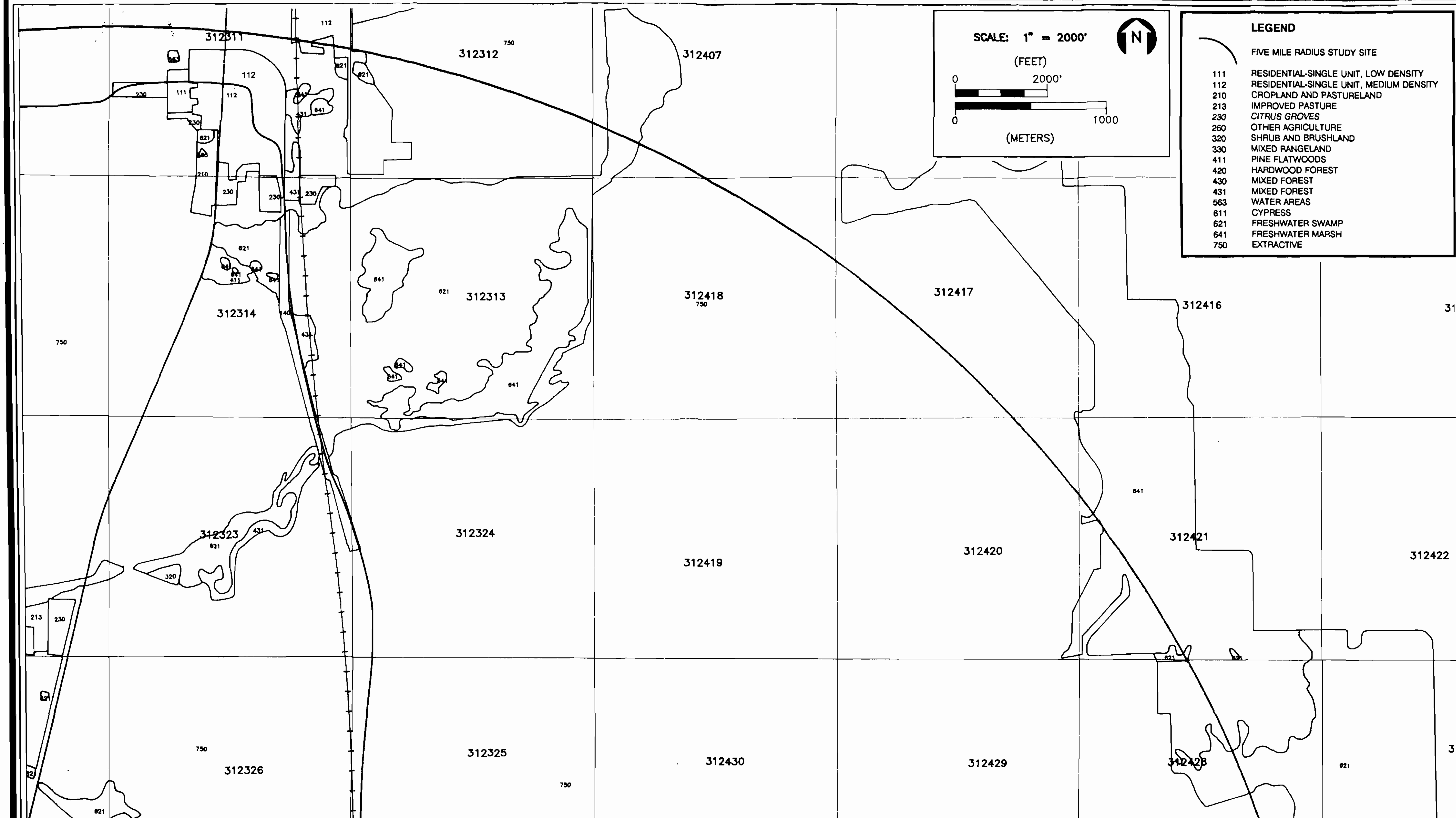

FIGURE 2.2.4-1.

LAND USE AND LAND COVER WITHIN A FIVE-MILE RADIUS OF THE POLK POWER STATION SITE (FIGURE 6 OF 6)

Sources: SWFWMD, 1991; ECT, 1992.

KEY: 1 OF 6, 2 OF 6, 3 OF 6, 4 OF 6, 5 OF 6, 6 OF 6

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System (FLUCFS). However, for consistency with other land use and land cover maps, the FLUCFS coding system was converted to the Florida Land Use and Cover Classification System (FLUCCS), to Level II and III detail, where available. The conversion and original SWFWMD data was reviewed and revised as appropriate to reflect current conditions.

As previously discussed, the predominant land form within the Polk Power Station site and adjacent 5-mile study area is 750, extractive. This land use is associated with the extraction of phosphate ore and includes mined areas, spoil banks, sand tailings areas, settling ponds, and reclaimed areas. Some of the mined-out areas that have been reclaimed are mapped as 750, but are being used as improved pasture.

Within the boundaries of the Polk Power Station, additional land use and land cover types include the following: 210, cropland and pastureland; 213, improved pasture; 260, other agriculture; 320, shrub and brushland; 411, pine flatwoods; 431, mixed forest; 563, other water areas; and 621, freshwater swamp. A more detailed description of onsite vegetation and land cover is contained in Section 2.3.5.

These land use and land cover types are also found within the 5-mile radius study area. In addition to the types previously discussed, the following land use and cover types are also located within the 5-mile radius study ares: 111, residential, single-unit, low-density (less than two dwelling units per acre); 112, residential, single-unit, medium density (two to six dwelling units per acre); 230, citrus groves; and 641, freshwater marsh.

Within the 5-mile radius study area, there are several beneficiation facilities associated with phosphate mining operations which include: the IMC Fertilizer Haynsworth mine located in portions of Sections 28 and 29 of Township 21 South, Range 23 East; the Mobil Chemical Company Big Four Mine located in Section 25 of Township 31 South, Range 22 East; and the Agrico Payne Creek Mine located in Section 29 of Township 32 South, Range 24 East. These facilities are considered part of the extractive (750) land use, and consequently, the actual areas have not been delineated separately.

Several land uses adjacent to the Polk Power Station site are known to exist based on the review of aerial photographs and field evaluations, but were not identified on SWFWMD maps. These areas include: a single-family residence (111) located east of the site in Section 1 of Township 32 South, Range 23 East within a parcel where a hazardous waste incinerator is proposed; a low-density residential (111) area located southeast of the site along Mills Road in Section 18 of Township 32 South, Range 24 East; low-density residential (111) areas located adjacent to the west of the site north of SR 674 in Section 12 of Township 32 South, Range 22 East; the Alafia Bible Camp, a religious/recreational facility (162/179) located along Bethlehem Road in Section 5 of Township 32 South, Range 23 East; and the Bethlehem Primitive Baptist Church (162) and Cemetery (167) located at the western edge of Bethlehem Road in Section 1 of Township 32 South, Range 22 East.

As previously described, the only areas containing urban (i.e., residential, commercial, and/or institutional) development within the 5-mile study area are residential areas along Albritton, Bethlehem, and Mills Roads, and mixed uses in Bradley Junction. While Bradley Junction is predominantly a residential area mapped as 112, residential, single-unit, medium-density uses (two to six dwelling units per acre), a few scattered commercial uses (i.e., convenience store and gas stations), a few institutional uses (i.e., post office, fire station, and churches), and a park (Bradley Junction Recreational Park) are contained in this unincorporated community.

The proposed northern transmission line corridor falls completely within the 5-mile study area; however, existing land use and land cover characteristics for the northern transmission line corridor are separately described in Section 6.1.2.2.

2.2.4.3 Proposed Development

The Polk Power Station will be compatible with industrial and utility projects proposed for the immediate region surrounding the Polk Power Station site. Two other electric generating facilities are proposed to be located in the immediate region surrounding the Polk Power Station. The Hardee Power Station is currently under construction on the Polk/Hardee County line, approximately 4 miles south of the Polk Power Station site. Florida Power Corporation also plans to build a 3,000-MW power plant approximately 5 miles east of the site.

2.2.5 EASEMENTS, TITLE, AGENCY WORKS

The Polk Power Station will be constructed on property that Tampa Electric Company intends to acquire prior to the commencement of construction.

2.2.6 REGIONAL SCENIC, CULTURAL, AND NATURAL LANDMARKS

The aesthetic character of lands within the boundaries of and adjacent to the Polk Power Station site are largely influenced by present and past mining operations. Because these lands have been previously disturbed by mining operations, there are virtually no areas of aesthetic or visual importance and significance. Additionally, no federal, state, regional, or local scenic, cultural, or natural landmarks are contained within the 5-mile study area surrounding the Polk Power Station site.

2.2.7 ARCHAEOLOGICAL AND HISTORIC SITES

The presence and potential presence of artifacts and/or structures which are of a cultural or historical value must be identified prior to the construction of the Polk Power Station. Correspondence from the Florida Division of Historical Resources (FDHR) stated that one prehistoric site had been previously recorded in the project area. This artifact is not eligible for listing on the National Register of Historic Places, nor is considered significant at a regional or local level. Therefore, no adverse impacts to significant cultural resources are proposed.

FDHR requested that a cultural resources assessment be conducted in Section 4 of Township 32 South, Range 23 East only (FDHR, 1991). A cultural resources assessment was conducted in 1991 in accordance with Chapter 403 and 167, F.S. and FDHR guidelines (see Appendix 11.5.3). No archaeological or historic sites and no historical structures were discovered or recorded as part of this assessment. It also indicated that no cultural resources eligible for nomination to the National Register of Historic Places will be impacted by the Polk Power Station project. FDHR concurred with the findings of the cultural resource assessment, and a copy of this confirmation letter is located in Appendix 11.5.1.

2.2.8 SOCIOECONOMICS AND PUBLIC SERVICES

The following discussion addresses the various infrastructure and growth management issues affected by the Polk Power Station site.

2.2.8.1 Social and Economic Characteristics

Employment and Income

The region's economic health can be largely determined by the level of unemployment. As shown in Table 2.2.8-1, Hillsborough and Manatee Counties have maintained unemployment rates below national and state levels in 1988, 1989, 1990, and 1991. Both Hardee and Polk Counties, conversely, have experienced unemployment rates at significantly higher levels than those of the nation and State of Florida, with high average annual unemployment rates in 1991 of 10.5 percent in Hardee County and 10.1 percent in Polk County (BEBR, 1991).

Although the average for the state was slightly higher than the national average, the 1988 and 1989 total per capita incomes in all four counties in the study region were below both state and national figures. For 1989, the state average per capita income was $17,739 compared to $17,555 nationally, while the averages were $16,640 in Manatee County, $16,292 for Hillsborough County, $14,455 for Polk County, and $13,542 for Hardee County, (BEBR, 1991).

Average Wage by Sector

Annual average employment and wage data for Hillsborough and Polk Counties in 1990 is shown in Table 2.2.8-2, illustrating significantly higher annual average employment and slightly higher average annual wages for Hillsborough County compared to Polk County. For Polk County in 1990, the highest average annual wage according to general service sector was also recorded for federal government employees, followed by state government, local government, and the private sector. The two highest average annual wages according to specific sector were services, transportation, communication, and public utilities employees of the federal government. The third highest average annual wage reported in Polk County for

Table 2.2.8-1. Percent Unemployment of Total Labor Force

	1988	1989	1990	1991
United States	5.4	5.2	5.4	6.7
Florida	5.0	5.6	5.9	7.3
Hardee County	7.7	8.7	10.9	10.5
Hillsborough County	4.5	4.9	4.8	6.0
Manatee County	4.3	4.6	4.6	5.8
Polk County	8.0	8.5	9.7	10.1

Sources: BEBR, 1991.
FDLES, 1992.
ECT, 1992.

Table 2.2.8-2. 1990 Average Annual Employment and Wages, Polk and Hillsborough Counties

Industry	Polk County		Hillsborough County	
	Average Annual Employment	Average* Annual Wage ($)	Average Annual Employment	Average* Annual Wage ($)
Total, all industries	157,062	19,399	440,584	21,120
Subtotal, private industry	134,074	19,106	378,681	20,587
Agriculture, forestry, and fishing	8,700	13,987	11,363	10,302
Mining	4,095	29,961	51	20,977
Construction	8,287	20,300	22,881	22,631
Manufacturing	22,352	23,740	40,059	23,148
Transportation, communication, and public utilities	7,032	23,128	25,412	28,789
Wholesale trade	7,935	23,120	33,794	29,742
Retail trade	34,337	13,467	80,683	12,694
Finance, insurance, and real estate	7,861	21,493	34,928	25,228
Services	33,420	19,159	139,424	20,005
Subtotal, federal government	1,482	28,124	10,892	30,578
Transportation, communication, and public utilities	1,019	30,674	4,194	32,193
Retail trade	0	0	448	10,550
Finance, insurance, and real estate	8	18,350	267	38,867
Services	1	35,162	3,013	30,032
Public administration	455	22,508	2,970	31,129
Subtotal, state government	3,904	22,360	13,611	21,582
Agriculture, forestry, and fishing	44	17,334	11	18,857
Construction	551	25,286	513	25,023
Services	242	24,401	8,059	21,201
Public administration	3,068	21,738	5,029	21,842
Subtotal, local government	17,602	20,238	37,346	23,581
Transportation, communication, and public utilities	0	0	656	26,619
Retail trade	9	10,304	74	12,075
Finance, insurance, and real estate	61	15,175	229	18,969
Services	10,859	19,310	22,585	23,050
Public administration	6,673	21,808	13,802	24,443

Note: Subtotals may not equal totals due to ES-202 Program disclosure editing and/or rounding.

*Total annual wages divided by annual average employment, rounded to nearest whole dollar.

Sources: FDLES, ES-202 Program, 1990.
ECT, 1992.

1990 was the mining sector of private industry [Florida Department of Labor and Employment Security (FDLES), 1991].

In Hillsborough County, the 1990 highest reported wage by general service sector was for federal government employees, followed by local government, state government, and private industry. Accordingly, the three highest annual average wages by specific sector were recorded within the federal government, and include in descending order: finance, insurance, and real estate; transportation, communications, and public utilities; and public administration. The highest private sector average annual wage reported in Hillsborough County for 1990 was in the wholesale trade sector (FDLES, 1991).

Employment Projections

Baseline year (1989) and projected (2000) employment figures by Standard Industrial Classification (SIC) code as prepared by FDLES, Bureau of Labor Market Information for Polk and Hillsborough Counties are shown on Table 2.2.8-3. For Polk County, an industry-wide increase of 45,674 employment positions at a 24.38-percent change is estimated to occur between 1989 and 2000, while employment increases in Hillsborough County are estimated at 155,107 positions at a 31.85-percent change. In Polk County, the two highest projected increases, both in terms of total positions and percent change, are services and wholesale and retail trade. The third highest projected increase in Polk County employment positions is in the manufacturing sector, while the third highest projected increase according to percent change is expected in the transportation and public utilities sector. In Hillsborough County, the three sectors with the highest projected increases, both in terms of total positions and percentage change are: services; wholesale and retail trade; and finance, insurance, and real estate (BEBR, 1991).

The discussion of employment projections was omitted for Hardee and Manatee Counties because data for these counties was combined with other counties, and was not available individually for these two counties.

Table 2.2.8-3. Baseline and Projected Employment by SIC Code, Polk and Hillsborough Counties

SIC Code	Occupation	Polk County: 1989 Annual Average Employment	Polk County: 2000 Projected Employment	Polk County: Change in Employment	Polk County: Percent Change	Hillsborough County: 1989 Annual Average Employment	Hillsborough County: 2000 Projected Employment	Hillsborough County: Change in Employment	Hillsborough County: Percent Change
000000	Total, all industries	187,378	233,052	45,674	24.38	487,023	642,130	155,107	31.85
100000	Agriculture, forestry, and fishing, total	15,904	19,959	4,055	25.50	15,472	17,735	2,263	14.63
200000	Mining, total	4,067	4,221	154	3.79	94	100	6	6.38
300000	Construction, total	8,989	10,602	1,613	17.94	25,762	30,613	4,851	18.83
400000	Manufacturing, total	23,004	27,909	4,905	21.32	40,483	48,065	7,582	18.73
500000	Transportation and public utilities	7,998	10,077	2,079	25.99	29,537	36,706	7,169	24.27
600000	Wholesale and retail trade, total	43,143	55,481	12,338	28.60	115,851	153,407	37,556	32.42
700000	Finance, insurance, and real estate, total	8,841	10,440	1,599	18.09	34,140	44,766	10,626	31.12
800000	Services, total	47,044	60,514	13,470	28.63	153,669	221,908	68,239	44.41
900000	Government, total	10,445	12,733	2,288	21.91	26,253	33,030	6,777	25.81
808800	Self-employed and unpaid family	17,943	21,116	3,173	17.68	45,762	55,800	10,038	21.94

Sources: FDLES, Division of Labor, Employment, and Training, Bureau of Labor Market Information, OES Matrix Industry Employment Estimates, 1991.
ECT, 1992.

Source of Income

The generalized 1989 source of income (labor versus proprietorship) for the four-county region is shown on Table 2.2.8-4. In Polk County, approximately 85.5 percent of total 1989 earnings were attributable to labor income (wage and salary disbursements combined with other labor income), with the remaining 14.5 percent derived from proprietorship. In Hillsborough County, the 1989 proportion was approximately 91.3 percent labor to 8.7 percent proprietorship, with the Hardee proportion approximately 66.6 percent labor to 33.4 percent proprietorship, and the Manatee proportion was approximately 83.1 percent labor to 16.9 percent proprietorship (BEBR, 1991).

Regional Economy

The general characteristics of the regional economy can be examined by reviewing local government revenue and expenditure per capita, distribution of the workforce, and distribution of land uses.

The relationship between revenue and expenditure per capita is an indicator of the cost of providing services and the economic stability of a local government. For 1989, Polk County reported $484.80 per capita for expenditures, compared to $498.40 per capita income from revenues, equating to a net surplus of $13.60 per capita in revenues. Hardee County also experienced a net surplus in per capita expenditures to revenues of $51.30. Both Hillsborough and Manatee Counties had net deficits in per capita revenues to expenditures with deficits of $64.60 and $34.60, respectively. Expenditures per capita were $484.80 for Polk County, $947.40 for Hillsborough County, $968.10 for Hardee County, and $1,099.00 in Manatee County, which suggests the costs of providing services and infrastructure improvements is lowest in Polk County. The total revenue per capita figures were $498.40 for Polk County, $882.80 for Hillsborough County, $1,019.40 for Hardee County, and $1,064.40 in Manatee County (BEBR, 1991).

Table 2.2.8-4. 1989 Source of Personal Income: Total Earnings on a Place-of-Work Basis by Major Type of Income

County	Total Earnings ($)	Wage and Salary Disbursements ($)	Other Labor Income ($)	Proprietor's Income Total ($)	Proprietor's Income Farm ($)	Proprietor's Income Nonfarm* ($)
Hardee	152,899	93,898	8,000	51,001	33,931	17,070
Hillsborough	11,161,518	9,358,268	833,259	969,991	145,172	824,819
Manatee	1,675,766	1,271,945	120,087	283,734	89,760	193,974
Polk	3,907,791	3,053,983	287,426	566,382	161,910	404,472

*Excludes limited partners.

Sources: BEBR, 1991.
ECT, 1992.

In terms of the distribution of the workforce in the four counties, Polk, Hillsborough, and Manatee Counties had the highest employment in the service sector, followed by retail and manufacturing, as the top three bases of employment. Hardee County had the agricultural sector as highest, followed then by service and retail sectors (BEBR, 1991).

All four counties have different distributions of land uses based on value of land according to land use. Land uses in Hardee County were primarily agricultural (45.5 percent), followed by residential (30.6 percent), and industrial (7.4 percent). Manatee, Hillsborough, and Polk Counties had residential uses as the highest percentage of land allocation, at 64.4, 59.8, and 53.9 percent, respectively. Hillsborough County had commercial uses as next highest, at 17.9 percent, with miscellaneous third highest, at 12.1 percent. Similarly, Manatee County had commercial as next highest at 14.6 percent, with miscellaneous uses third highest at 9.7 percent of the total land uses. This relationship was reversed in Polk County, with a close distribution of 15.9 percent miscellaneous and 15.8 percent commercial. The miscellaneous category includes utilities, mining, recreational, government, and other lands not categorized as residential, commercial, industrial, agricultural, or institutional (BEBR, 1991).

Housing

Information describing 1990 housing stock as based on census data for the four-county study area is shown on Table 2.2.8-5, which identifies 677,151 total housing units, 98,859 total vacant units, and 34,651 vacant seasonal or recreational units within the four-county region. This number of available units is large enough to easily accommodate the minimal additional demand anticipated for employees of the Polk Power Station (see Sections 4.6.7 and 5.9).

Hillsborough County had a significantly higher number of total 1990 housing units, at 367,740, or approximately 54 percent of the four-county total. Polk County had the second highest number of total housing units at 186,225, approximately half as many as in Hillsborough County, and approximately 28 percent of the four-county

Table 2.2.8-5. 1990 Housing Stock

County	Total Units	Total Vacant Units	Vacant Seasonal or Recreational Units*	Vacancy Rate, Home-owner† (%)	Vacancy Rate, Rental† (%)	Occupied Homeowner Units**	Occupied Rental Units**
Hardee	7,941	1,550	664	1.6	15.5	4,844	1,547
Hillsborough	367,740	42,868	6,188	3.6	13.5	204,966	119,906
Manatee	115,245	24,185	14,669	3.7	11.8	64,574	26,486
Polk	186,225	30,256	13,130	3.3	12.6	109,885	46,084
Total/ Average	677,151	98,859	34,651	3.05††	13.35††	384,269	194,023

* Vacant units intended for use only in certain seasons, for recreational or other occasional use throughout the year.

† Percentage relationship of vacant units for sale to total homeowners inventory, or for rent to total rental inventory.

** Usual place of residence of the person or group of persons living in the unit at the time of census enumeration.

†† Arithmetic average of the four counties.

Sources: BEBR, 1991.
ECT, 1992.

total. Manatee County had the third highest number of total housing units, at 115,245, approximately 17 percent; Hardee County contains a total of 7,941 housing units, approximately 1 percent of the four-county total.

In terms of total vacant units, Hillsborough County contained the highest number (42,868 units) and greatest proportion, at approximately 43 percent of the four-county total. For these four counties, the next highest number of total vacant units was reported in Polk County (30,256 units, approximately 30 percent of the total), followed by Manatee (24,185 units, approximately 24 percent) and Hardee (1,550 units, approximately 3 percent). The highest number of vacant seasonal units was reported in Manatee County, followed by Polk, Hillsborough, and Hardee Counties.

The highest homeowner vacancy rate of the four counties was identified in Manatee County (3.7 percent), followed by Hillsborough (3.6 percent), and Polk (3.3 percent), with Hardee County having a relatively low homeowner vacancy rate of 1.6 percent. These homeowner vacancy rates suggest that adequate housing stock exists to provide for any minimal housing demands associated with the Polk Power Station operational workforce (see Section 5.9).

The highest 1990 rental vacancy rate within the four-county study area was reported in Hardee County (15.5 percent), followed by Hillsborough (13.5 percent), Polk (12.6 percent), and Manatee (11.8 percent). These rental vacancy rates indicate sufficient supply of rental housing available to adequately support those temporary housing demands associated with the Polk Power Station construction workforce (see Section 4.6).

County-wide building permit activity for 1991 as recorded by BEBR is shown in Table 2.2.8-6, illustrating that a significantly higher number of construction permits were issued in Hillsborough County compared to other counties in the four-county study area. A total of 3,164 new single-family homes were permitted in Hillsborough County, representing approximately 51 percent of the four-county total. Of the

Table 2.2.8-6. 1991 Building Permit Activity

County	Total Value (x $1,000) ($)	Value of All Housekeeping Residential Units (x $1,000) ($)	Number of Single-Family Homes	Number of Housing Units in Multifamily Structures	Average Unit Cost, Combined Single-Family and Multifamily* ($)	Value of Non-Housekeeping Residential (x $1,000) ($)	Value of Non-Residential (x $1,000) ($)
Hardee	12,573	3,328	51	0	65,225	0	6,889
Hillsborough	622,086	318,308	3,164	1,243	72,228	2,308	182,221
Manatee	157,195	83,280	1,012	801	45,935	0	6,194
Polk	234,159	141,812	1,988	598	54,838	873	6,194
Total/average	1,026,013	136,682†	6,215	2,642	59,557†	3,181	201,498

*Rounded to the nearest whole dollar.
†Arithmetic average of four counties.

Sources: BEBR, Building Permit Activity in Florida, Preliminary Annual 1991, Volume XXXVII, No. 13, February, 1992.
ECT, 1992.

remaining three counties, Polk County issued the second highest single-family building permits, at 1,988 units, or approximately 32 percent of the study area total, followed by Manatee County (1,012 units at approximately 16 percent), with Hardee County reporting 51 single-family residential permits, at approximately 1 percent of the four-county total.

The average housing unit cost for combined single-family and multifamily buildings averaged $59,557 for the four-county study area. Hillsborough County had recorded the highest housing unit cost at $72,228, followed by Hardee at $65,255, Polk at $54,838, and Manatee at $45,935 (BEBR, 1992). The per unit housing costs for Hardee County described in Table 2.2.8-6 are disproportionately high in comparison to other counties because only single-family and not multifamily residences are accounted for. Since the value of multifamily structures is generally lower than their single-family counterparts, a higher proportion of multifamily units would have been expected to result in a lower average per unit housing cost. For example, in Manatee County, almost half of the permitted residences were in multifamily units, accounting for the low average housing cost of $45,938.

The distribution of new homes permitted for construction in 1991 as reported by BEBR is shown in Table 2.2.8-7, which depicts the trend of a higher proportion of new home construction in unincorporated areas, rather than within municipalities. This trend is accounted for by the relatively large size of unincorporated areas compared to municipalities, and to some extent, by growth occurring in unincorporated areas such as Brandon in Hillsborough County. For the municipalities, the largest cities had the largest proportion of new home construction permits. The cities with the largest number of single-family building permits include the following as listed in descending order: Tampa, Lakeland, Plant City, Bradenton, and Winter Haven.

The four closest municipalities to the Polk Power Station, Bowling Green, Fort Meade, Mulberry, and Bartow, had a combined total of 27 single-family new home construction permits in 1991. The majority, or 19 of these 27 residences, were

Table 2.2.8-7. Distribution of New Single-Family Home Building Permits

County/City	Number of Single-Family Home Building Permits	Percentage of County Total
Hardee County Total	51	100
Bowling Green	2	3.9
Wauchula	8	15.7
Zolfo Springs	7	13.7
Unincorporated area	34	66.7
Hillsborough County Total	3,164	100
Plant City	163	5.2
Tampa	459	14.5
Temple Terrace	19	0.6
Unincorporated area	2,523	79.7
Manatee County Total	1,012	100
Anna Maria	25	2.5
Bradenton	139	13.7
Bradenton Beach	2	0.1
Homes Beach	32	3.2
Longboat Key	22	2.2
Palmetto	32	3.2
Unincorporated area	760	75.1
Polk County Total	1,988	100
Auburndale	31	1.6
Bartow	19	1.0
Davenport	8	0.4
Dundee	3	0.2
Eagle Lake	2	0.1
Fort Meade	6	0.3
Frostproof	12	0.6
Haines City	27	1.3
Lake Alfred	6	0.3
Lake Hamilton	2	0.1
Lakeland	200	10.1
Lake Wales	30	1.5
Mulberry	0	0.0
Polk City	21	1.0
Winter Haven	98	4.9
Unincorporated area	1,523	76.6

Sources: BEBR Building Permit Activity in Florida, Preliminary Annual 1991, Volume XXXVII, No. 13, February, 1992.
ECT, 1992.

permitted in Bartow, with six permits issued in Fort Meade, two permits recorded in Bowling Green, and none in Mulberry (BEBR, 1992). This low level of building activity confirms that these areas are not high-growth residential areas and are experiencing no significant residential development pressures.

2.2.8.2 Public Services and Utilities

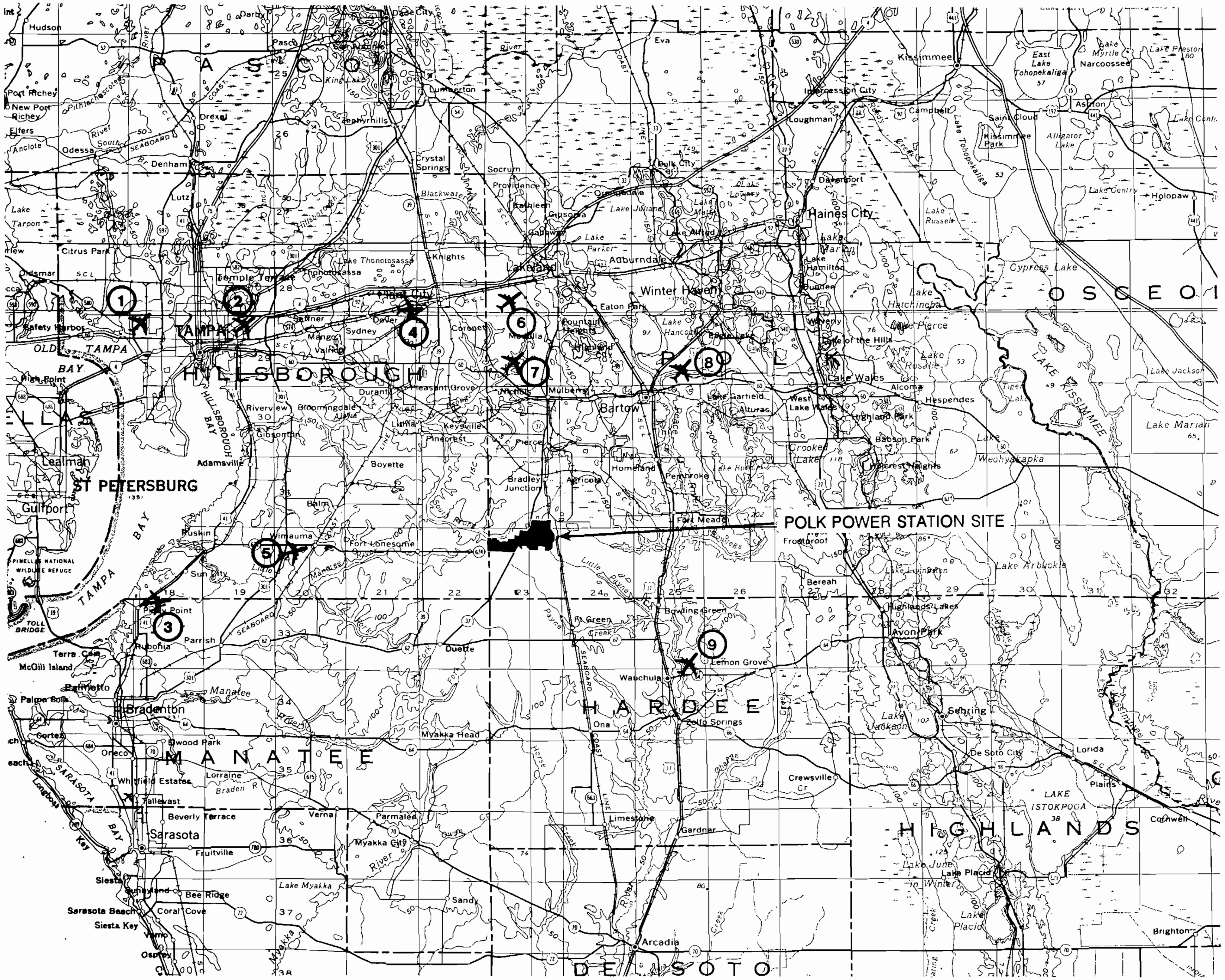
Transportation Facilities

Transportation facilities servicing the Polk Power Station include roadways and rail. No public or private airport facilities are located within a 5-mile radius of the Polk Power Station site. Regional transportation facilities are shown on Figure 2.2.8-1.

Major roadways within a 5-mile radius of the Polk Power Station include SR 37, SR 674, and CR 630. Those within a 10-mile radius include CR 640, CR 39, and SR 62, while major roadways outside of a 10-mile radius include SR 60, U.S. Highway 17, U.S. Highway 98, Interstate 4, and Interstate 75.

The Polk Power Station is provided with direct rail access by the CSX Railroad via an existing north-south rail line adjacent to the east along Fort Green Road. Additional regional CSX rail lines traverse to the northwest from Bradley Junction through unincorporated Keysville in Hillsborough County through unincorporated Brandon west to Tampa, and east from Brandon to northeast through Lakeland and Winter Haven.

As previously stated, no public or private aviation facilities are located within a 5-mile radius of the Polk Power Station. The nearest private airports to the Polk Power Station power block include the Circle K Airport, approximately 14.5 miles to the north, and the Anderson Airport, approximately 18 miles to the west along SR 674 in Hillsborough County. The closest public airports to the Polk Power Station power block area include: the Wauchula Airport approximately 17.5 miles to the southeast, Lakeland Municipal Airport approximately 18 miles to the north, and



LEGEND

POLK POWER STATION SITE

1. TAMPA INTERNATIONAL AIRPORT
2. VANDENBURG AIRPORT
3. MANATEE COUNTY AIRPORT
4. PLANT CITY MUNICIPAL AIRPORT
5. ANDERSON AIRPORT (PRIVATE)
6. LAKELAND MUNICIPAL AIRPORT
7. CIRCLE K AIRPORT (PRIVATE)
8. BARTOW MUNICIPAL AIRPORT
9. WAUCHULA MUNICIPAL AIRPORT

SCALE: 1 : 633,600
SCALE: 1" = 10 MILES

(MILES) 0 10

0 10 20 (KILOMETERS)

N

FIGURE 2.2.8-1.
TRANSPORTATION FACILITIES

Source: USGS, 1978; ECT, 1992.

TAMPA ELECTRIC
A TECO ENERGY COMPANY

POLK POWER STATION

Bartow Municipal Airport approximately 19.5 miles to the northeast. Tampa International Airport lies more than 37 miles to the west-northwest.

Traffic Volumes

The Polk Power Station site is bounded by SR 37 to the west, CR 630 to the north, SR 674/Wimauma Road to the south, and partially by Fort Green Road to the east. SR 37 is a two-lane highway classified as a Minor Arterial which currently functions at level of service (LOS) B from the Manatee County line to CR 640, based on 1990 traffic counts of 2,951 average annual daily trips (AADT) and 320 peak hour, peak direction trips. From CR 640 to Cameron Street in Mulberry, SR 37 currently functions at LOS C with 1990 volumes of 6,649 AADT and 710 peak hour, peak direction trips. SR 674 is also a two-lane highway classified as a Minor Arterial currently functioning at LOS A from the Hillsborough County line to SR 37 with a 1990 AADT of 1,232 and 130 peak hour, peak direction trips. CR 630 from SR 37 to U.S. Highway 98 is a two-lane highway functionally classified as a Major Collector currently functioning at LOS A with a 1990 AADT of 2,294 with 227 peak hour, peak direction trips. Fort Green Road/CR 663 is a two-lane highway classified as a Minor Collector currently functioning at LOS A, with a 1990 AADT of 519 and 51 peak hour peak direction trips. The county minimum LOS standard for rural arterial and collector roads is LOS D.

Educational Facilities

Public school information for Hillsborough and Polk Counties is shown in Table 2.2.8-8, which indicates that Hillsborough County has almost twice as many pre-kindergarten to 12^{th} grade students enrolled for the 1989-1990 school year, and correspondingly more pre-kindergarten to 12^{th} grade schools. In Hillsborough County, 62.1 percent of high school graduates and 50.5 percent of Polk County high school graduates enrolled in some higher form of education (i.e., vocational school, junior college, state college). Though Hillsborough County collected more total revenues per full-time equivalent (FTE) student than Polk County, both counties had comparable expenditures per FTE student, school tax millage rates, and percentage

Table 2.2.8-8. Public Education Information

	Polk County	Hillsborough County
1989-1990 School Year Data		
Total PK-12 public school enrollment[1]	64,256	120,364
High school graduates continuing education[2]	1,641 (50.5%)	3,885 (62.1%)
FTE teacher-to-FTE student ratio[3]		
Elementary	1:20.37	1:20.85
Secondary	1:17.61	1:19.41
Percentage of total staff that are full-time teachers[3]	51.47%	48.78%
Total all revenues ($1,000)[3]	$265,226	$583,706
Revenue/FTE student	$3,999	$4,534
Total expenditures, all funds ($1,000)[3]	$268,233	$561,030
Expenditure/FTE student	$3,761	$3,828
Debt service ($1,000)	$3,187	$19,932
Operating tax millage	6.217	6.347
1991-1992 School Year Data[4]		
Total public schools		
Elementary	61	102
Middle junior	17	26
Other secondary	12	14
Total pre-kindergarten through 12th grade	90	142
Adult	3	17
Vocational	3	3
Other	37	21

Sources: [1] State of Florida, Department of Education, MIS Statistical Brief, Series 90-10B, 1990.
[2] State of Florida, Department of Education, MIS Statistical Brief, Series 90-09B, 1990.
[3] BEBR, 1991, Florida Statistical Abstract, 1991.
[4] State of Florida, Department of Education, 1991-1992 Florida Public Schools MIS Data Sheet, 1991.

of total staff that are teachers. Hillsborough County has a significantly greater debt service than Polk County, caused by the planned construction of five new schools for the 1991-1992 school year and two additional schools in 1992-1993 (Hillsborough County Board of Education, 1991).

Table 2.2.8-9 consists of a listing of the nearest Hillsborough and Polk County schools to the Polk Power Station, for the 1991-1992 school year. The nearest Polk County schools are in Mulberry and Fort Meade, while the nearest public schools in Hillsborough County are in Lithia and Plant City. No public schools are located in unincorporated Bradley Junction; school-age children in Bradley Junction attend Mulberry schools (Polk County Board of Education, 1992).

Medical Facilities

The nearest hospitals to the Polk Power Station are Bartow Memorial and Polk General, both located in Bartow approximately 13 miles to the northeast. Bartow Memorial is a private facility, while Polk General is a public hospital established primarily for indigent care. Both hospitals are equipped with emergency rooms, but neither are equipped with a trauma center. Persons requiring emergency trauma center services would be sent to Lakeland Regional Hospital located approximately 17 miles to the north, or would be air lifted to Tampa General Hospital, which is an approximately 20-minute helicopter flight from the Polk Power Station (Polk County Division of Public Safety, 1992).

Polk County has eight hospitals totaling 1,785 general hospital beds at a ratio of 434 general hospital beds per 100,000 population. Hillsborough County has 19 hospitals totaling 3,366 general hospital beds, averaging 400 general hospital beds per 100,000 population. The State of Florida ratio of adequate hospital services is 406 general hospital beds per 100,000 population (BEBR, 1991).

The emergency medical services (EMS) facilities that would respond to the Polk Power Station are located at the Fort Meade Fire Station. These facilities include

Table 2.2.8-9. Nearest Polk and Hillsborough County Public Schools to the Polk Power Station, 1991-1992 School Year

POLK COUNTY

Mulberry (approximately 11 miles north)

Grades K-3
Kingford Elementary School
1400 Dean Street
Mulberry

Grades 4-6
Purcell Elementary School
305 Northeast 1st Avenue
Mulberry

Grades 7-8
Mulberry Middle School
500 Southeast 9th Avenue
Mulberry

Grades 9-12
Mulberry Senior High School
Northeast 4th Circle
Mulberry

Fort Meade (approximately 11 miles east)

Grades Pre K-3
Lewis Elementary School
115 South Oak Avenue
Fort Meade

Grades 4-5
Riverside Elementary School
1002 Northeast 6th Street
Fort Meade

Grades 6-7
Fort Meade Middle School
610 South Charleston Avenue
Fort Meade

Grades 8-12
Fort Meade Junior-Senior High School
700 Edgewood Drive
Fort Meade

HILLSBOROUGH COUNTY

Lithia (approximately 13 miles northwest)

Grades K-6
Pinecrest Elementary School
7950 Lithia Pinecrest Road
Lithia

Plant City (approximately 19 miles northwest)

Grades 7-9
Turkey Creek Middle School
5005 South Turkey Creek Road
Plant City

Grades 10-12
Plant City High School
One Raider Place
Plant City

Sources: Hillsborough County School Board, 1992.
Polk County School Board, 1992.
ECT, 1992.

advanced life support. The Fort Meade Fire Station EMS response time is estimated to be 20 to 30 minutes (Polk County Division of Public Safety, 1992).

Fire Protection

The nearest fire station to the Polk Power Station within Polk County is the Bradley Station, located approximately 4.4 miles to the north, in Bradley Junction. This station is manned by two full-time firefighters on duty from 8 a.m. to 5 p.m., 5 days per week, and 8 to 12 volunteer firefighters. This facility is a primary response unit and is equipped with a pumper truck [approximately 750 gallons per minute (gpm)], tanker truck, and rescue truck. Estimated response times range from 8 to 12 minutes for responses by full-time firefighters and 12 to 20 minutes when using volunteer firefighters. The next nearest facility is the Fort Meade Station, which is a city rather than county facility manned by 15 to 20 volunteers, at an estimated response time of 20 to 25 minutes. This station is equipped with three full-size pumper trucks (greater than 1,000 gpm capacity) and a tanker truck. Haz-Mat capabilities or an aerial truck would respond from the Bartow Air Base Station (Polk County Fire Marshall, 1992).

Fire protection services in Hillsborough County are divided into four regional quadrants. The Polk Power Station falls within the southwest quadrant, and firefighting efforts would be coordinated through the Southwestern Battalion Officer. There are a total of 28 county fire stations, of which 10 stations are manned 24 hours, 10 are manned by career firefighters during the daytime, with the remainder using volunteer firefighters. There are approximately 10 additional city-operated fire stations in Polk County (Polk County Fire Marshall, 1992).

For most responses, Polk County would exhaust their firefighting resources before requiring assistance from another county, such as Hillsborough. If assistance is necessary from Hillsborough County, it is likely to include Haz-Mat or aerial truck assistance from Hillsborough County's Brandon Station (Polk County Fire Marshall, 1992). In the event that additional firefighting capabilities would be necessary, the nearest Hillsborough County station is the Southeastern Station located on Lithia

Pinecrest Road west of CR 39 on Browning Road. This facility is manned 24 hours by three full-time volunteers, with an estimated response time of 20 to 25 minutes. The next nearest fire station is the Wimauma Station, located on 7th Avenue in Wimauma. This facility is manned by three permanent firefighters over 24-hour periods. The Hillsborough County Fire Department has 32 facilities with 330 career firefighters and 220 volunteers (Hillsborough County Fire Department, 1992).

Police Protection

The Polk Power Station lies in unincorporated Polk County, and would receive police services from the Polk County Sheriff's Department. Deputies patrolling this area are based out of the West Regional Substation, located at 2105 East Lakewood Drive in south Lakeland. A total of approximately 109 sworn officers are located at the West Regional Substation. Responses are prioritized according to urgency, with an average estimated response time of 10 to 15 minutes for a routine response, with a considerably shorter time expected for high-priority emergencies. Because the Polk Power Station lies in unincorporated Polk County and is more than 10 miles from the nearest municipality, responses by city police departments under most all circumstances are not expected (Polk County Sheriff's Department, 1992).

A total of six sheriff's stations are contained in Polk County, with a total of 383 sworn officers, 590 automobiles, and 242 patrol units (Polk County Sheriff's Department, 1991).

Hillsborough County has a total of seven sheriff's stations, and 838 sworn officers. The nearest Hillsborough County district station to the Polk Power Station is located in Brandon (Hillsborough County Sheriff's Department, 1991.)

Potable Water, Sanitary Sewer, and Solid Waste

The Polk Power Station site is located in rural Polk County, an area not provided with public potable water supply or sanitary sewerage service. Because this rural area is not provided with municipal service, relevant system capacities are not applicable in this area. The applicant will be its own provider for most utilities required by the project and its employees. Electricity, potable water, and sanitary sewage treatment/disposal services will be provided by onsite facilities appropriately designed to meet these expected service demands. Domestic, construction, and certain industrial solid waste disposal services will be provided by contracted services with an approved, licensed contractor serving the region.

Three landfills are currently operating in Polk County which have a total available capacity of 1,350 tons per day (tpd). The North Central Landfill is located nearest the Polk Power Station site and has a capacity of 1,000 tpd. The solid wastes generated from the Polk Power Station is expected to consume less than 0.1 percent of the available capacity of the North Central Landfill. The useful life of these landfills is projected to the year 2010; however, Polk County has proposed a solid waste processing plant which, if constructed, could extend the useful life of these landfills to the year 2030.

Recreation and Open Space

No recreational areas, open space, or public lands are located adjacent to, or in the immediate vicinity of the Polk Power Station site. The nearest recreational facility to the Polk Power Station is the Bradley Junction Recreational Park, located at the extreme northern perimeter of the 5-mile study area, within Section 11 of Township 31 South, Range 23 East. This 1.5-acre neighborhood park is located on Pine Street between Whidden and 1st Streets and contains a baseball/softball field, basketball court, and small playground. This facility has no restrooms, showers, concessions, shelters, or electric service, and is not manned by a county attendant

Electricity

Electricity service within the four-county region is provided by public utilities, electric cooperatives, and local municipal electric departments as based on discussions with representatives of these entities. Within Polk County, electricity is primarily provided by Tampa Electric Company, Florida Power Corporation (FPC), and Lakeland

Electric and Water. The City of Fort Meade and City of Bartow provide local service. The Seminole Electric Cooperative, Inc., also generates power which is distributed by sub-regional electric cooperatives including the Withlacoochee River Electric Cooperative in extreme northwestern Polk County, and the Peace River Electric Cooperative (PRECO). Within Hillsborough County, electric service is provided by Tampa Electric Company, Florida Power & Light Company, and PRECO. Electric service in Manatee County is provided by Florida Power & Light Conpany and PRECO, while FPC, PRECO, and the City of Wauchula service Hardee County.

Natural Gas

The four-county region is provided with wholesale natural gas service by the Florida Gas Transmission Company (FGT), who in turn distributes gas to local or sub-regional retailers. These retailers include People's Gas (Polk, Hillsborough, and Manatee Counties), Central Florida Gas (Haines City-Winter Haven area), and Plant City Natural Gas. No natural gas pipelines are contained in Hardee County (FGT, 1992).

Concurrency Management

The Polk County concurrency/growth management requirements include the issuance of a Certificate of Concurrency in accordance with the Concurrency Management Ordinance of Polk County, adopted in June 1992. Since the Polk Power Station will provide its own potable water and sanitary sewerage services, a Certificate of Concurrency will not be required or issued for these services. Similarly, because the Polk Power Station has no residential element, it is exempted from the parks and recreation concurrency provisions of this ordinance.

Based on adequate existing and future capacity of Polk County landfills, appropriate site drainage design and engineering, and existing transportation volumes and proposed improvements, the Polk Power Station will fulfill requirements of the Concurrency Management Ordinance of Polk County.

2.3 BIOPHYSICAL ENVIRONMENT

2.3.1 GEOHYDROLOGY

2.3.1.1 Geological Description of Site Area

Regional Stratigraphy

The Polk Power Station site and surrounding region contain surficial layers of unconsolidated sand and clay underlain by a thick sequence of sedimentary rocks. A summary of the hydrogeologic framework for the central Florida phosphate district of west-central Florida is presented in Table 2.3.1-1 and illustrated on Figure 2.3.1-1.

The deepest formation encountered is the Paleocene Cedar Keys Formation which overlies strata greater than 2,000 ft deep. Above these units is the Eocene Series which includes the Oldsmar Formation, Avon Park Limestone, and Ocala Group. The Avon Park Limestone is the lower of two highly productive units of the upper Floridan aquifer. The Ocala Group crops out in the area of the Green Swamp of northern Polk County and increases in depth toward the south.

The Suwannee Limestone of Oligocene age overlies the Ocala Group. The Suwannee Limestone ranges in thickness from approximately 80 ft to more than 250 ft. In Polk County, the Suwannee Limestone pinches out to the north and east. The Suwannee Limestone is the top of two highly productive units of the upper Floridan aquifer, and is overlain by strata comprising the Hawthorn Group.

The Hawthorn Group consists of the Arcadia Formation and the Peace River Formation, in ascending order. The Arcadia Formation contains, in ascending order, the Nocatee and Tampa Members plus an unnamed member. The Arcadia Formation consists of dolomite, sand, clay, and silty, phosphatic limestone. The Peace River Formation is comprised of clayey phosphatic sand beds (Scott, 1986). The thickness of the Hawthorn Group ranges from very thin to approximately 300 ft.

The Tamiami Formation, Caloosahatchee Marl, and Fort Thompson Formation generally occur west and south near the Gulf Coast. Near the Tampa Electric Company

Table 2.3.1-1. Hydrogeological Framework of West-Central Florida

System	Series	Stratigraphic Unit	General Lithology	Major Lithologic Unit	Hydrogeological Unit
Quaternary	Holocene and Pliestocene	Undifferentiated Surficial Deposits	Predominantly fine quartz sand; shell interbedded clay, marl, peat, dolostone, sandstone, and phosphorite.	Sand	Surficial Aquifer System
		Fort Thompson Formation	Shelly quartz sand, unfossiliferous quartz sand, and thin limestone beds.		
		Caloosahatchee Formation	Shelly quartz sand. Thin, shelly limestone beds, and marl.		
Tertiary	Pliocene	Tamiami Formation	Sandy limestone, clayey and pebbly sand; clay, marl, shell, phosphatic.	Clastic	Confining Unit (Intermediate Aquifer System)
	Miocene	Hawthorn Group: Peace River Formation[1]	Clayey, phosphatic, sandy beds; silty and sandy phosphatic clay beds, and clayey phosphatic quartz sand.	Carbonate and Clastic	Aquifer (Intermediate Aquifer System)
		Hawthorn Group: Arcadia Formation[2]	Dolomite and, clay, and limestone, silty, phosphatic.		Confining Unit (Intermediate Aquifer System)
	Oligocene	Suwannee Limestone	Limestone, sandy limestone, fossiliferous	Carbonate	Floridan Aquifer System
	Eocene	Ocala Group	Limestone, chalky, foraminiferal, dolomitic, near bottom.		
		Avon Park Formation	Limestone and hard brown dolomite; intergranular evaporite in lower part in some areas.		Upper Floridan Aquifer Middle Confining Unit
		Oldsmar Formation	Dolomite and limestone, with intergranular gypsum in most areas.		Lower Floridan Aquifer
	Paleocene	Cedar Keys Formation	Dolomite and limestone with beds of anhydrite.	Carbonate with evaporites	Sub-Floridan Confining Unit

1 Peace River Formation includes Bone Valley Member and undifferentiated deposits.
2 Arcadia Formation includes undifferentiated deposits, Tampa Member, and Nocatee Member.

Sources: Modified from Ryder, 1985 (Table 1) and Johnson, 1989.

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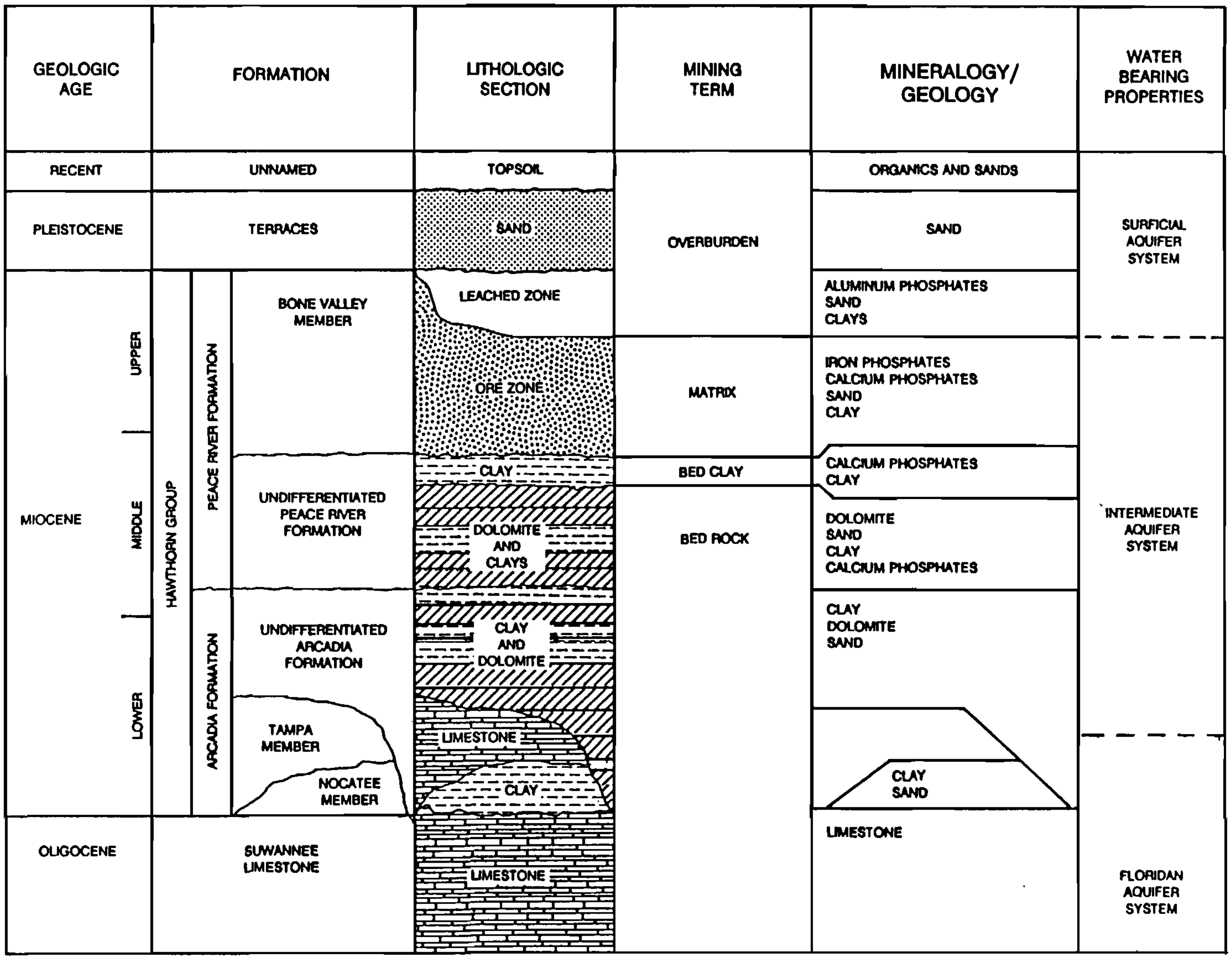

FIGURE 2.3.1-1.

HYDROGEOLOGIC FRAMEWORK OF FLORIDA PHOSPHATE DISTRICT

Source: Yon, 1983; Scott, 1986; Campbell, 1986.

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Polk Power Station, these formations are discontinuous and the Bone Valley member dominates. The Bone Valley member of the Peace River Formation ranges from 20 to 60 ft in thickness and is the primary ore zone for phosphate pebble mining.

The most recent deposits are undifferentiated sands and terrace deposits which may range in thickness from 0 to 70 ft.

The location of geologic cross-sections by the Florida Geologic Survey (FGS) are illustrated in Figure 2.3.1-2. The geologic cross-sections depicted in Figures 2.3.1-3 and 2.3.1-4 were constructed from the available well logs in the general region (Campbell, 1986).

Lithology

Generalized descriptions (Campbell, 1986 and Stewart, 1966, except as noted) of the formations in the site area are summarized here in ascending order.

Oldsmar Formation--Limestones and dolomites with evaporites, soft to hard, chalky zones, occasional fine honeycomb, abundant nodules, and nests of nodules of gypsum altered from anhydrite.

Avon Park Formation--Limestone, chalky, nodular, oolitic, fragmental, intergranular anhydrite and gypsum, very fossiliferous, cream, white, to dark brown; commonly dolomite zones in middle park, dense to finely crystalline, yellow to grayish brown. Lower dolomite unit massive, dense to finely crystalline or sucrosic, some coarsely crystalline, pale-yellow and brown to dark brown and gray, mottled (Wilson, 1977).

Ocala Group--Limestone, chalky, nodular, granular, fragmental, some oolitic, generally very fossiliferous, cream, white, some buff; occasional dolomite in lower part, dense and cherty, white, cream to dark brown and gray.

Suwannee Limestone--Limestone, nodular, granular, chalky, some fragmental, some oolitic, usually very fossiliferous, cream to white, occasionally some clear quartz grains.

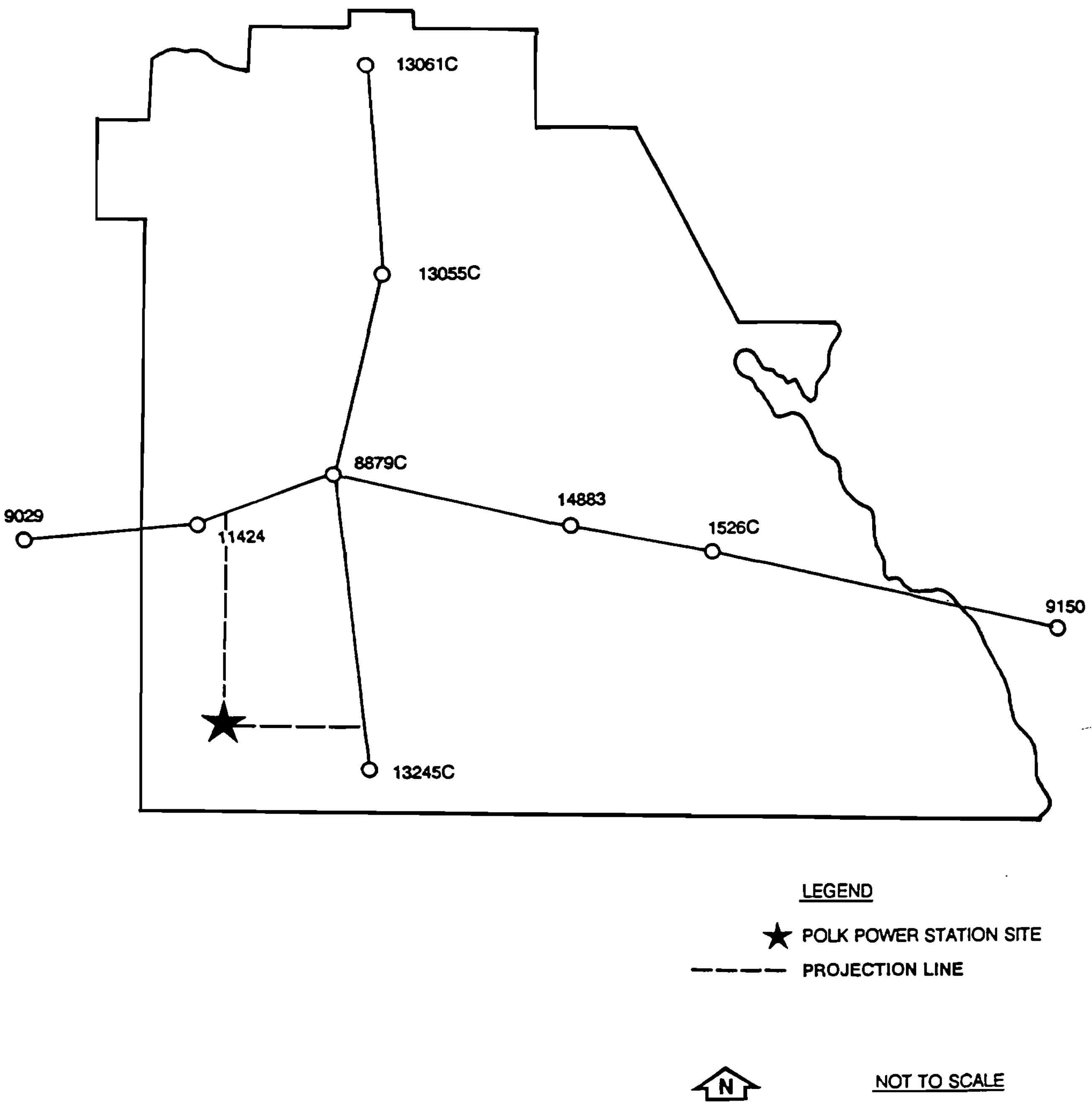

FIGURE 2.3.1-2.

REGIONAL GEOLOGIC CROSS-SECTION
LOCATION MAP
Source: Campbell, 1986.

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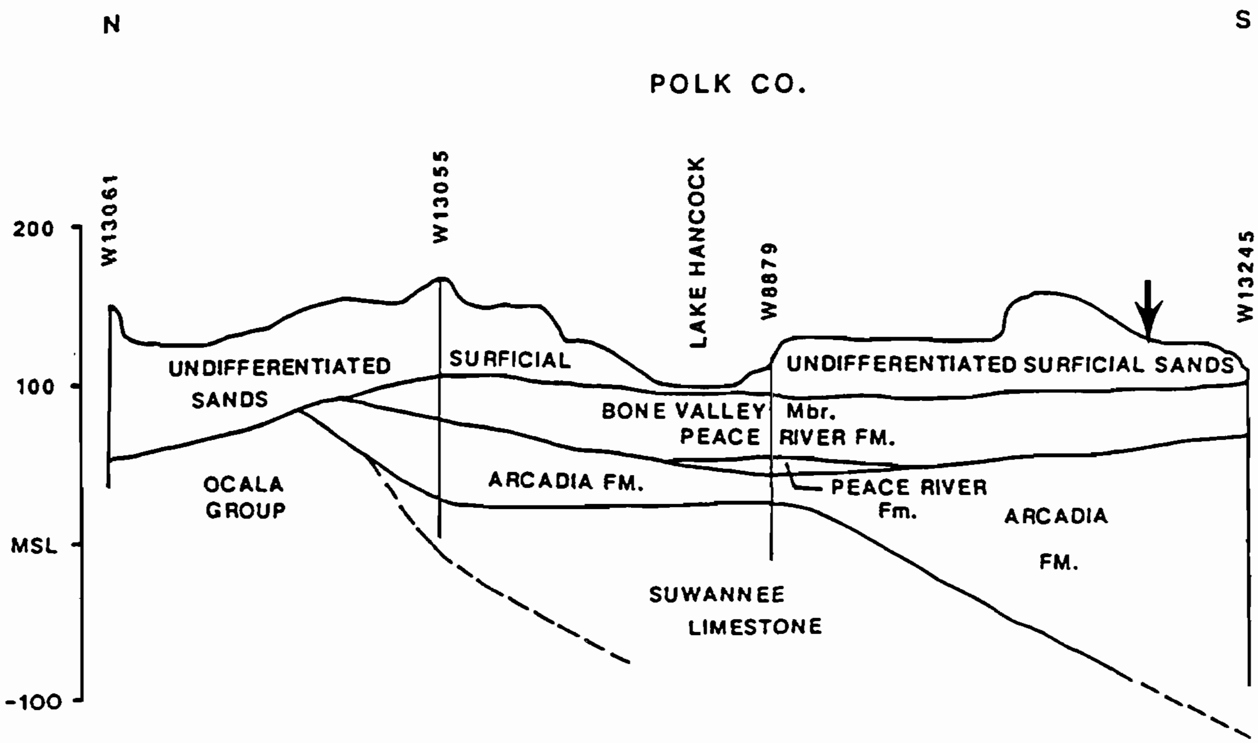

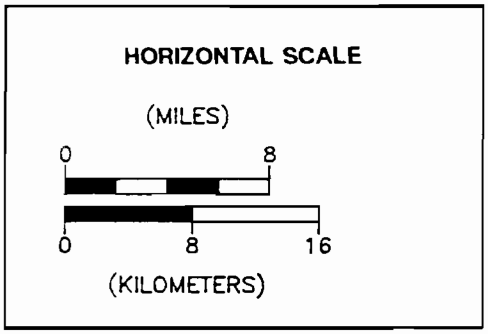

LEGEND

↓ PROJECTED POLK POWER STATION SITE LOCATION

FIGURE 2.3.1-3.

NORTH-SOUTH GEOLOGIC CROSS-SECTION

Source: Campbell, 1986.

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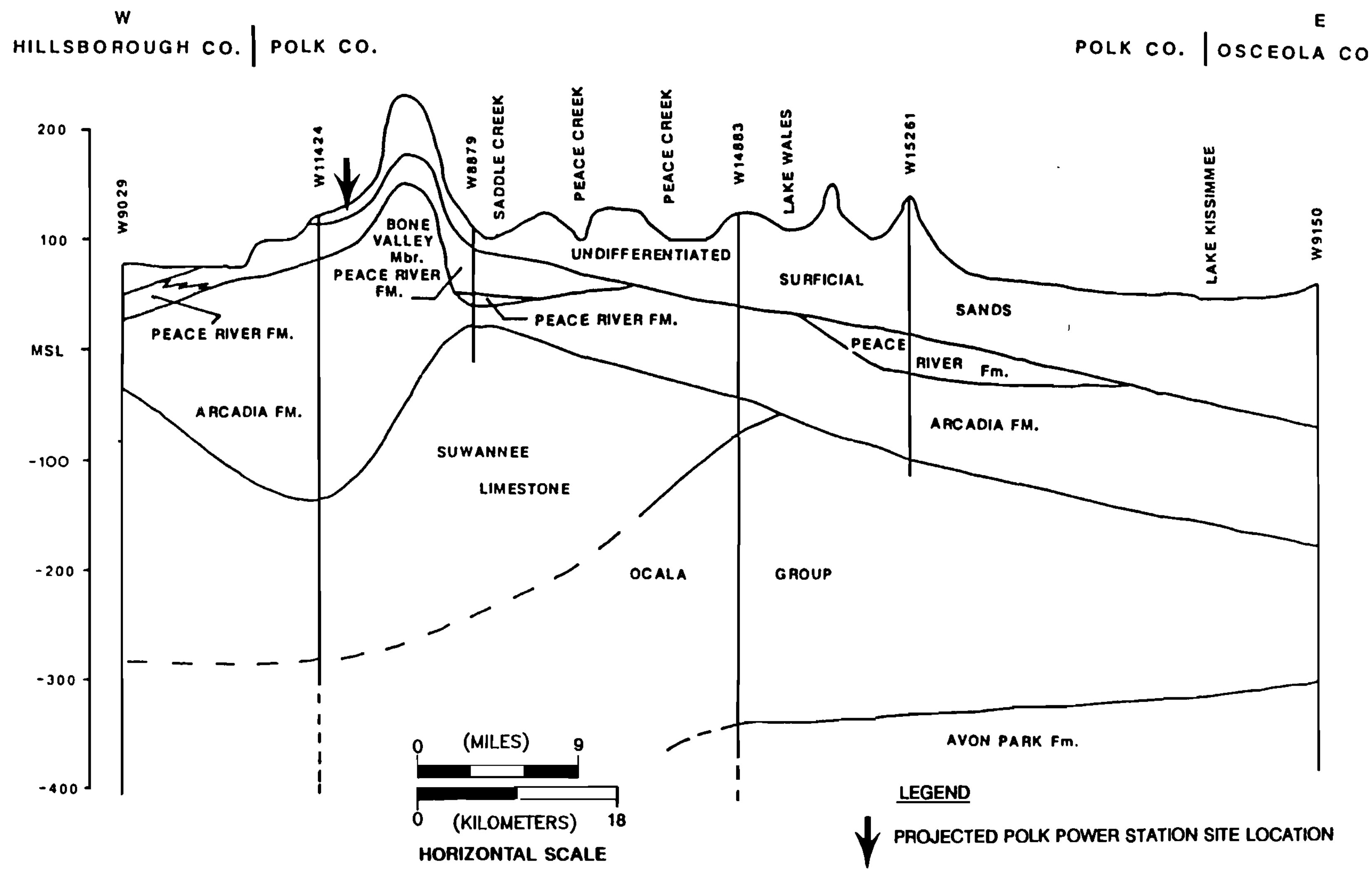

FIGURE 2.3.1-4.

WEST-EAST GEOLOGIC CROSS-SECTION

Source: Campbell, 1986.

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Hawthorn Group-Arcadia Formation--**Nocatee member**: sand, fine-coarse grained, clean to silty, limey, grayish green; and clay, silty, sandy, marly, gray to pale green, and hard, waxy, dark green to black, marly; minor limestone. **Tampa member**: limestone, massive or thick-bedded, hard, dense, cherty, fossiliferous, phosphatic, white to gray and brown; minor thin bedded sand and clay. Where underlying sand and clay unit is absent, equivalent beds are limestone, predominantly sandy, fossiliferous, gray, cherty; in places marly, soft, pebbly. **Undifferentiated member** (Hawthorn Carbonate unit): predominantly marl, dolomite and limestone; soft, chalky, fine-grained to sandy or pebbly; abundant brown or black phosphorite grains or pebbles; minor thin-bedded sand and clay. Generally the uppermost limestone in the section is less clastic than the underlying sand and clay unit, phosphatic throughout.

Hawthorn Group-Peace River Formation--**Undifferentiated member**: interbedded sands, clays, and dolomite with varying phosphate content. **Bone Valley member**: clayey sand and sandy clay, fine-grained, calcareous to noncalcareous; abundant phosphorite nodules up to pebble size, white to gray in upper part, amber or black in lower part; includes beds of clean phosphatic sand and sand and gravel.

Undifferentiated Surficial Deposits--Sand, clayey, very fine- to medium-grained, predominantly fine-grained; white to brown; trace of phosphate in lower part, minor thin beds of limestone and bluish gray clayey sand and clay.

Site Area Stratigraphy

Stratigraphic data was collected from a wire-line core at Monitor Station GW-1 (Figure 2.3.1-5) to prepare a general stratigraphic section and column (Figure 2.3.1-6) for the site. Monitor Station GW-1 is located in the northeast quarter of Section 9 of Township 32 South, Range 23 East, east of SR 37. Data from the wireline core and other borings conducted onsite were used to evaluate the site area stratigraphy. The undifferentiated surficial sand deposits ranged in thickness from 15 to 28 ft. For the Hawthorn Group, the Peace River Formation ranged in thickness from 16 to 40 ft and the Arcadia Formation was approximately 225 ft thick. The Suwannee

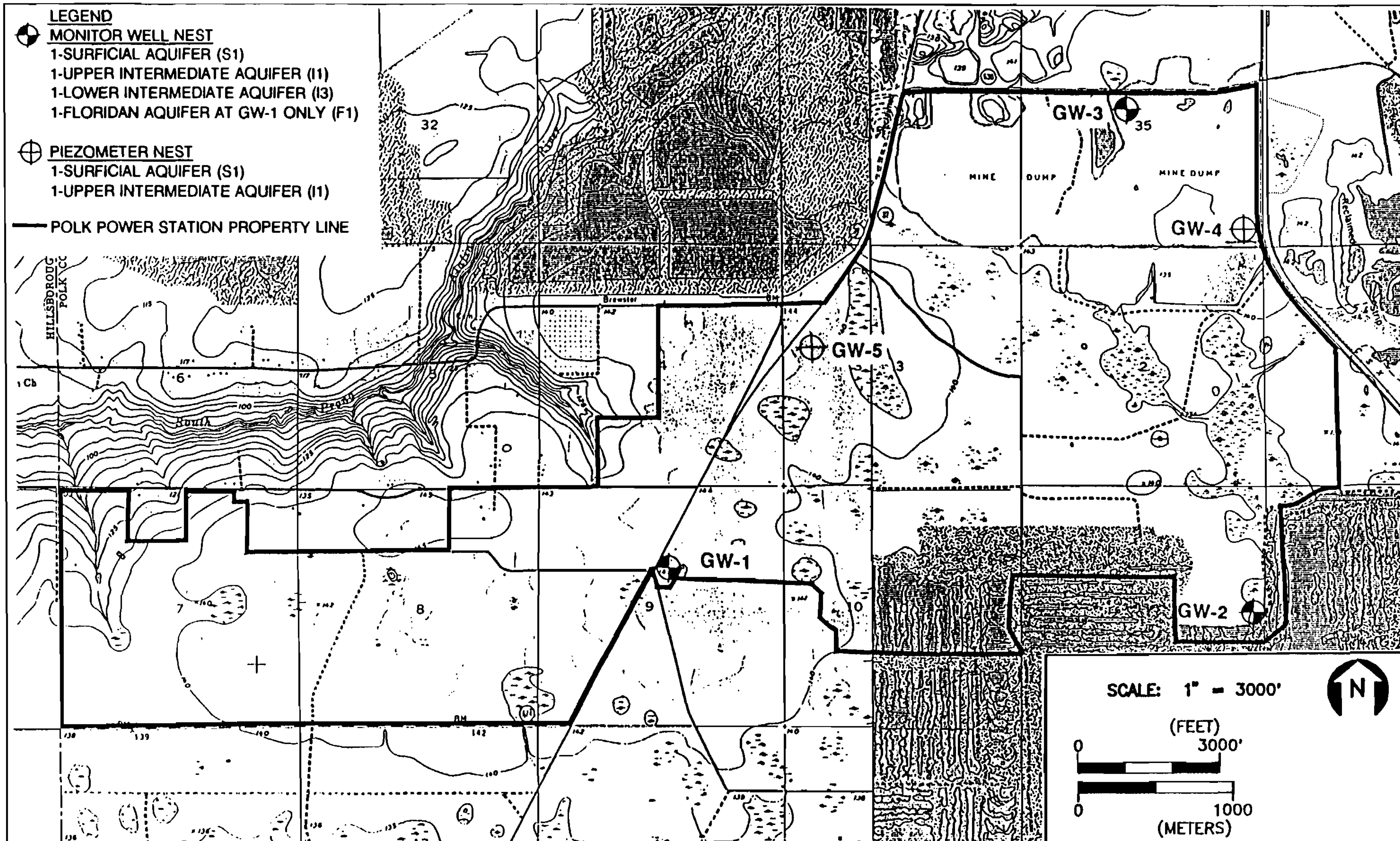

FIGURE 2.3.1-5.

GROUNDWATER MONITORING STATION LOCATION MAP

Source: USGS, Duette NE, FL, 1972; Baird, FL, 1987; ECT, 1992.

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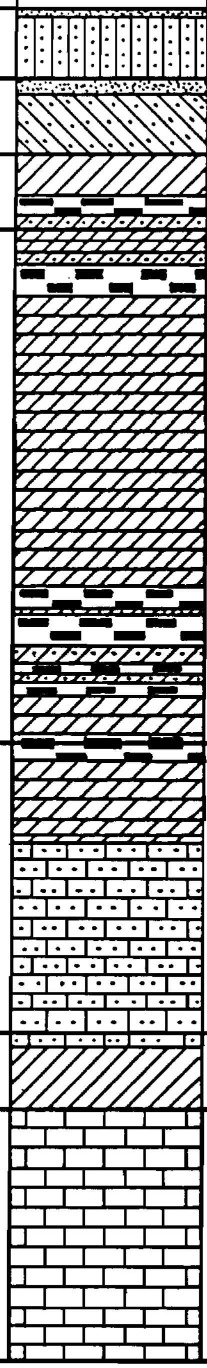

THICKNESS (FEET)	GRAPHIC LOG	STRATIGRAPHY
18		RECENT AND PLEISTOCENE - UNDIFFERENTIATED SURFICIAL DEPOSITS
20		MIOCENE HAWTHORN GROUP - PEACE RIVER FORMATION - BONE VALLEY MEMBER
19		PEACE RIVER FORMATION - UNDIFFERENTIATED
133		MIOCENE HAWTHORN GROUP ARCADIA FORMATION - UNDIFFERENTIATED
75		ARCADIA FORMATION - TAMPA MEMBER
20		ARCADIA FORMATION - NOCATEE MEMBER ARCADIA FORMATION - NOCATEE MEMBER - "TAMPA CLAY"
65		OLIGOCENE "SUWANNEE" LIMESTONE TOTAL DEPTH = 350 FEET

SAND	SILTY SAND	SILTY-CLAYEY SAND	CLAY
MUDSTONE	CLAYEY SAND	DOLOMITIC LIMESTONE	SANDY LIMESTONE
LIMESTONE			

NOTE: LITHOLOGY AND STRATIGRAPHY FROM NQ WIRELINE CORE AT GW-1 FLORIDA AQUIFER WELL

NOT TO SCALE

FIGURE 2.3.1-6.

STRATIGAPHIC COLUMN FROM NQ WIRELINE CORE AT GW-1

Source: ECT, 1992.

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Limestone was encountered at a depth of approximately 285 ft. This unit was not fully penetrated during this investigation. The carbonate sequence including the Suwannee Limestone, Ocala Group, Avon Park Formation, and Oldsmar Limestone extends to depths ranging from 1,500 to 1,800 ft.

Site Area Structure

Three features influenced the depositional environments and geologic setting of southwest central Florida (Figure 2.3.1-7). These features are the Peninsular Arch, Ocala Uplift, and South Florida Basin.

The main axis of the Peninsular Arch is located east of the site area, trends generally north-northwestward, and is estimated to be 275 miles long. The trend of the arch is approximately south 35 degrees (°) east, and extends from south-central Georgia to slightly northeast of Lake Okeechobee (Applin and Applin, 1965). The arch is thought to be an anticlinal fold of late Paleozoic and early Mesozoic time which caused differential subsidence of the overlying strata (Faulkner, 1970).

The Ocala Platform, or Ocala Uplift, is an additional geologic feature which parallels the Peninsular Uplift to the southwest. The Ocala Platform trends approximately north 25° west and covers an elliptical area approximately 230 miles long and 70 miles wide (Vernon, 1951). This feature extends from the vicinity of Dunellin to Otter Springs in Levy County and affects the Eocene and younger stratigraphic units. The Ocala Platform is not a true uplift, but rather an anomalous buildup of carbonates (Winston, 1976). A southern extension of this platform is the Central Florida Platform which underlies much of the Central Florida Phosphate District (Hall, 1983). The Tampa Electric Company Polk Power Station is located near the approximate center of the Central Florida Platform.

A third structural feature is the South Florida Basin. This basin is a broad, relatively flat, synclinal feature that trends approximately south 45° west and extends nearly

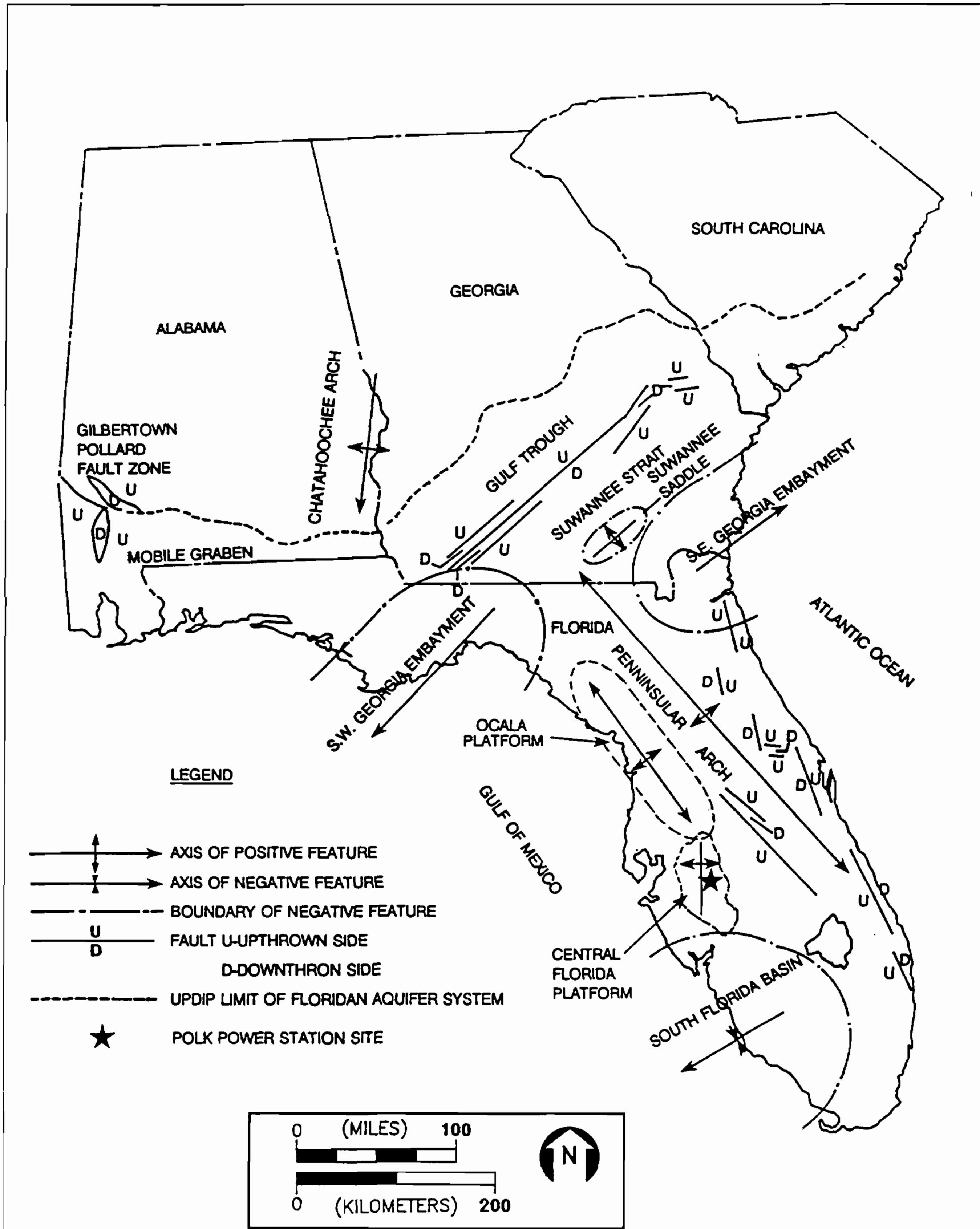

FIGURE 2.3.1-7.

STRUCTURAL AND GEOLOGIC FEATURES OF FLORIDA

Source: Modified Miller, 1986 and Hall, 1983.

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200 miles across the Florida peninsula. The maximum depositional thickening occurred during the Jurassic and Lower Cretaceous periods in the South Florida Basin.

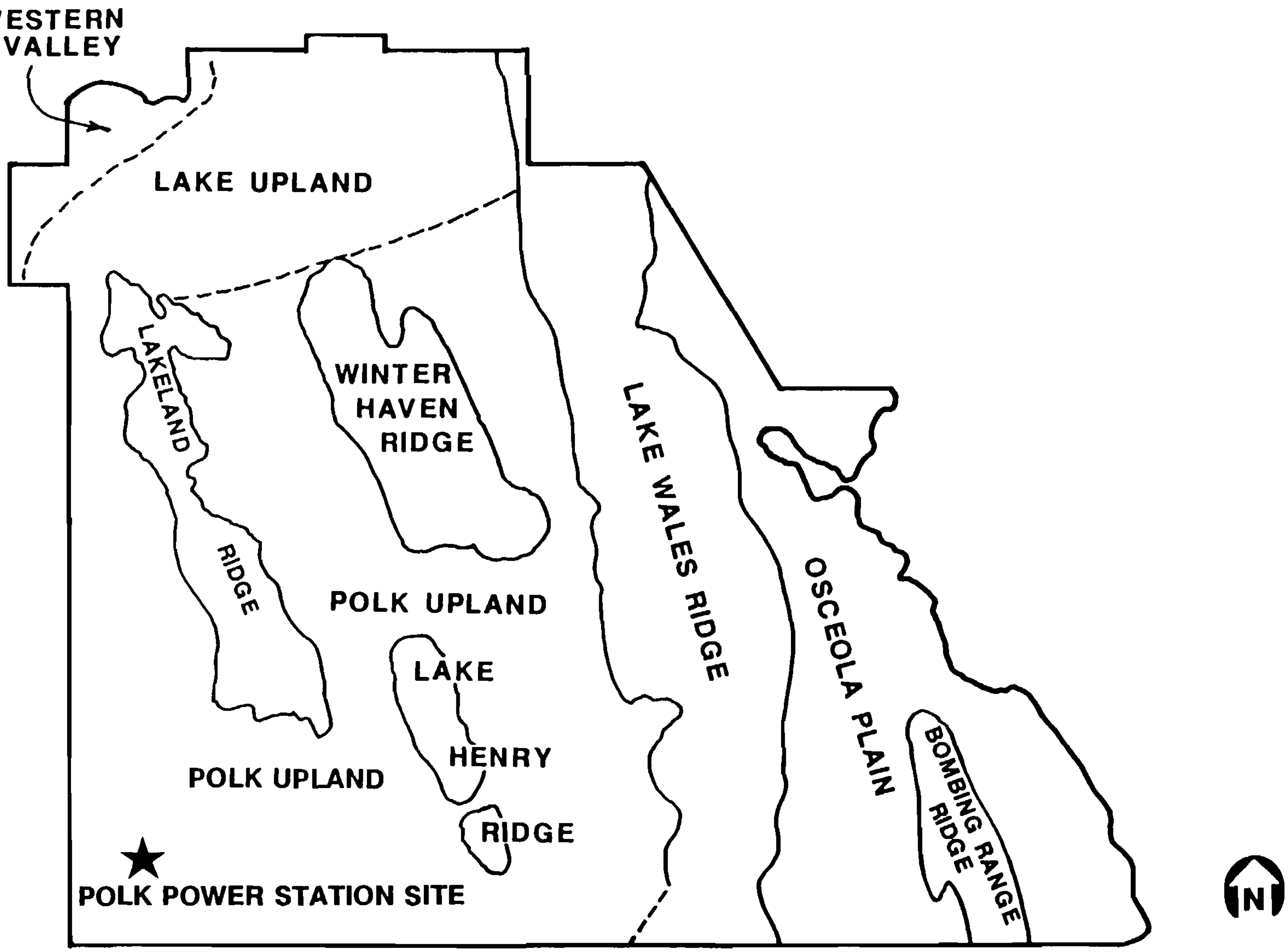
No faulting has been identified within the immediate vicinity of the Tampa Electric Company Polk Power Station site.

Site Area Physiography

The site area falls in the geomorphic province known as the Polk Upland (White, 1970). The majority of the Tampa Electric Company Polk Power Station site occurs on the Okefenokee Terrace (Sunderland Terrace) with an altitude range of +100 to +170 ft-msl, and a shoreline altitude at +170 ft-msl. The Polk Upland is bounded by the DeSoto Plain on the south and the Lake Henry or Lake Wales Ridge on the east (Campbell, 1986) (Figure 2.3.1-8). The topography of the Polk Upland is flat and underlain by a veneer of sands. Only geomorphic features associated with remnants of ancient shorelines mark the land form as it slopes gently toward the south (Campbell, 1986).

Prior to the recent mining activities, the land surface elevations ranged from approximately 130 to 200 ft-msl. The low elevation occurs at the southeast corner of the project site. Mine tailings mounds (from the early 1900s) in the northeast portion of the site range between approximately 170 to 200 ft-NGVD adjacent to Fort Green Road. The land surface elevation along SR 37 ranges from approximately 145 to 150 ft-NGVD. West of SR 37 the site elevation ranges from approximately 150 to 110 ft-NGVD. Prior to recent mining, the land surface was relatively flat with shallow slopes. The two exceptions are the old mine tailings mounds (northeast corner) and adjacent to the South Prong Alafia River (west-northwest corner). Several circular depressions are visible on soils and topographic maps and areal photographs. These features may predate mining activities and will be further discussed in Section 2.3.2.2.

2.3.1-14



Generalized Physiographic Map of Polk County, after White (1970).

NOT TO SCALE

FIGURE 2.3.1-8.

GENERALIZED PHYSIOGRAPHIC MAP OF POLK COUNTY

Source: Modified Campbell, 1986; ECT, 1992.

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2.3.1.2 Detailed Site Lithologic Description

Phosphate mining activities have disturbed much of the power plant site. The presence of the Bone Valley member with its pebble-sized phosphate grains dominates the detailed surficial geohydrology. The phosphate mining activities remove the overburden (Figure 2.3.1-1) and place this material in adjacent mine cut bottoms. The phosphate ore, *matrix*, is removed, and soils are piled adjacent to mine cuts resulting in deep ponds of standing water surrounded by spoil piles. At the Polk Power Station, the mining activities impacted or removed soils to a depth between 30 to 40 ft. The central area of the Polk Power Station site has not been mined and is the intended location for the power plant facility.

An exploratory drilling program was conducted to characterize the hydrogeologic units and subsurface conditions under the site. The subsurface investigation included:

1. Eight standard penetration test (SPT) borings illustrated on Figure 2.3.1-9 (identified as GW-1, GW-3, GW-4, GW-5, SPT-1N, SPT-2M, SPT-3SD, SPT-4ND, and SPT-5S) and drilled to depths varying from 12 to 60 ft;
2. Three cone penetration test (CPT) borings illustrated on Figure 2.3.1-9 (identified as SPT-2M, SPT-3SD, and SPT-4ND) and drilled to depths varying from 32 to 42 ft;
3. Three monitor wells [4-inch diameter, polyvinyl chloride (PVC)] and two piezometers (2-inch diameter, PVC) drilled, completed, and developed into the surficial aquifer (designated S1). These wells/piezometers ranged from 13 to 23 ft in depth. The well site locations are illustrated on Figure 2.3.1-5 and are identified as GW1-S1, GW2-S1, GW3-S1, GW4-S1, and GW5-S1;
4. Three monitor wells (4-inch diameter, PVC) and two piezometers (2-inch diameter, PVC) drilled, completed, and developed into the upper intermediate aquifer (designated I1). These wells/piezometers ranged from 90 to 106 ft in depth. The well site locations are illustrated on Figure 2.3.1-5 and are identified as GW1-I1, GW2-I1, GW3-I1, GW4-I1, and GW5-I1;

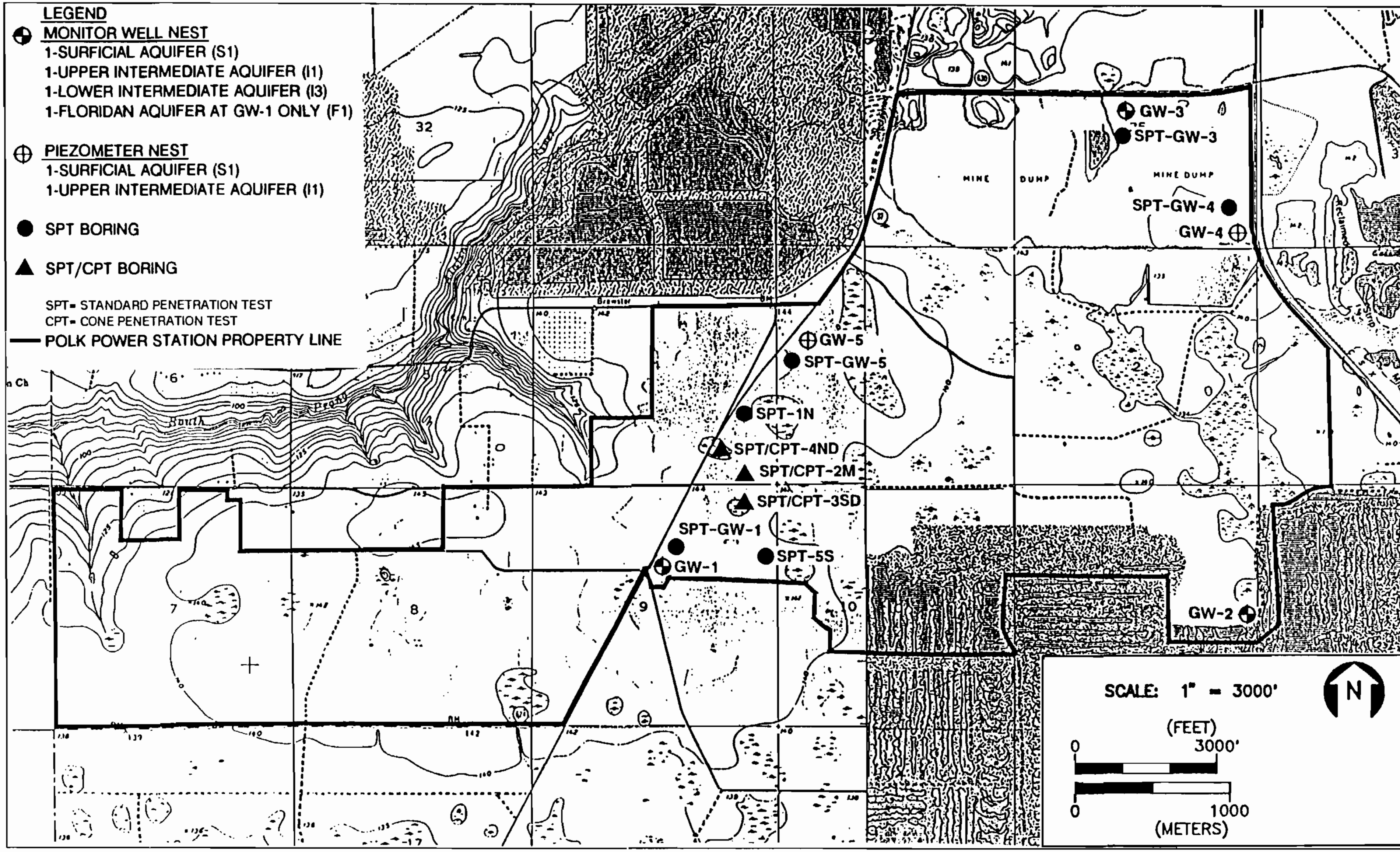

FIGURE 2.3.1-9.

STANDARD AND CONE PENETRATION TEST
BORING LOCATION MAP

Sources: USGS Quad. Duette NE., Fl. 1972; Baird, Fl. 1987; ECT, 1992.

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5. Three monitor wells (4-inch diameter, PVC) drilled, completed, and developed into the lower intermediate aquifer, Tampa member of the Arcadia Formation (designated I3). These wells ranged from 235 to 242 ft in depth. The well site locations are illustrated on Figure 2.3.1-5 and are identified as GW1-I3, GW2-I3, and GW3-I3; and
6. One monitor well (4-inch diameter, PVC) drilled, completed, and developed into the upper Floridan aquifer (designated F1). This well was drilled to a depth of 338 ft. The well site location is illustrated on Figure 2.3.1-5 and is identified as GW1-F1.

The logs for these borings and the construction details for the monitor wells and piezometers are provided in Appendix 11.7.1.

Split-spoon, Shelby tube, and wash samples were obtained. The laboratory soil testing program consisted of soil classification, grain-size analysis, natural moisture content, percent fines, liquid limits, plasticity index, vertical permeability, dry density, porosity, and cation exchange capacity. Soil classifications were determined in accordance with the unified method [American Society for Testing and Materials (ASTM) D2487] for all split-spoon samples.

A soil classification chart is provided as Figure 2.3.1-10. A soil profile location map and a soil profile for the upper 60 ft of soil are shown as Figures 2.3.1-11 and 2.3.1-12, respectively. The stratigraphic column presented in Figure 2.3.1-6 is representative of the geologic units encountered at depth at the Tampa Electric Company Polk Power Station site.

The undifferentiated sand unit is being removed by mining activities and replaced with tailing sands over much of the site. The sands are gray to brown, fine- to medium-grained, with a varying amount of silt and/or clay present. The natural moisture content of the soil averages 26 percent from tests, and the percent fines ranged from 4 to 73 percent in 11 tests. Eleven permeability tests ranged from a low

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-Grained Soils More than 50 % retained on No. 200 sieve	Gravels More than 50 % of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5 % fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12 % fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50 % or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5 % fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12 % fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50 % or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OH	Organic clay[K,L,M,P] / Organic silt[K,L,M,Q]
Highly organic soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12 % fines require dual symbols:
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12 % fines require dual symbols:
- SW-SM well-graded sand with silt
- SW-SC well-graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15 % sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15 % gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29 % plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30 % plus No. 200, predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30 % plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.

FIGURE 2.3.1-10.

UNIFIED SOIL CLASSIFICATION CHART SYSTEM

Source: ASTM, 1990.

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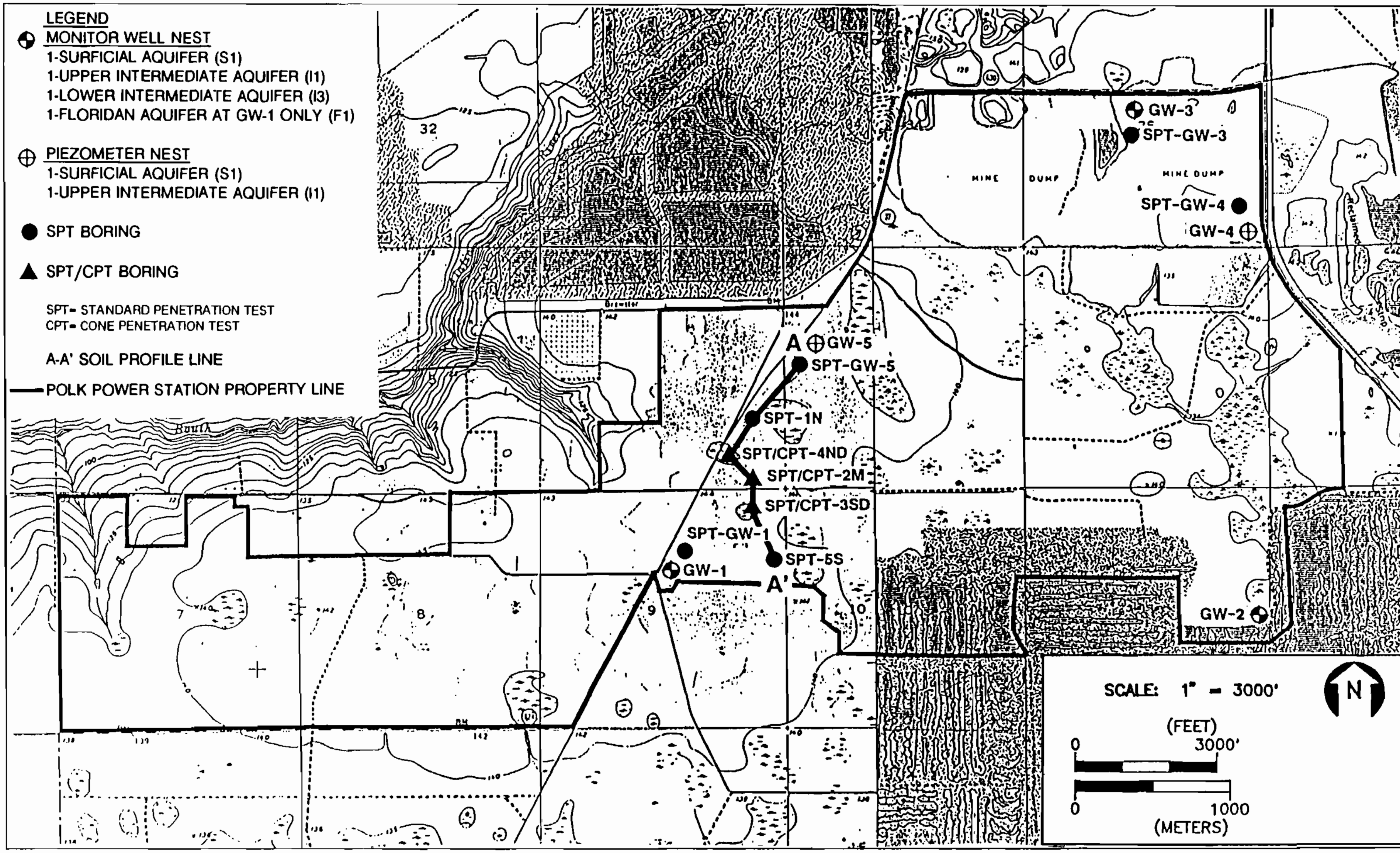

FIGURE 2.3.1-11.

SOIL PROFILE LOCATION MAP

Source: USGS, Duette NE, FL, 1972; Baird, FL, 1987; ECT, 1992.

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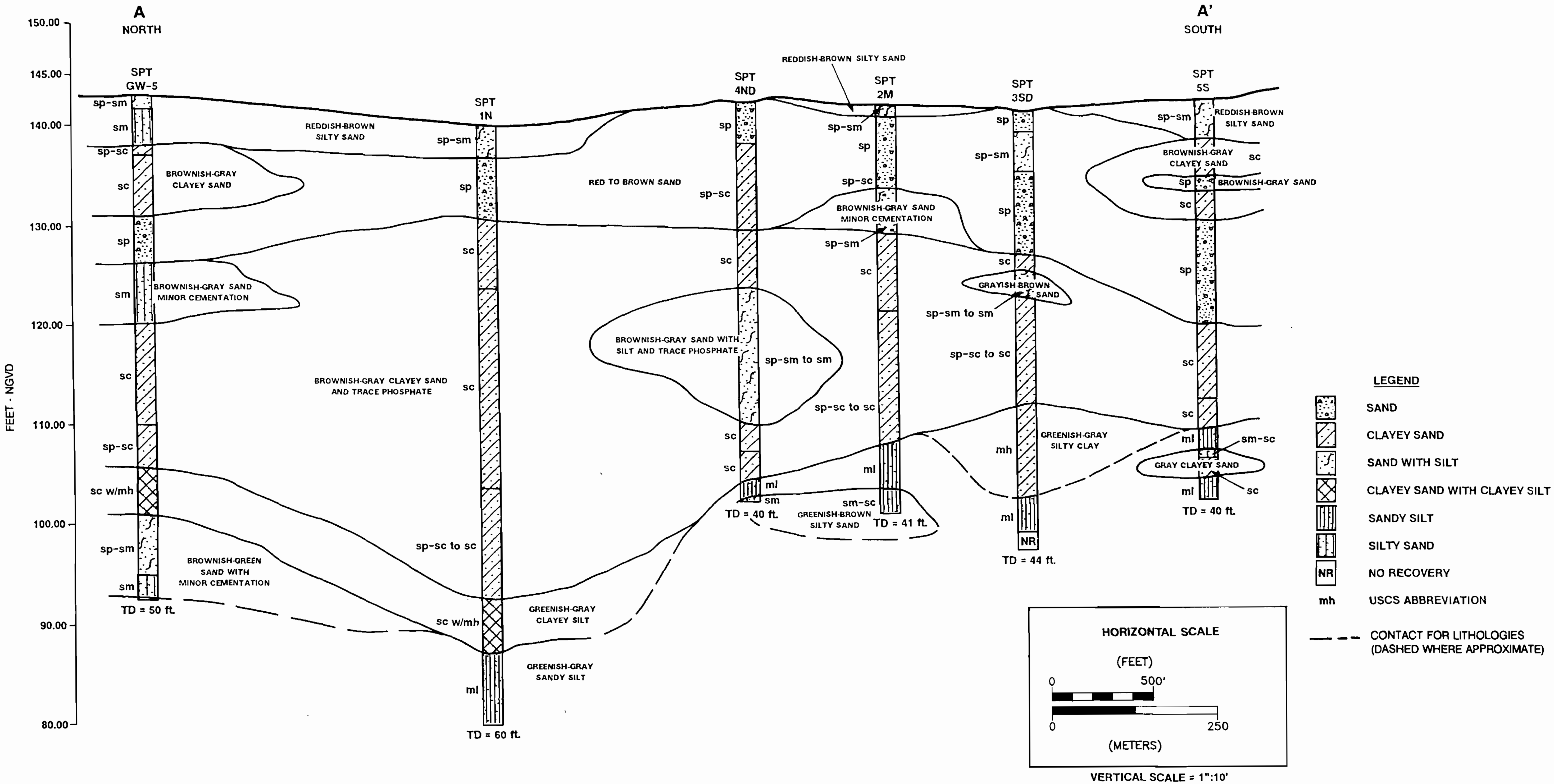

NOTE: EXCEPT AT WELL LOCATIONS, GROUND SURFACE AND STRATIGRAPHY ARE INFERRED.

FIGURE 2.3.1-12.

SOIL PROFILE A-A'

Source: ECT, 1992.

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of 3.2 x 10^{-8} centimeters per second (cm/sec) to 5.1 x 10^{-4} cm/sec. The results of the laboratory testing for these soil samples are summarized in Table 2.3.1-2, and the laboratory report (with grain-size analyses curves) are provided in Appendix 11.7.2.

At depths ranging from 50 to 60 ft, calcareous mudstone or carbonate strata were encountered with interbedded lenses of sand and clay. These calcareous or carbonate units were consolidated, well compacted, and moderately hard to hard. Thus, extensive soil testing was not conducted on the consolidated, carbonate units. Soil laboratory tests were conducted on a calcareous sandy clay sample (80 to 81 ft deep) and a hard clay to soft claystone sample (270 ft deep) at monitor station GW-1. The results of the laboratory testing for these samples are summarized in Table 2.3.1-2 and the laboratory report is provided in Appendix 11.7.2.

2.3.1.3 Geologic Maps

Soil types have been mapped by the U.S. Department of Agriculture in cooperation with the Polk County Soil Conservation Services (SCS) (1990a).

The Tampa Electric Company Polk Power Station plant site is situated primarily on Smyrna-Myakka, Arents-Water, and Ona soil types (Figure 2.3.1-13). Seventeen other soil types occur across the site, but cover significantly less area.

The Smyrna-Myakka soil complex consists primarily of fine sands which cover broad areas of flatwoods. These soils are somewhat poorly drained with slopes that are smooth to concave at 0 to 2 percent. The water table within these soils is typically 0 to 1 foot below land surface (ft bls) for 1 to 4 months in most years. The Smyrna soils have an organic matter content of 1 to 5 percent, and the Myakka soils have an organic matter content of 2 to 5 percent (SCS, 1990a). This soil complex has only a slight erosional risk.

The Arents-Water complex is a soil type resulting from mining activities. The Arents consists of piles (various slopes) of soil material and overburden that originally

Table 2.3.1-2. Soil Laboratory Test Results

Boring Number	Sample Number	Depth Sampled (ft)	Natural Moisture (%)	Percent Fines (%)	Liquid Limits	Plasticity Index	Vertical Permeability (cm/sec)	Dry Density (pcf)	Porosity (%)	CEC (meq Ba/ 100 g soil)
<u>Unconsolidated Surficial Soils</u>										
SPT-1N	US 1	16 to 18	19.0	17.0			$3.8x10^{-5}$	110.7	33.7	
SPT-2M	US 1	18.5 to 20.5	16.8	13.0	24	10	$2.3x10^{-5}$	105.4	28.4	
SPT-3SD	US 1	17 to 18.5	18.9	11.0			$2.8x10^{-5}$	104.8	31.7	
SPT-3SD	US 2	27 to 29	18.8	16.0	26	10	$6.3x10^{-6}$	108.9	32.8	
SPT-4ND	US 2	36 to 38	44.8	23.0	89	47	$1.1x10^{-5}$	74.9	53.8	
SPT-4ND	US 1	12 to 14	26.7	73.0			$3.2x10^{-8}$	100.2	42.9	
SPT-5S	US 2	36 to 38	33.4	25.0	97	63	$6.2x10^{-7}$	86.4	46.2	
SPT-5S	US 1	16 to 18	20.1	7.0			$3.3x10^{-4}$	103.3	33.3	
GW-5	US 1	16.5 to 18.5	27.0	12.0			$4.3x10^{-7}$	90.9	39.3	
GW-4	US 1	12 to 14	19.7	7.0			$2.4x10^{-5}$	102.0	32.2	
GW-4	MT-1	38 to 40	52.3					69.3	58.1	7.11
GW-3	US PI1	49 to 51	20.4					110.0	36.0	
GW-3	US 1	12 to 14	25.8	5.0			$1.2x10^{-3}$	99.4	41.1	
GW-2										
GW-1	US 1	10 to 12	22.5	4.0			$5.1x10^{-3}$	114.4	40.3	
GW-1	US MT-1	36 to 38	27.1	73.0			$6.4x10^{-7}$	99.1	43.0	3.04
Average			26.2	22.0	59	32.5	$5.2x10^{-4}$	98.6	39.5	
Maximum			52.3	73.0	97	63	$5.1x10^{-3}$	114.4	58.1	
Minimum			16.8	4.0	24	10	$3.2x10^{-8}$	69.3	28.4	
GW1-I1	*	~ 270	18.6	38.0			$3.0x10^{-7}$	108.3	32.3	0.27
	US 1	80 to 81	30.6					96.0	47.1	

Note: GW1-F1 and GW1-I1 are not part of surficial soils.
Boring locations are illustrated in Figure 2.3.1-9.
CEC = cation exchange capacity.
meq = milliequivalents.
pcf = pounds per cubic foot.

N = north SPT boring.
M = middle SPT boring.
SD = south depression boring.
ND = north depression boring.
S = south SPT boring.

*Mineral barrel sample.

Sources: Ardaman & Associates, 1991.
ECT, 1992.

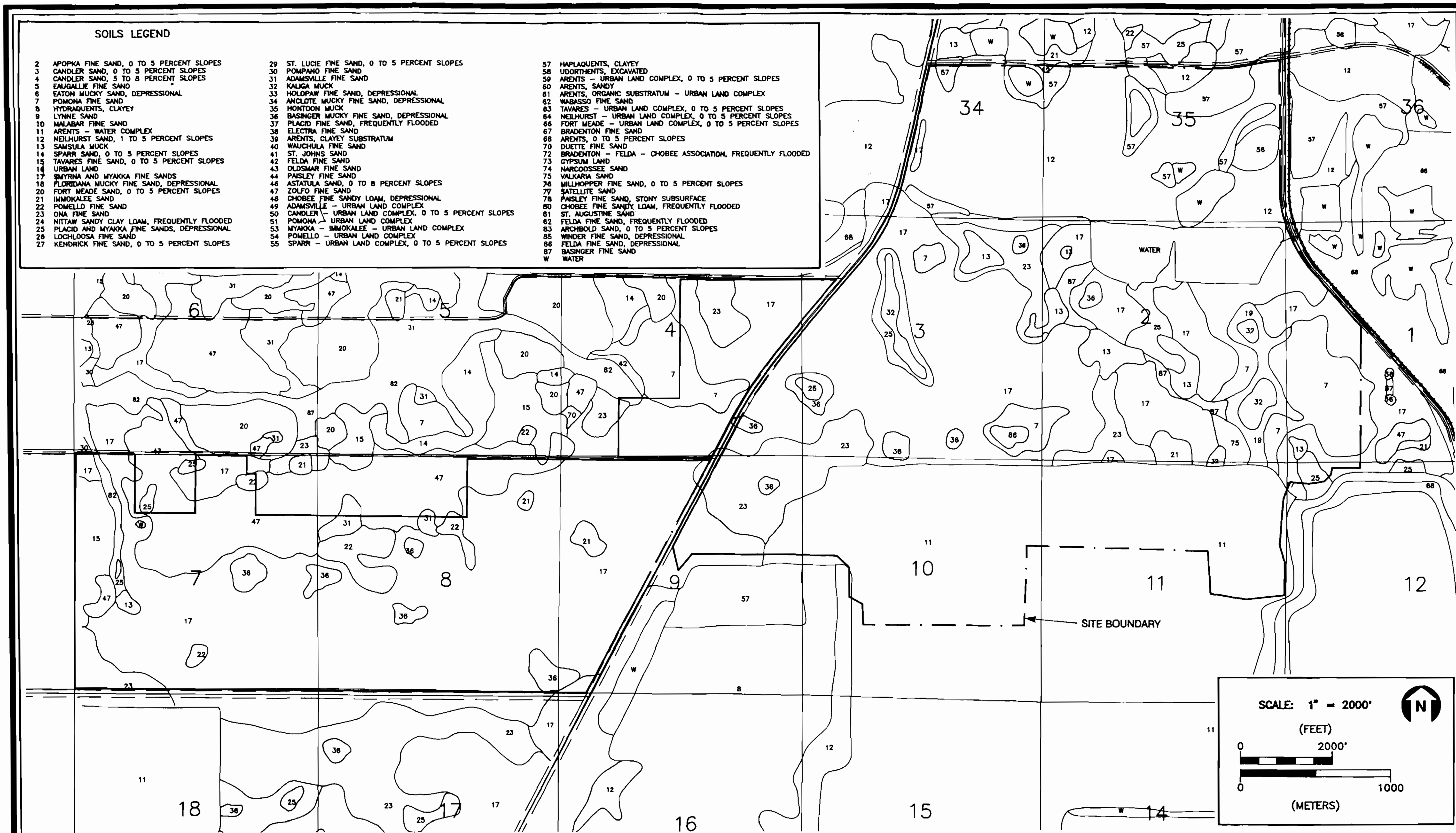

FIGURE 2.3.1-13.

SCS SOIL TYPE MAP - PREMINING CONDITIONS

Source: ECT, 1992.

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overlaid the phosphate matrix. The water part of this classification forms after the ore has been mined.

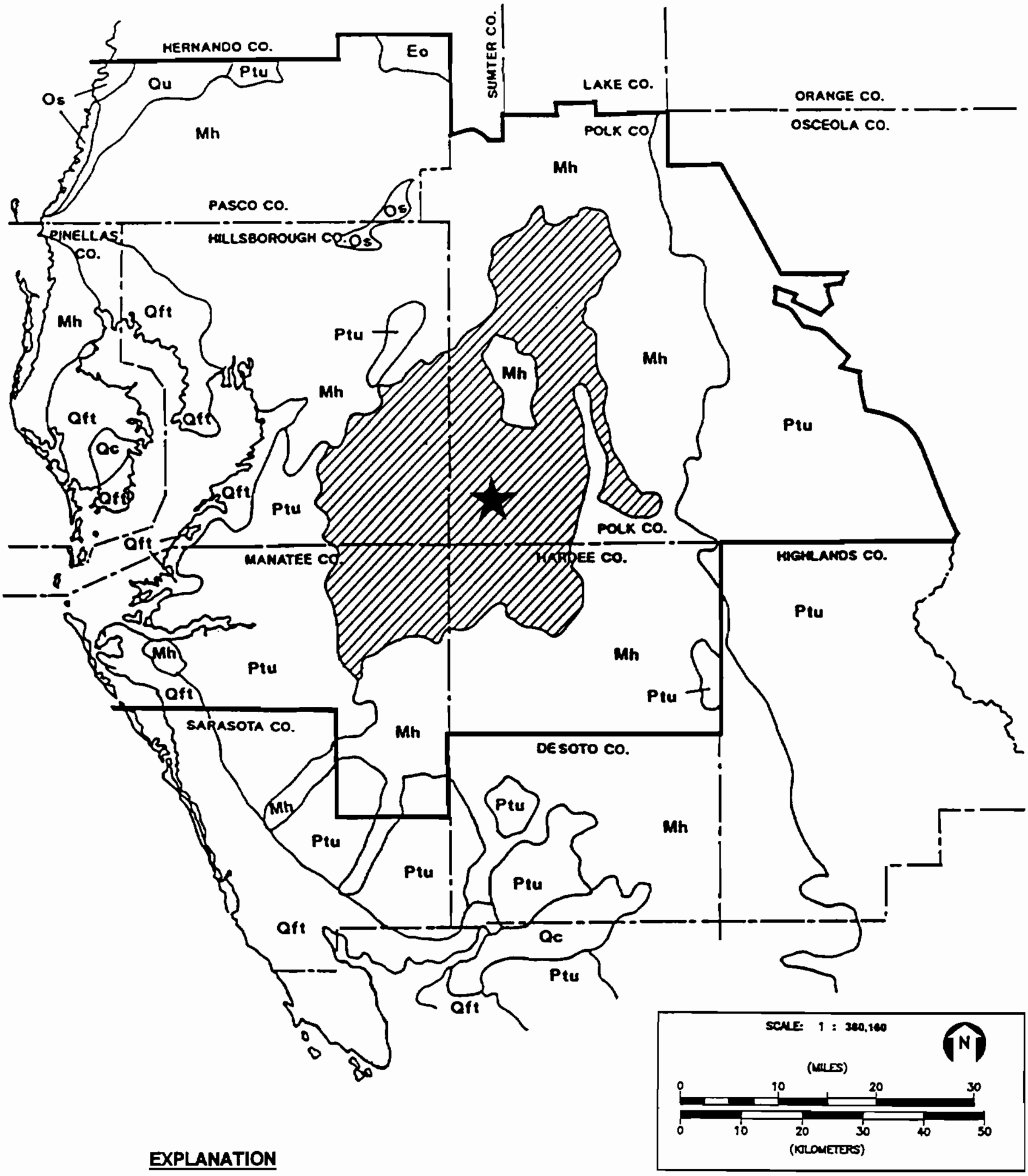
The Ona fine sands are also found in broad areas of flatwoods. The Ona soils are somewhat poorly drained with shallow slopes of 0 to 2 percent. The water table within this soil unit is typically 0 to 1 ft bls for 1 to 4 months in most years. The Ona sand has only a slight erosional risk.

The geology for Polk County and west-central Florida have been mapped by Campbell (1986) and Brook (1981), respectively. Figure 2.3.1-14 illustrates the surficial geology for west-central Florida. As illustrated, the Bone Valley member of the Peace River Formation is the predominant surficial geologic unit in the study area.

Distinguishing the undifferentiated surficial sands from the Bone Valley member is based on a change in the clay content. The mine cuts, pits, and ditches from recent mining may penetrate most of the surficial sands and Bone Valley member. The first confining unit generally encountered would be the calcareous clay/mudstone or calcareous cemented strata of the Hawthorn Group.

2.3.1.4 Bearing Strength

Eight SPT and three CPT borings were drilled near the power plant site in areas undisturbed by recent mining activities (Figure 2.3.1-11). The SPT test borings were performed in accordance with ASTM D1586 standards, which determine the bearing strength of the unconsolidated soils. An SPT *N* value profile for borings identified in Figure 2.3.1-11 is illustrated in Figure 2.3.1-15. Figure 2.3.1-15 illustrates profiles, N values horizontally, and sample depth vertically for each boring in the soil profile A-A'. The larger N values indicate more compaction and consolidation of the soils, while smaller values indicate less compaction and less consolidation. The unconsolidated soils had blow counts ranging from zero blows per foot (GW-4, mine tailings) to more than 50 blows per foot. The strength of the carbonate units in the Hawthorn



EXPLANATION

★ POLK POWER STATION
Qu - UNDIFFERENTIATED SAND, SHELL, CLAY, MARL, AND PEAT
Qft - FORT THOMPSON FORMATION
Qc - CALOOSAHATCHEE FORMATION
Ptu - TAMIAMI FORMATION AND UNDIFFERENTIATED DEPOSITS
Mh - HAWTHORN GROUP
PEACE RIVER FORMATION – BONE VALLEY MEMBER
Os - SUWANNEE LIMESTONE
Eo - OCALA LIMESTONE

FIGURE 2.3.1-14.
SURFICIAL GEOLOGY OF WEST CENTRAL FLORIDA

Sources: Modified from Brooks, 1981; ECT, 1991.

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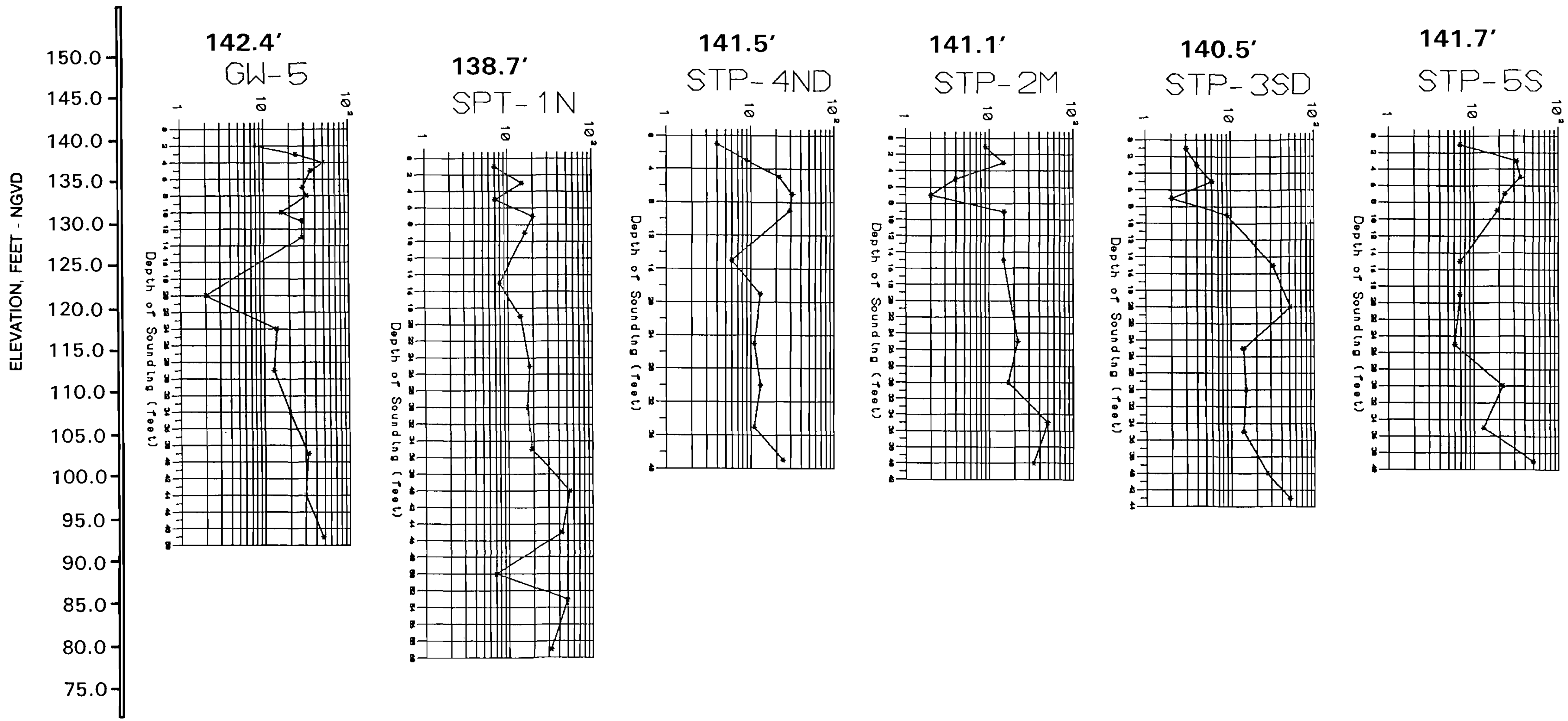

NOTES: HORIZONTAL AXIS REPRESENTS "N" VALUE
VERTICAL AXIS REPRESENTS DEPTH OF SAMPLE
142.4'- ELEVATION OF BORING LOCATION

FIGURE 2.3.1-15.

SPT " N VALUE" PROFILE FOR SOIL PROFILE A-A'

Source: ECT, 1992.

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Group generally were greater than 50 blows per foot. Thus, these units are considered well compacted.

The power plant structures have rigid settlement requirements but apply a relatively light load. Due to the compressible surficial deposits, foundations for the main plant structures will be supported on either driven displacement piles (with pre-drilling) or auger cast piles. Either pile type will be placed into competent carbonate strata within the Hawthorn Group.

For smaller structures with less stringent settlement requirement and smaller loads, shallow spread footings will be used. Tank structures are to be placed on ring beam footings.

At the time of these baseline studies, the central power block area of the site was inaccessible by a drill rig due to previous and existing mining activities. To supplement the baseline data previously presented, additional geotechnical and drilling programs are scheduled for the central area. This data, along with the geotechnical data obtained from the numerous clay settling ponds near the site, will be evaluated for final foundation designs.

2.3.2 SUBSURFACE HYDROLOGY

The groundwater aquifer systems in Polk County include, in descending order, the surficial aquifer (usually unconfined), intermediate aquifer (usually semi-confined to confined), and the Floridan aquifer (usually confined). The confining units of the intermediate aquifer system separate the aquifers from one another, including the upper and lower intermediate aquifers. In southwest Polk County, the surficial aquifer and upper intermediate are hydraulically interconnected as are the lower intermediate and Floridan aquifers. However, the two upper aquifers are not in good hydraulic connection to the two lower aquifers.

2.3.2.1 Subsurface Hydrological Data for the Site

Shallow Aquifer

The surficial aquifer is composed of the undifferentiated sands and clays, plus the upper sandy section of the Bone Valley member of the Peace River Formation. The precipitation at the site is approximately 53 inches per year. The amount of recharge entering the surficial aquifer is affected by runoff and evapotranspiration. Runoff and evapotranspiration may account for more than 90 percent of the precipitation received. The surficial aquifer is typically in hydraulic communication with the streams and lakes within southwestern Polk County.

A network of five PVC observation wells (three 4-inch diameter monitor wells and two 2-inch diameter piezometers) were used to monitor the groundwater levels within the surficial aquifer (Figure 2.3.1-5). These wells had either 10- or 15-ft screens that were placed to intercept the water table (see Appendix 11.7.1 for well construction details). Groundwater levels across the site ranged from approximately 130 to 144 ft-NGVD. The water table fluctuation has been approximately 4 to 6 ft from the end of the dry season to the end of the wet season. The hydrograph presented in Figure 2.3.2-1 shows the time-dependent surficial aquifer water level fluctuations from the five observation wells. Figure 2.3.2-2 shows the groundwater contours for the surficial aquifer on May 20, 1991. In addition to the groundwater contours, Figure 2.3.2-2 illustrates the approximate location of a groundwater divide. The

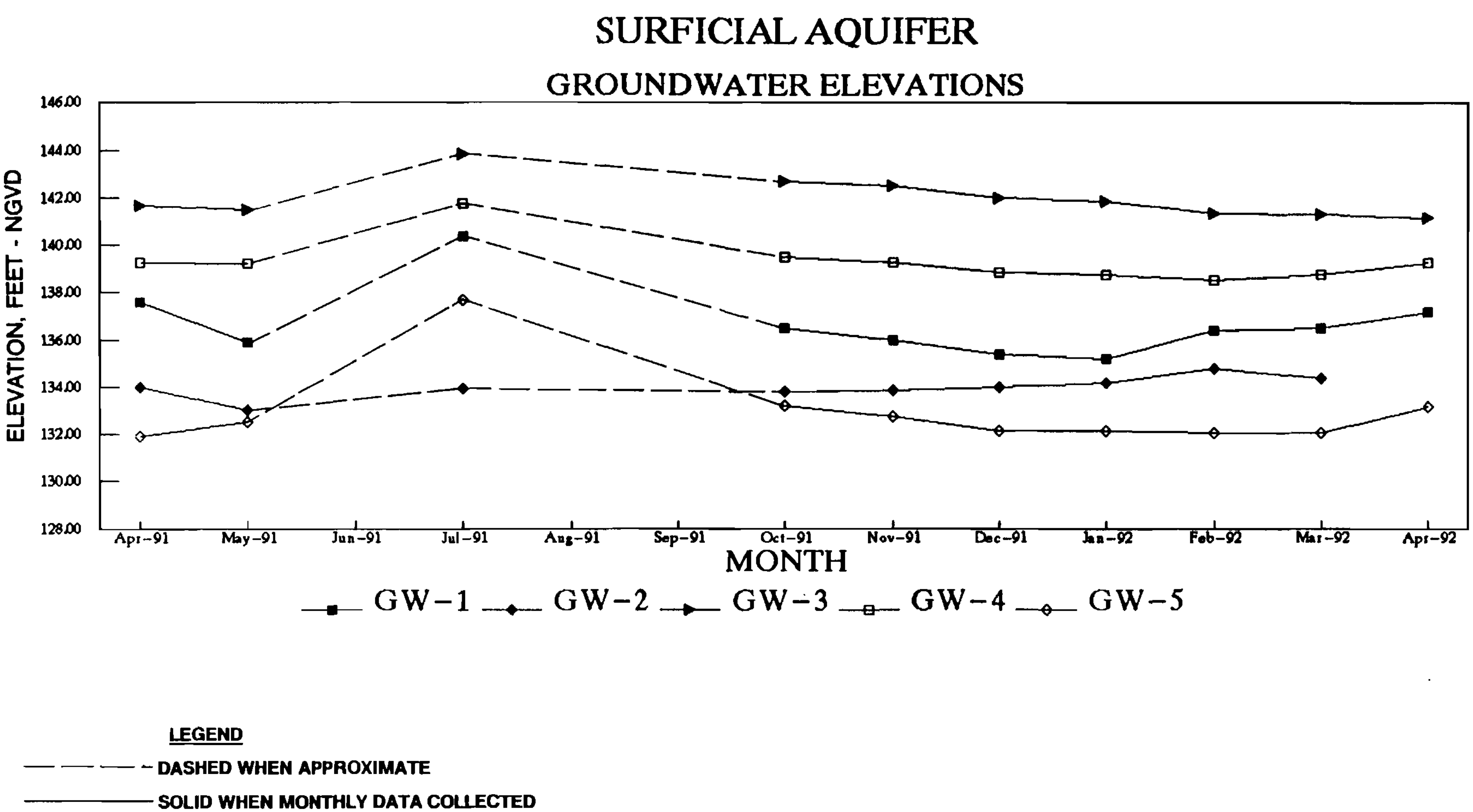

FIGURE 2.3.2-1.

HYDROGRAPH FOR SURFICIAL AQUIFER

Source: ECT, 1992.

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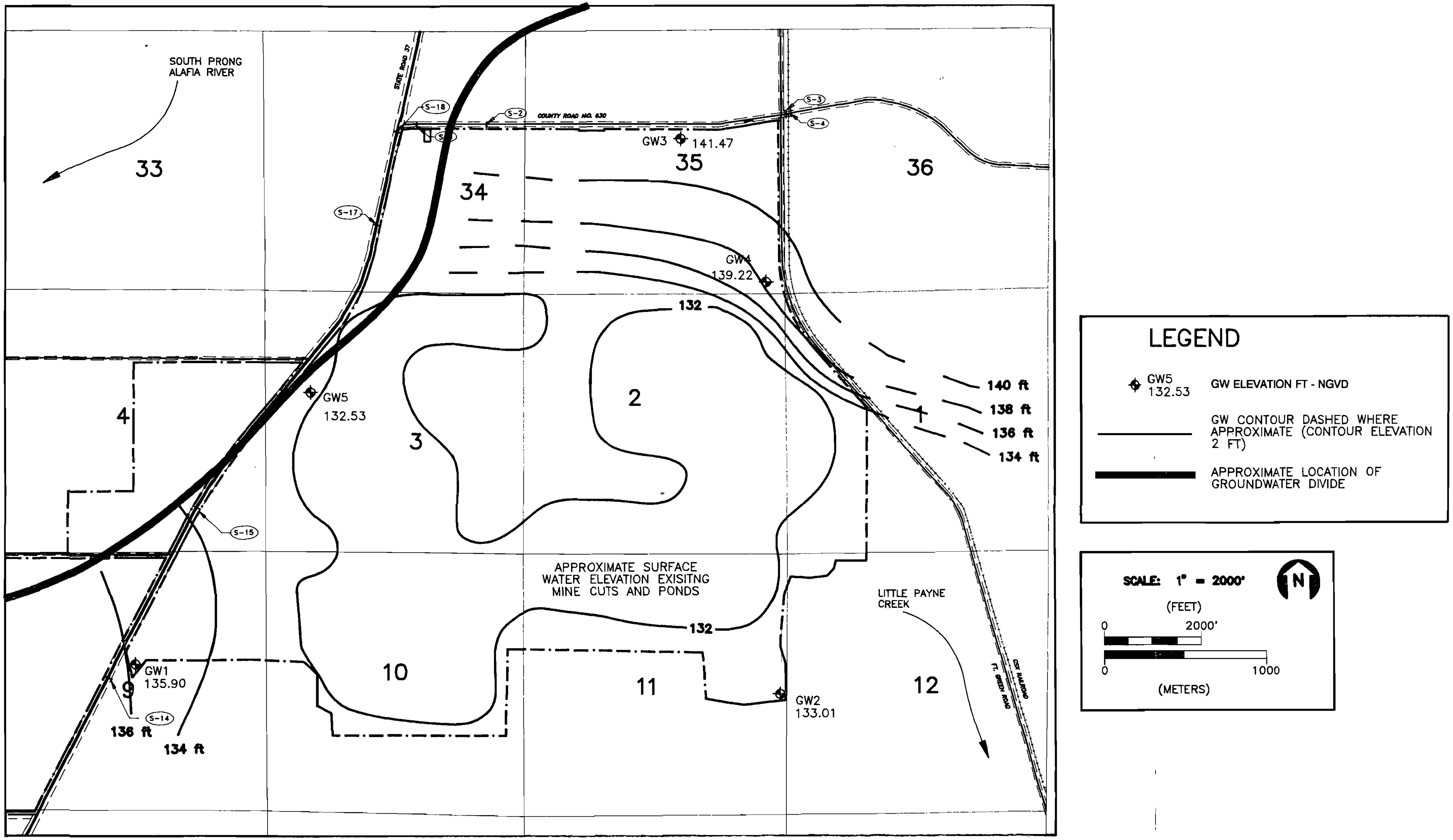

FIGURE 2.3.2-2.

GROUNDWATER CONTOUR MAP OF SURFICIAL AQUIFER (05/91)

Source: ECT, 1992.

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groundwater divide location is controlled by the surface water drainage basins. Groundwater north of the divide flows to the South Prong Alafia River. Groundwater south of the divide flows to the Little Payne Creek. Table 2.3.2-1 summarizes the groundwater level measurements for all observation wells and aquifers monitored. Permeability tests (short duration pump and recovery tests) were conducted on all 4-inch diameter monitor wells within the surficial and intermediate aquifer systems (Table 2.3.2-2). The hydraulic conductivity data for the surficial aquifer ranged from 5 to 11 feet per day (ft/day) and are summarized in Table 2.3.2-2.

Groundwater flow in the surficial aquifer are toward two surface water features and form a groundwater divide near SR 37 (Figure 2.3.2-2). Groundwater east and south of the divide flows toward the Little Payne Creek (south and southeast). Hydraulic gradients within the surficial aquifer ranged from approximately 0.0007 to 0.007 feet per foot (ft/ft). The linear groundwater flow velocities for the surficial aquifer may range from approximately 0.001 to 1.0 ft/day .

Average aquifer characteristics from ten surficial aquifer tests within a 15-mile radius of the site were obtained from SWFWMD (SWFWMD, 1988) and summarized in Table 2.3.2-3. For the surficial aquifer, average values of transmissivity and specific yield are 1,223 square feet per day (ft^2/day) and 0.11 or 11 percent, respectively. The ratio of horizontal to vertical hydraulic conductivities may range from approximately 1 to 2 orders of magnitude (10 to 100).

The groundwater quality of the surficial (water table) aquifer is classified as G-II and is dependent on the chemical constituents within the rainfall and surface activities. Based on the ambient groundwater quality monitoring program by SWFWMD (SWFWMD, 1988), several regional trends are presented for background quality:

- Total dissolved solids (TDS), <250 milligrams per liter (mg/L);
- Total hardness, <25 mg/L;
- Chlorides, <25 mg/L; and
- Sulfates, <25 mg/L.

Table 2.3.2-1. Tampa Electric Company Polk Power Station Summary of Groundwater Levels

Aquifer	Station	Well Nest	Reference Elevation (ft-NGVD)	Groundwater Elevations (ft-NGVD) 11-Apr-91	20-May-91	10-Jul-91	31-Oct-91	19-Nov-91	31-Dec-91
Surficial	GW1	S1	145.70	137.60	135.90	140.39	136.50	135.96	135.38
	GW2	S1	138.79	134.00	133.01	133.96	133.81	133.85	134.01
	GW3	S1	154.84	141.69	141.47	143.84	142.68	142.50	142.00
	GW4	S1	147.06	139.28	139.22	141.76	139.50	139.26	138.86
	GW5	S1	145.07	131.92	132.53	137.68	133.23	132.77	132.17
Upper Intermediate	GW1	I1	145.00	126.50	126.72	127.92	128.10	127.56	126.32
	GW2	I1	138.83	134.41	134.08	134.80	133.97	134.87	135.03
	GW3	I1	152.45	133.13	133.07	134.27	134.11	133.43	130.75
	GW4	I1	146.06	130.76	130.68	131.64	132.76	132.46	131.90
	GW5	I1	145.73	126.18	126.79	128.46	129.59	129.23	129.03
Lower Intermediate	GW1	I3	145.45	49.25	48.21	58.57	62.19	57.89	53.11
	GW2	I3	139.29	49.61	49.70	58.79	62.71	58.41	53.35
	GW3	I3	151.08	54.36	57.12	61.73	68.04	65.34	60.66
Floridan	GW1	F1	146.03	41.93	40.58	51.79	53.13	49.03	44.81

Aquifer	Station	Well Nest	Reference Elevation (ft-NGVD)	Groundwater Elevations (ft-NGVD) 14-Jan-92	26-Feb-92	26-Mar-92	28-Apr-92
Surficial	GW1	S1	145.70	135.21	136.38	136.50	137.20
	GW2	S1	138.79	134.19	134.79	134.37	Not Taken
	GW3	S1	154.84	141.83	141.34	141.28	141.16
	GW4	S1	147.06	138.74	138.52	138.76	139.28
	GW5	S1	145.07	132.15	132.05	132.05	133.15
Upper Intermediate	GW1	I1	145.00	126.07	124.98	124.64	124.00
	GW2	I1	138.83	135.18	136.01	136.05	Not Taken
	GW3	I1	152.45	130.42	129.65	130.89	131.29
	GW4	I1	146.06	131.86	131.66	131.58	131.44
	GW5	I1	145.73	128.99	128.25	128.25	128.39
Lower Intermediate	GW1	I3	145.45	51.41	51.77	52.33	55.11
	GW2	I3	139.29	51.91	52.23	52.87	Not Taken
	GW3	I3	151.08	60.37	59.42	59.84	60.66
Floridan	GW1	F1	146.03	42.99	43.99	44.35	46.91

Source: ECT, 1992.

Table 2.3.2-2. Summary of Hydraulic Conductivity Results

Monitor Well	Q (gpm)	Q (ft^3/m)	Change in Head - dh (ft)	Change in Time - dh (minutes)	T (ft^2/min)	T (ft^2/day)	b (ft)	K (ft/day)	Method of Analysis
GW-1 S1-R			6.43	0.0 to 6.5		238.0	34.0	7.0	Bouwer and Rice
I1-D	2.70	0.36	6.07	0.2 to 2.0	$1.1x10^{-2}$	15.7			Jacob St. Line
I1-R	2.70	0.36	6.33	1.0 to 10.0	$1.0x10^{-2}$	15.0			Jacob St. Line
I3-D	*								
I3-R	*								
GW-2 S1-R			3.99	0.0 to 7.0		189.0	35.0	5.4	Bouwer and Rice
I1-D	4.30	0.57	61.50	2.0 to 20.0	$1.7x10^{-3}$	2.5			Jacob St. Line
I1-R	4.30	0.57	39.00	5.0 to 50.0	$2.7x10^{-3}$	3.9			Jacob St. Line
I3-D	*								
I3-R	*								
GW-3 S1-R			3.99	0.0 to 7.0		328.6	31.0	10.6	Bouwer and Rice
I1-D	3.00	0.40	35.80	2.0 to 20.0	$2.1x10^{-3}$	3.0			Jacob St. Line
I1-R	3.00	0.40	24.00	20.0 to 200.0	$3.1x10^{-3}$	4.4			Jacob St. Line
I3-D	3.30	0.44	31.20	2.0 to 20.0	$2.6 x 10^{-3}$	3.7			Jacob St. Line
I3-R	3.30	0.44	26.90	4.0 to 40.0	$3x10^{-3}$	4.3			Jacob St. Line

Note: ft^3/m = cubic feet per meter.
ft^2/min = square feet per minute.
S1 = surficial aquifer.
I1 = upper intermediate aquifer.
I3 = lower intermediate aquifer.
R = recovery test.
D = drawdown test.

*Erratic data due to electronic interference obtained, unable to analyze.

Source: ECT, 1992.

Table 2.3.2-3. Aquifer Characteristic Test Data (15-mile radius)

Aquifer	Minimum	Maximum	Average
Surficial (10 tests)			
Transmissivity (ft^2/day)	254	2,393	1,223
Specific yield (ND)	5×10^{-3}	0.20	0.11
Intermediate (9 tests)			
Transmissivity (ft^2/day)	160	3,837	808
Storage coefficient (ND)	4.0×10^{-5}	3×10^{-4}	1.3×10^{-4}
Leakance (ft^3/day/ft^3)	8.0×10^{-7}	3×10^{-4}	1.5×10^{-4}
Floridan (10 tests)			
Transmissivity (ft^2/day)	103,610	735,294	292,850
Storage coefficient (ND)	4.0×10^{-4}	3×10^{-3}	1×10^{-3}
Leakance (ft^3/day/ft^3)	1.0×10^{-5}	3×10^{-4}	2.1×10^{-4}

Note: ND = non-dimensional.

Source: SWFWMD, 1988.

Additional background groundwater quality data for Polk County was obtained from the FDER groundwater quality monitoring program. The data for the surficial aquifer is summarized in Table 2.3.2-4. Site-specific groundwater quality from the surficial aquifer was measured from a sampling event in May 1991. The groundwater quality for the surficial aquifer is summarized in Table 2.3.2-5, and the laboratory analyses are included in Appendix 11.7.3. With the exceptions of total iron (GW-1, GW-2, and GW-3) and gross alpha with Radium 226 and 228 (GW-2 and GW-3), primary and secondary drinking water standards were met.

Radiation within the groundwater is a result of weathering of uranium-bearing phosphatic soils and rock. The radionuclides of general concern include Radium 226, Radon 222, and Polonium 210. While other radioactive isotopes may exist, they are not considered to be hazardous. The presence of the phosphatic soils and rock can cause gross alpha activities to exceed state and Federal drinking water standards. These high activity levels are generally the result of natural releases from phosphatic material and are not considered to be a direct result of mining activities (Upchurch, 1986). However, mining activities may act to redistribute or disturb the radioactive materials. Numerous studies have been conducted regarding uranium and its daughter products in groundwater systems and potential relationship to mining/industrial activities. One study by Kaufmann and Bliss (1977) compared radium in groundwater from the mining district and the coastal areas. The study reported that the elevated radium in the coastal areas was not related to the industrial or mining activities, but was rather a natural condition for the geologic setting.

Analytical results from the May 1991 sampling event indicate that the radionuclide emissions exceeding primary drinking water standards were detected from the surficial aquifer at Stations GW-2 and GW-3 and the intermediate aquifer at Station GW-1 (Table 2.3.2-6). These samples were not filtered prior to analysis and had total solids concentrations greater than 250 mg/L. It is believed that the elevated radionuclide emissions are related to the amount of solids present within the groundwater samples.

Table 2.3.2-4. FDER Surficial Aquifer Groundwater Quality Monitoring Program--Polk County

Surficial Aquifer Parameters	Units	Groundwater Quality Standard*	Average Value	Standard Deviation	Range Minimum	Range Maximum
In situ Measurements						
pH	SU		6.0292	0.941	4.700	8.600
Classical						
Arsenic	mg/L	0.05	0.0004	0.001	0.000	0.003
Arsenic (dissolved)	μg/L	--	0.0000	0.000	0.000	0.000
Chloride	mg/L	250	14.0484	10.135	4.000	38.000
Fluoride	mg/L	2.0	0.1819	0.180	0.000	0.576
Nitrate	mg/L	10.0	0.6204	1.220	0.000	3.610
Selenium	mg/L	0.01	0.0000	0.000	0.000	0.000
Selenium (dissolved)	μg/L	--	2.5000	3.075	0.000	7.500
Sodium	mg/L	160	7.3760	5.591	2.000	27.000
Sulfate	mg/L	250	38.2300	48.896	0.000	148.000
TDS	mg/L	500	182.1250	121.180	23.000	454.000
Other Metals						
Barium	mg/L	1.0	0.0041	0.012	0.000	0.380
Barium (dissolved)	μg/L	--	0.0000	0.000	0.000	0.000
Cadmium	mg/L	0.010	0.0036	0.005	0.000	0.014
Cadmium (dissolved)	μg/L	--	1.0000	2.236	0.000	5.000
Chromium (total)	mg/L	0.05	0.0057	0.012	0.000	0.032
Chromium (dissolved)	μg/L	--	0.0000	0.000	0.000	0.000
Copper	mg/L	1.0	0.0076	0.012	0.000	0.032
Copper (dissolved)	μg/L	--	0.0000	0.000	0.000	0.000
Iron	mg/L	0.3	3.9685	5.195	0.030	19.300
Iron (dissolved)	μg/L	--	0.6107	0.910	0.000	2.910
Lead	mg/L	0.05	0.0661	0.113	0.000	0.369
Manganese	mg/L	0.05	0.1368	0.182	0.001	0.438
Manganese (dissolved)	μg/L	--	27.7500	26.735	0.000	72.000
Mercury	mg/L	0.002	0.0003	0.001	0.000	0.003
Silver	mg/L	0.05	0.0000	0.000	0.000	0.001
Zinc	mg/L	5.0	0.0388	0.077	0.000	0.295
Zinc (dissolved)	μg/L	--	4.0000	6.856	0.000	15.000

Table 2.3.2-4. FDER Surficial Aquifer Groundwater Quality Monitoring Program--Polk County (Continued, Page 2 of 2)

Surficial Aquifer Parameters	Units	Groundwater Quality Standard*	Average Value	Standard Deviation	Range	
					Minimum	Maximum
<u>Organics</u>						
Endrin	$\mu g/L$	0.2	0.0000	0.000	0.000	0.000
Methoxychlor	$\mu g/L$	100.0	0.0000	0.000	0.000	0.000
Toxaphene	$\mu g/L$	5.0	0.0000	0.000	0.000	0.000
2,4-D	$\mu g/L$	100	0.0000	0.000	0.000	0.000
2,4,5-TP, silvex	$\mu g/L$	10	0.0000	0.000	0.000	0.000
Benzene	$\mu g/L$	1.0	0.0238	0.109	0.000	0.500
Carbon tetrachloride	$\mu g/L$	3.0	0.0238	0.109	0.000	0.500
Ethylene dibromide	$\mu g/L$	0.02	0.0000	0.000	0.000	0.000
Tetrachloroethene	$\mu g/L$	3.0	0.0238	0.109	0.000	0.500
Trichloroethene	$\mu g/L$	3.0	0.0312	0.125	0.000	0.500
Vinyl chloride	$\mu g/L$	1.0	0.0238	0.109	0.000	0.500
1,2-Dichloroethane	$\mu g/L$	3.0	0.0238	0.109	0.000	0.500
1,1,1-Trichloroethane	$\mu g/L$	0.2	0.0312	0.125	0.000	0.500

Note: SU = standard units.
-- = no data available.

*Standards from Chapter 17-550, F.A.C.

Source: FDER, 1991.

Table 2.3.2-5. Groundwater Quality Summary for Surficial Aquifer

Parameter	Units	Groundwater Quality Standard	GW-1S-1	GW-2S-1	GW-3S-1	Mean	Maximum	Minimum	Standard Deviation
pH (*in situ*)	su	6.5-8.5	7.0	5.4	8.1	6.8	8.1	5.4	1.1
Arsenic EPA 206.2	µg/L	50.0	<10.000	<10.000	<10.000	--	--	--	--
Barium	mg/L	1.0	<0.300	<0.300	<0.300	--	--	--	--
Cadmium	µg/L	0.010	1.6	<0.800	3.8	1.8	3.8	<MDL	1.6
Chromium	mg/L	0.05	<0.050	<0.050	<0.050	--	--	--	--
Lead EPA 239.2	µg/L	50.0	19	<5.000	14	11	19	<MDL	8
Mercury EPA 245.1	µg/L	0.2	<0.200	<0.200	<0.200	--	--	--	--
Nitrogen, nitrate	mg/L	10.0	<1.000	<1.000	<1.000	--	--	--	--
Silver	µg/L	50.0	<0.070	<0.070	<0.070	--	--	--	--
Chloride	mg/L	250.0	11	17	3.2	10.4	17	3.2	5.7
Color	Pt-Co	15	5	500	75	193	500	5	219
Copper	mg/L	1.0	<0.030	<0.030	<0.030	--	--	--	--
Fluoride, soluble	mg/L	4.0	0.1	0.26	1.6	0.65	1.6	0.1	0.67
Iron	mg/L	0.3	0.9	7.4	2.3	3.5	7.4	0.9	2.7
Manganese	mg/L	0.05	<0.050	<0.050	<0.050	--	--	--	--
Sodium	mg/L	160.0	10	12	3	8	12	3	4
Sulfate	mg/L	250	<5.000	<5.000	27	9	27	<MDL	13
Surfactants	mg/L	0.5	0.038	<0.020	<0.020	0.013	0.038	<MDL	0.018
TDS	mg/L	500	70	200	86	119	200	70	58
Endrin	µg/L	0.2	<0.080	<0.080	<0.080	--	--	--	--
Methoxychlor	µg/L	100.0	<100.000	<100.000	<100.000	--	--	--	--
Toxaphene	µg/L	5.0	<3.000	<3.000	<3.000	--	--	--	--
2,4-D	µg/L	100.0	<10.000	<10.000	<10.000	--	--	--	--
2,4,5-Trichlorophenol	µg/L	10.0	<1.000	<1.000	<1.000	--	--	--	--
Benzene	µg/L	1.0	<0.600	<1.200	<0.600	--	--	--	--
Carbon tetrachloride	µg/L	3.0	<0.500	<1.000	<0.500	--	--	--	--
1,2-Dibromoethane	µg/L	0.02	<0.020	<0.020	<0.020	--	--	--	--
Tetrachloroethylene	µg/L	3.0	<5.000	<5.000	<5.000	--	--	--	--
Trichloroethylene	µg/L	3.0	<5.000	<5.000	<5.000	--	--	--	--
Chloroform	µg/L	*	<0.400	<0.800	<0.400	--	--	--	--
Bromodichloromethane	µg/L	*	<0.600	<1.200	<0.600	--	--	--	--
Dibromochloromethane	µg/L	*	<1.000	<2.000	<1.000	--	--	--	--

Table 2.3.2-5. Groundwater Quality Summary for Surficial Aquifer (Continued, Page 2 of 2)

Parameter	Units	Groundwater Quality Standard	GW-1S-1	GW-2S-1	GW-3S-1	Mean	Maximum	Minimum	Standard Deviation
Bromoform	µg/L	*	<2.000	<4.000	<2.000	--	--	--	--
Vinyl chloride	µg/L	1.0	<0.800	<1.600	<0.800	--	--	--	--
1,2-Dichloroethane	µg/L	3.0	<1.000	<2.000	<1.000	--	--	--	--
1,1,1-Trichloroethane	µg/L	200.0	<0.800	<1.600	<0.800	--	--	--	--
Turbidity	NTU	1	110	510	190	270	510	110	173
Gross alpha	pCi/L	15	13.5 ±6.8	44 ±6.6	16.6 ±6.4	24.7	44	13.5	13.7
Radium 226	pCi/L	†	2.2 ±0.5	8.9 ±1.0	8.5 ±1.0	6.5	8.9	2.2	3.1
Radium 228	pCi/L	†	1.4 ±1.2	<1.0	1.3 ±1.1	0.9	1.4	<MDL	0.6

Note: Pt-Co = platinum-cobalt units.
NTU = nephelometric turbidity units.
pCi/L = picoCuries per liter.
MDL = method detection limit.

*Total trihalomethane water quality standard is 100 mg/L.
†Combined Radium 226 and 228 water quality standard is 5 pCi/L.

Source: ECT, 1992.

Table 2.3.2-6. Summary of Radionuclide Emission Results

Laboratory Report Date	Sample Location	Field Filtered or Unfiltered	Date Sampled	Gross Alpha (pCi/L)	Radium 226 (pCi/L)	Radium 228 (pCi/L)	Total Solids (mg/L)	TSS (mg/L)	TDS (mg/L)
07/19/91	GW1-S1	Unfiltered	05/21/91	13.5 ±6.8	2.2 ±0.5	1.4 ±1.2	94	24	70
	GW2-S1	Unfiltered	05/22/91	44 ±6.6	8.9 ±1	ND	264	64	200
	GW3-S1	Unfiltered	05/20/91	16.6 ±6.4	8.5 ±1	1.3 ±1	376	290	86
	GW1-I1	Unfiltered	05/21/91	4.8 ±6.9	6.2 ±0.9	1.4 ±3	362	42	320
	GW2-I1	Unfiltered	05/22/91	ND	0.6 ±0.3	ND	270	ND	270
	GW3-I1	Unfiltered	05/20/91	ND	ND	ND	295	55	240
	GW1-I3	Unfiltered	05/21/91	ND	0.7 ±0.3	3.4 ±3.2	296	16	280
	GW2-I3	Unfiltered	05/23/91	ND	1.2 ±0.4	ND	640	40	600
	GW3-I3	Unfiltered	05/20/91	ND	ND	ND	299	69	230
	GW1-F1	Unfiltered	05/22/91	ND	1 ±0.4	ND	253	33	220
04/21/92	GW1-S1	Unfiltered	03/03/92	9.4 ±1.9	2 ±0.1	5 ±3.5	80	18	62
	GW2-S1	Unfiltered	03/03/92	119 ±11.3	5.9 ±0.1	ND ±1.3	280	58	222
	GW3-S1	Unfiltered	03/03/92	3.3 ±1.4	0.4 ±0.08	ND ±2.5	91	7	84
	GW1-S1	Filtered	03/03/92	6.6 ±1.7	19.7 ±0.3	0.6 ±2.9	47	ND	47
	GW2-S1	Filtered	03/03/92	59 ±6.5	2.1 ±0.08	1.6 ±2.6	140	ND	140
	GW3-S1	Filtered	03/03/92	ND ±0.9	0.9 ±0.09	2.2 ±2.9	91	ND	91
05/07/92	Sample 1		03/03/92	3.5 ±2.6	0.8 ±1.3	ND ±1.1	360	12	348
	Sample 2		03/03/92	2,990 ±517	15.4 ±3.4	0.3 ±1	49,000	70,000	*
	Sample 3		03/03/92	2.1 ±3.1	1.4 ±1.4	ND ±1	330	ND	330
	Sample 4		03/03/92	450 ±125	23.6 ±4	6.4 ±1.2	14,000	6,200	7,800
	Sample 5		03/03/92	1.1 ±2.4	2.2 ±1.8	ND ±1	300	ND	300
	Sample 6		03/03/92	191 ±37.6	12.7 ±3.4	0.8 ±1.1	2,800	1,800	1,000

Note: S1 = surficial aquifer.
I1 = upper intermediate aquifer.
I3 = lower intermediate aquifer.
F1 = Floridan aquifer.
ND = not detected at or above the method detection limits (see laboratory reports, Appendices 11.7.3 and 11.7.4).
Descriptions for Samples 1 through 6 are provided in Table 2.3.2-8.

*An erroneous TDS value has resulted from a high concentration of total solids and TSS. These concentrations exceed the normal concentration range for this analysis.
Source: ECT, 1992.

To verify the aforementioned theory, a second round of groundwater samples was collected from the surficial aquifer monitor wells in March 1992. Both unfiltered and field filtered groundwater samples were collected. The field filtration was completed by use of an inline 0.45-micron filter. The groundwater samples were analyzed for gross alpha, Radium 226, and Radium 228 emissions plus total solids and total suspended solids (TSS) concentrations (Table 2.3.2-6). By comparing the filtered versus unfiltered data and considering the error bands, there is typically a reduction in the radiation emission rate.

In addition to the filtered and unfiltered sample comparison, an engineering test was conducted and evaluated potential groundwater impacts related to excavating cooling reservoirs from existing mine cuts. The objectives and procedure for this engineering test are summarized in Tables 2.3.2-7 and 2.3.2-8. This test was conducted to support two theories: first, that elevated radionuclide emissions are related to the amount of solids present within the groundwater samples; and second, that the aquifer matrix (soil) will act to filter out solids and reduce the radionuclide emissions from the groundwater. The sample descriptions are summarized in Tables 2.3.2-7 and 2.3.2-8, while the sample results are presented in Table 2.3.2-6. The data supports both theories presented. The samples with less total solids typically have lower radioactive emissions, and a thin layer of aquifer material was able to reduce radioactive emissions.

<u>**Intermediate Aquifer**</u>

The intermediate aquifer system consists of portions of the Peace River and Arcadia Formations of the Hawthorn Group. At the Tampa Electric Company Polk Power Station site, this aquifer has two producing zones which are separated by confining units. The primary recharge to the upper intermediate aquifer is leakage from the surficial aquifer system. The amount of recharge received by the upper intermediate aquifer system ranges from zero to greater than 10 inches per year (SWFWMD, 1988). The rate of recharge into and through the intermediate aquifer is dependent on the potential head difference between the aquifers (or producing zones) and the

Table 2.3.2-7. Radionuclide Engineering Test Procedure Summary

Objective: Conduct an engineering test on a radionuclide sampling program to demonstrate and evaluate potential groundwater impacts related to developing the cooling reservoir within existing mine cuts.

Approach and Procedures: (modified Method 1312, Synthetic Precipitation Leaching Procedure)

Step 1: Personnel collected a representative sample of mine cut surface water at surface water station SW-7 (Sample 1, liquid), mine cut sediment (semi-solid, clayey sludge), and surficial aquifer material (solid, soil).

Step 2: A volume of the mine cut water (liquid) and the mine cut sediment (semi-liquid) was placed into the agitation apparatus. The weight ratio of liquid to semi-solid was approximately four parts liquid and one part semi-solid. The agitation had taken place for a period of 4 ±0.25 hours. After agitation, sufficient quantity of agitated elutriate was obtained to analyze Samples 2 (unfiltered) and 3 (filtered) yielding acceptable detection levels.

Step 3: A volume of the surficial aquifer material (soil) was placed in the synthetic leaching extraction device. A thickness of approximately 2.5 inches of soil was placed between two support screens (top and bottom). A 0.7-micron filter was placed between the support screen and the liquid outlet valve. After placing the soil in the extraction device, the agitated elutriate was poured into the device.

Step 4: A sufficient quantity of extraction leachate (from agitated elutriate sample) was obtained to analyze Samples 4 (unfiltered) and 5 (filtered) yielding acceptable detection levels.

Step 5: An unfiltered control sample (Sample 6) was collected using the same technique as described in Step 3 using deionized water rather than the agitated elutriate.

Results: Comparing unfiltered to filtered water samples, the radionuclide emissions were lower for the filtered samples with less total solids and TSS. The agitated elutriate sample showed some reduction in gross alpha emission after passing through the aquifer material. The control sample (deionized water through the aquifer material) had elevated emission rates for gross alpha and Radium 226, likely resulting from the acquisition of fines from within the aquifer material. The data supports the position that the undisturbed aquifer will have a filtering affect on the groundwater and should prevent significant transport of the radionuclides from the reservoir area after construction.

Source: ECT, 1992.

Table 2.3.2-8. Radionuclide Engineering Test Sample Summary

Sample Number	Sample Description and Purpose
1	Mine Cut Water--A sample volume of the mine cut water from surface water station SW-7 (unfiltered) was collected and analyzed for total solids, TSS, gross alpha, Radium 226, and Radium 228.
2	Elutriate--A sample volume of agitated elutriate (unfiltered) was collected and analyzed for total solids, TSS, gross alpha, Radium 226, and Radium 228.
3	Filtered Elutriate--A sample volume of agitated elutriate was collected and analyzed after filtration through a 0.45-micron filter for total solids, TSS, gross alpha, Radium 226, and Radium 228.
4	Extraction Leachate (Elutriate Filtered through Aquifer Material--A sample volume of extraction leachate (unfiltered) was collected and analyzed for total solids, TSS, gross alpha, Radium 226, and Radium 228.
5	Filtered Extraction Leachate (Sample 4 Filtered)--A sample volume of extraction leachate was collected and analyzed after filtration through a 0.45-micron filter for total solids, TSS, gross alpha, Radium 226, and Radium 228.
6	Control Extraction Leachate (Deionized Water Filtered through Aquifer Material--A sample volume of a control extraction leachate (unfiltered) was collected and analyzed for total solids, TSS, gross alpha, Radium 226, and Radium 228.

Source: ECT, 1992.

thickness and conductivity of the confining units within the intermediate system. The intermediate aquifer is typically in hydraulic communication with the larger rivers in southwestern Polk County.

A network of five PVC observation wells (three 4-inch diameter monitor wells and two 2-inch diameter piezometers) were placed and used to monitor the groundwater levels within the upper intermediate aquifer (Figure 2.3.1-5). Three 4-inch diameter monitor wells were also placed into the lower intermediate aquifer system to monitor the groundwater levels. The wells completed into the upper intermediate and lower intermediate aquifers had 5- and 10-ft screens, respectively.

The screen depth intervals for the upper and lower intermediate aquifers were approximately between 90 and 105 ft bls and 235 to 240 ft bls, respectively (see Appendix 11.7.1 for well construction details).

The potentiometric surface of the upper intermediate aquifer across the Polk Power Station site ranged from approximately 126 to 135 ft-NGVD. The potentiometric surface has fluctuated approximately 2 to 4.5 ft from the end of the dry season to the end of the wet season. The potentiometric surface of the lower intermediate aquifer has ranged from approximately 48 to 68 ft-NGVD across the site. The potentiometric surface has fluctuated approximately 13 to 14 ft from the end of the dry season to the end of the wet season. Table 2.3.2-1 provides a summary of the groundwater level measurements taken on the upper and lower intermediate aquifers. The hydrographs illustrated in Figures 2.3.2-3 and 2.3.2-4 show the time-dependent fluctuations of the potentiometric surfaces for the intermediate aquifer systems.

The most recent published regional potentiometric surface maps (May and September 1990) of the upper intermediate aquifer indicate that the potentiometric surface ranges from 115 ft to 125 ft-msl for the dry season (Figure 2.3.2-5) and wet season (Figure 2.3.2-6), respectively. The groundwater flow direction for the intermediate aquifer system is radially outward from beneath the Tampa Electric Company Polk

90263 0401 05/92

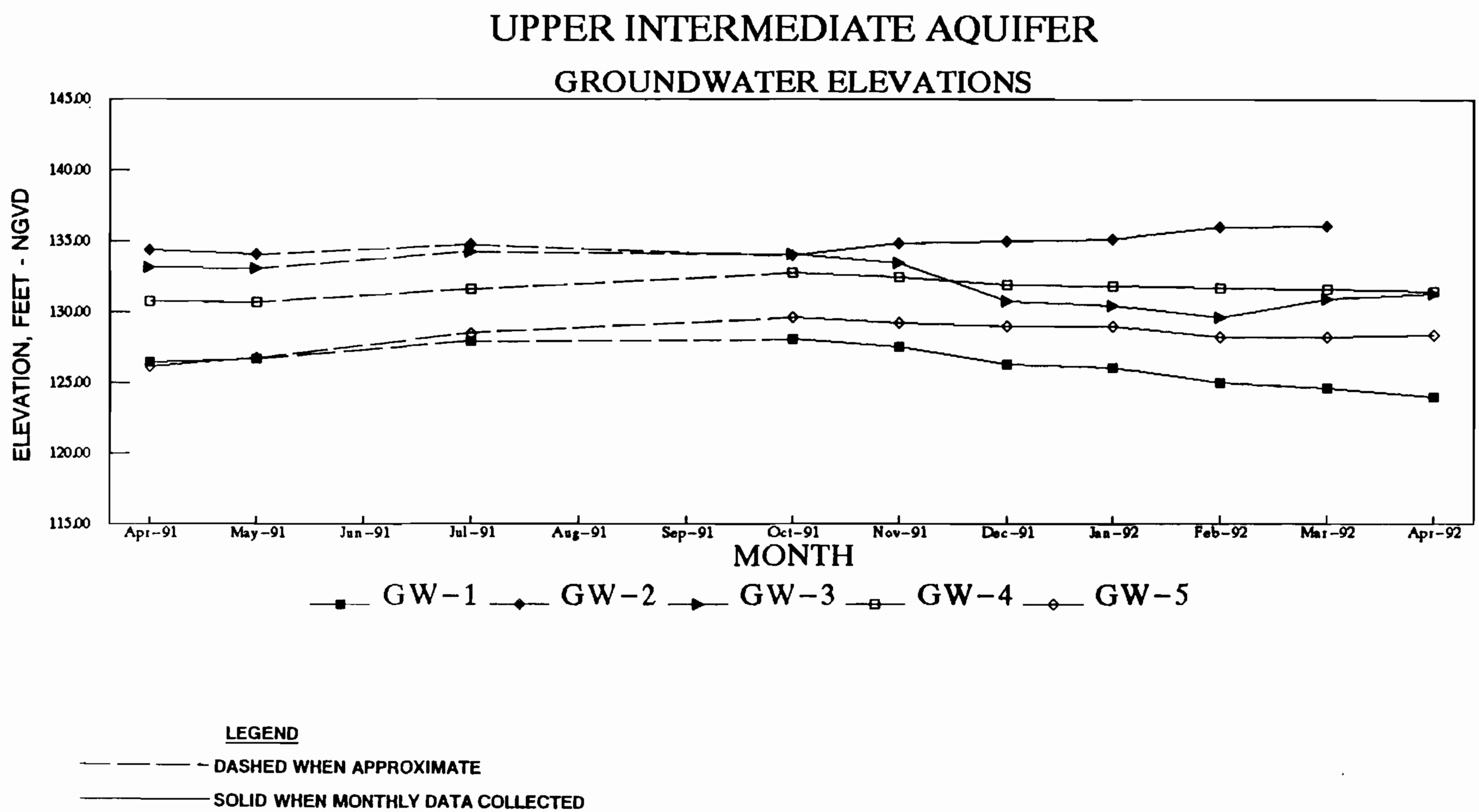

FIGURE 2.3.2-3.

HYDROGRAPH FOR UPPER INTERMEDIATE AQUIFER

Source: ECT, 1992.

TAMPA ELECTRIC
A TECO ENERGY COMPANY

POLK POWER STATION

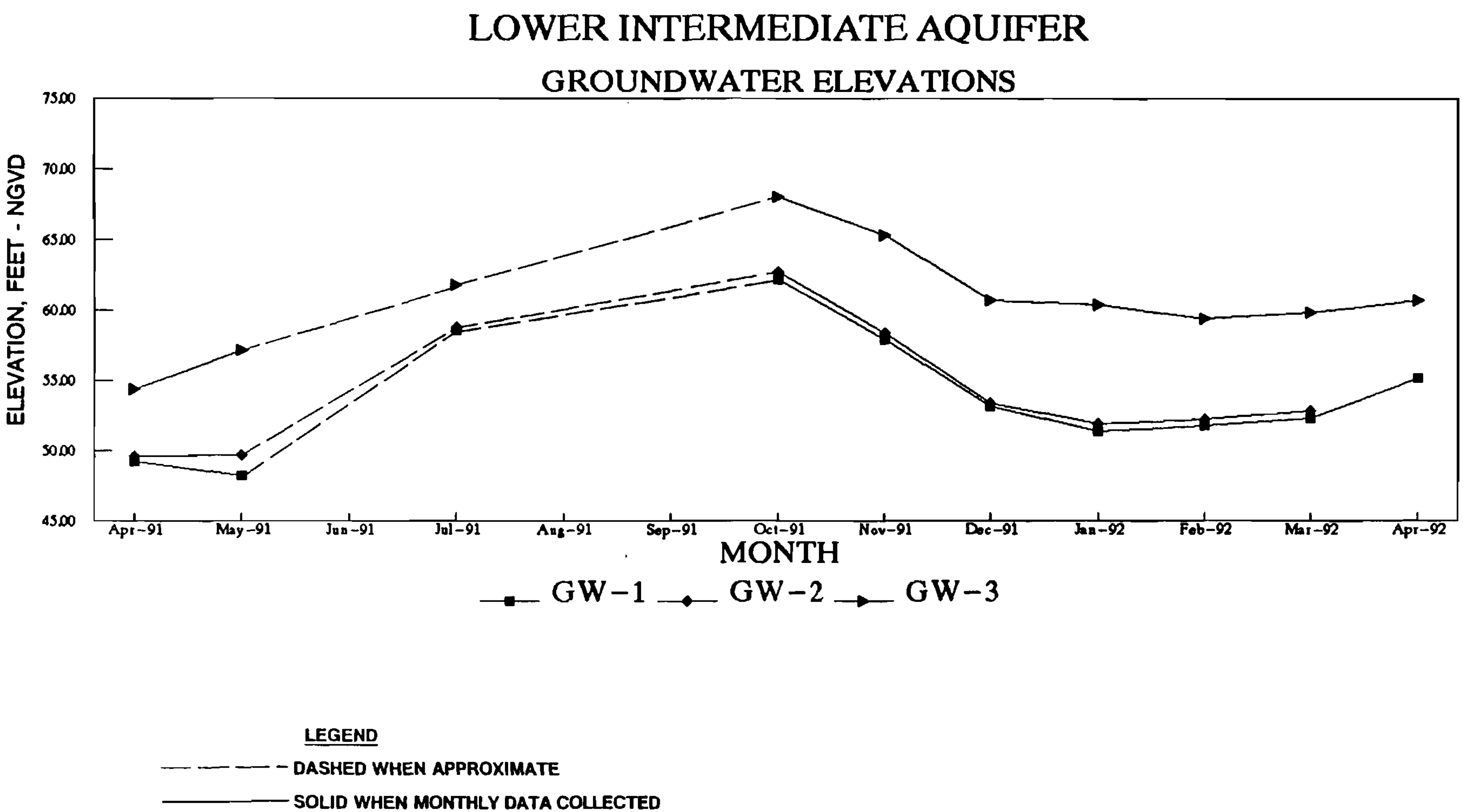

FIGURE 2.3.2-4.

HYDROGRAPH FOR LOWER INTERMEDIATE AQUIFER

Source: ECT, 1992.

TAMPA ELECTRIC
A TECO ENERGY COMPANY

POLK POWER STATION

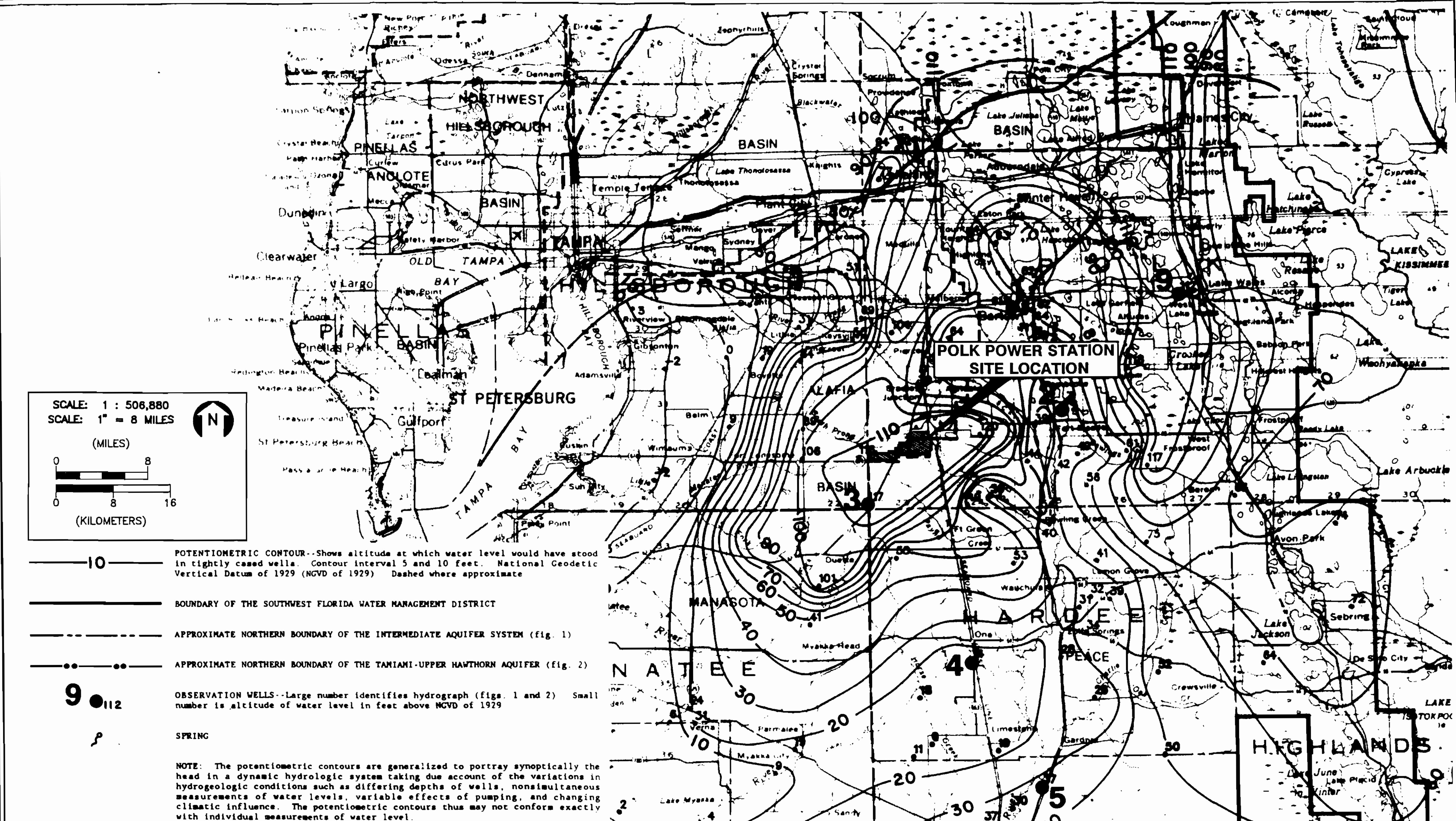

FIGURE 2.3.2-5.

POTENTIOMETRIC SURFACE OF THE INTERMEDIATE AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, MAY 1990

Source: L.A. Knochenmus, 1990.

TAMPA ELECTRIC
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POLK POWER STATION

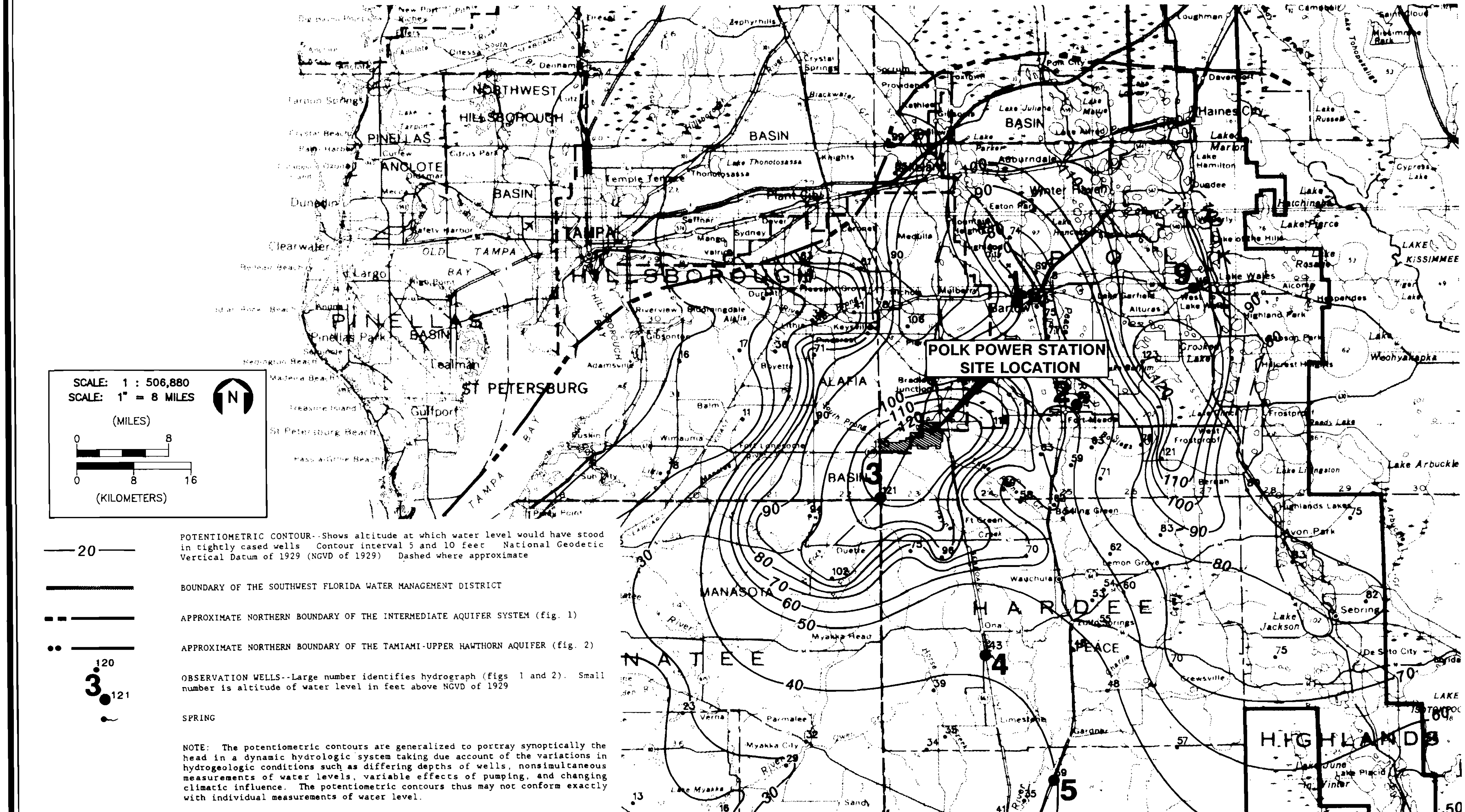

FIGURE 2.3.2-6.

POTENTIOMETRIC SURFACE OF THE INTERMEDIATE AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, SEPTEMBER 1990

Source: R.A. Mularoni & L.A. Knochenmus, 1991.

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POLK POWER STATION

Power Station site. Permeability tests were conducted on the 4-inch monitor wells completed into the upper and lower intermediate aquifers. The resulting hydraulic conductivity data is summarized in Table 2.3.2-2.

Hydraulic gradients within the intermediate aquifer system ranged from approximately 0.0004 to 0.004 ft/ft. Linear groundwater flow velocities for the intermediate aquifer system range between 0.002 to 0.2 ft/day.

Nine aquifer tests for the intermediate aquifer (SWFWMD, 1988) were performed within a 15-mile radius of the site. The average aquifer characteristics from these tests were determined and are summarized in Table 2.3.2-3. For the intermediate aquifer, average values of transmissivity, storage coefficient, and leakance are 808 ft^2/day, 0.00013, and 0.00015 cubic foot per day per cubic foot (ft^3/day/ft^3), respectively. The ratio of horizontal to vertical hydraulic conductivity may range between 2 to 3 orders of magnitude (100 to 1,000).

The groundwater quality of the intermediate aquifer system is generally classified as G-II. The water quality of the intermediate aquifer is dependent on the chemical constituents of the aquifer matrix and the quality of the surficial aquifer. The ambient groundwater quality monitoring program of SWFWMD (1988) presents the following regional trends:

- TDS, 200 to 300 mg/L;
- Total hardness, <120 mg/L;
- Chlorides, <25 mg/L;
- Sulfates, <25 mg/L.

Additional background groundwater quality data for Polk County was obtained from the FDER groundwater monitoring program. The data for the intermediate aquifer is summarized in Table 2.3.2-9. Site-specific groundwater quality from the intermediate aquifer was measured from a sampling event in May 1991. The groundwater quality data for the upper and lower intermediate aquifer systems are summarized

Table 2.3.2-9. FDER Intermediate Aquifer Groundwater Quality Monitoring Program--Polk County

Intermediate Aquifer Parameters	Units	Groundwater Quality Standard*	Average Value	Standard Deviation	Range Minimum	Range Maximum
In situ Measurements						
pH	SU		7.4944	0.331	7.100	8.200
Classical						
Arsenic	mg/L	0.05	0.0006	0.002	0.000	0.005
Arsenic (dissolved)	µg/L	--	0.0000	0.000	0.000	0.000
Chloride	mg/L	250	17.4380	17.644	4.200	64.100
Fluoride	mg/L	2.0	0.3665	0.147	0.193	0.685
Nitrate	mg/L	10.0	0.0215	0.029	0.000	0.075
Selenium	mg/L	0.01	0.0000	0.000	0.000	0.000
Selenium (dissolved)	µg/L	--	0.0000	0.000	0.000	0.000
Sodium	mg/L	160	14.2150	13.420	2.900	45.000
Sulfate	mg/L	250	26.2900	60.319	0.000	205.000
TDS	mg/L	500	259.8000	159.503	44.000	640.000
Other Metals						
Barium	mg/L	1.0	0.0096	0.019	0.000	0.050
Barium (dissolved)	µg/L	--	0.0000	0.000	0.000	0.000
Cadmium	mg/L	0.010	0.0004	0.001	0.000	0.002
Cadmium (dissolved)	µg/L	--	0.0000	0.000	0.000	0.000
Chromium (total)	mg/L	0.05	0.0028	0.009	0.000	0.028
Chromium (dissolved)	µg/L	--	0.0000	0.000	0.000	0.000
Copper	mg/L	1.0	0.0030	0.005	0.000	0.016
Copper (dissolved)	µg/L	--	30.0000	0.000	30.000	30.000
Iron	mg/L	0.3	2.9767	2.559	0.000	7.280
Iron (dissolved)	µg/L	--	0.0000	0.000	0.000	0.000
Lead	mg/L	0.05	0.0120	0.026	0.000	0.070
Manganese	mg/L	0.05	0.0301	0.036	0.000	0.114
Manganese (dissolved)	µg/L	--	0.0000	0.000	0.000	0.000
Mercury	mg/L	0.002	0.0000	0.000	0.000	0.000
Silver	mg/L	0.05	0.0000	0.000	0.000	0.000
Zinc	mg/L	5.0	0.0389	0.045	0.000	0.130
Zinc (dissolved)	µg/L	--	0.0000	0.000	0.000	0.000

Table 2.3.2-9. FDER Intermediate Aquifer Groundwater Quality Monitoring Program--Polk County (Continued, Page 2 of 2)

Intermediate Aquifer Parameters	Units	Groundwater Quality Standard*	Average Value	Standard Deviation	Range	
					Minimum	Maximum
<u>Organics</u>						
Endrin	µg/L	0.2	0.0000	0.000	0.000	0.000
Methoxychlor	µg/L	100.0	0.0000	0.000	0.000	0.000
Toxaphene	µg/L	5.0	0.0000	0.000	0.000	0.000
2,4-D	µg/L	100	0.0000	0.000	0.000	0.000
2,4,5-TP, silvex	µg/L	10	0.0000	0.000	0.000	0.000
Benzene	µg/L	1.0	1.6330	4.081	0.000	13.200
Carbon tetrachloride	µg/L	3.0	0.0000	0.000	0.000	0.000
Ethylene dibromide	µg/L	0.02	0.0000	0.000	0.000	0.000
Tetrachloroethene	µg/L	3.0	0.0000	0.000	0.000	0.000
Trichloroethene	µg/L	3.0	0.0000	0.000	0.000	0.000
Vinyl chloride	µg/L	1.0	0.0000	0.000	0.000	0.000
1,2-Dichloroethane	µg/L	3.0	0.0000	0.000	0.000	0.000
1,1,1-Trichloroethane	µg/L	0.2	0.0000	0.000	0.000	0.000

Note: -- = no data available.

*Standards from Chapter 17-550, F.A.C.

Source: FDER, 1992.

in Tables 2.3.2-10 and 2.3.2-11, respectively. The laboratory analyses may be found in Appendix 11.7.3. With the exception of Radium 226 (GW1-I1) and TDS (GW2-I3), the intermediate aquifer meets primary and secondary drinking water standards.

Floridan Aquifer

The Floridan aquifer includes the Suwannee Limestone, Ocala Group, Avon Park Formation, and a portion of the Oldsmar Formation. At the Polk Power Station site, the Floridan aquifer has two highly transmissive and producing zones: the Suwannee Limestone and Avon Park Formation. Primary recharge to the Floridan aquifer comes from the physiographic ridge areas to the north and east of the Polk Power Station site. Recharge from the intermediate aquifer system to the Floridan aquifer ranges from zero to greater than 10 inches per year (SWFWMD, 1988).

One 4-inch diameter monitor well was completed into the Suwannee Limestone within the Floridan aquifer (Figure 2.3.1-5). This well was used to monitor the changes in the groundwater level of the Floridan aquifer. A 35-ft screen was placed at approximately 300 to 335 ft bls (see Appendix 11.7.1 for well construction details). The potentiometric surface of the Floridan aquifer at the Tampa Electric Company Polk Power Station site ranged from approximately 40 to 53 ft-NGVD. The potentiometric surface has fluctuated approximately 10 to 15 ft from the end of the dry season to the end of the wet season. Table 2.3.2-1 provides a summary of the groundwater level measurements taken from the Floridan aquifer. The hydrograph illustrated as Figure 2.3.2-7 presents the time-dependent fluctuation of the potentiometric surface for the Floridan aquifer. The most recent published regional potentiometric surface maps (May and September 1990) of the Floridan aquifer indicate that the potentiometric surface ranges from 30 to 50 ft for the dry season (Figure 2.3.2-8) and wet season (Figure 2.3.2-9), respectively. The groundwater flow direction for the Floridan aquifer is from the northeast toward the southwest. Hydraulic gradients for this aquifer range from approximately 0.0003 to 0.001 ft/ft.

Table 2.3.2-10. Groundwater Quality Summary for Upper Intermediate Aquifer

Parameter	Units	Groundwater Quality Standard	GW-1S-I1	GW-2S-I1	GW-3S-I1	Mean	Maximum	Minimum	Standard Deviation
pH (*in situ*)	s.u.	6.5-8.5	8.4	8.2	7.4	8.0	8.4	7.9	0.28
Arsenic EPA 206.2	µg/L	50.0	<10.000	<10.000	21	7	21	<MDL	10
Barium	mg/L	1.0	<0.300	<0.300	<0.300	--	--	--	--
Cadmium	µg/L	0.010	<0.800	<0.800	<0.800	--	--	--	--
Chromium	mg/L	0.05	<0.050	<0.050	<0.050	--	--	--	--
Lead EPA 239.2	µg/L	50.0	<5.000	<5.000	<5.000	--	--	--	--
Mercury EPA 245.1	µg/L	0.2	<0.200	<0.200	<0.200	--	--	--	--
Nitrogen, nitrate	mg/L	10.0	<1.000	<1.000	<1.000	--	--	--	--
Silver	µg/L	50.0	<0.070	<0.070	<0.070	--	--	--	--
Chloride	mg/L	250.0	5.7	16	14	11.9	16	5.7	4.5
Color	Pt-Co	15	15	20	15	17	20	15	2
Copper	mg/L	1.0	<0.030	<0.030	<0.030	--	--	--	--
Fluoride, soluble	mg/L	4.0	0.53	1	1	0.84	1	0.53	0.22
Iron	mg/L	0.3	<0.300	<0.300	<0.300	--	--	--	--
Manganese	mg/L	0.05	<0.050	<0.050	<0.050	--	--	--	--
Sodium	mg/L	160.0	22	30	20	24	30	20	4
Sulfate	mg/L	250	5.2	38	7.8	17	38	5.2	14.9
Surfactants	mg/L	0.5	0.063	0.02	0.1	0.061	0.1	0.02	0.033
TDS	mg/L	500	320	270	240	277	320	240	33
Endrin	µg/L	0.2	<0.080	<0.080	<0.080	--	--	--	--
Methoxychlor	µg/L	100.0	<100.000	<100.000	<100.000	--	--	--	--
Toxaphene	µg/L	5.0	<3.000	<3.000	<3.000	--	--	--	--
2,4-D	µg/L	100.0	<10.000	<10.000	<10.000	--	--	--	--
2,4,5-Trichlorophenol	µg/L	10.0	<1.000	<1.000	<1.000	--	--	--	--
Benzene	µg/L	1.0	<0.600	<0.600	<0.600	--	--	--	--
Carbon tetrachloride	µg/L	3.0	<0.500	<0.500	<0.500	--	--	--	--
1,2-Dibromoethane	µg/L	0.02	<0.020	<0.020	<0.020	--	--	--	--
Tetrachloroethylene	µg/L	3.0	<5.000	<5.000	<5.000	--	--	--	--
Trichloroethylene	µg/L	3.0	<5.000	<5.000	<5.000	--	--	--	--
Chloroform	µg/L	*	<0.400	<0.400	<0.400	--	--	--	--
Bromodichloromethane	µg/L	*	<0.600	<0.600	<0.600	--	--	--	--

Table 2.3.2-10. Groundwater Quality Summary for Upper Intermediate Aquifer (Continued, Page 2 of 2)

Parameter	Units	Groundwater Quality Standard	GW-1S-I1	GW-2S-I1	GW-3S-I1	Mean	Maximum	Minimum	Standard Deviation
Dibromochloromethane	µg/L	*	<1.000	<1.000	<1.000	--	--	--	--
Bromoform	µg/L	*	<2.000	<2.000	<2.000	--	--	--	--
Vinyl chloride	µg/L	1.0	<0.800	<0.800	<0.800	--	--	--	--
1,2-Dichloroethane	µg/L	3.0	<1.000	<1.000	<1.000	--	--	--	--
1,1,1-Trichloroethane	µg/L	200.0	<0.800	<0.800	<0.800	--	--	--	--
Turbidity	NTU	1	7.4	<1.000	20	9.1	20	<MDL	8.3
Gross alpha	pCi/L	15	4.8 ±6.9	<2.0	<2.0	1.6	4.8	<MDL	2.3
Radium 226	pCi/L	†	6.2 ±0.9	0.6 ±0.3	<0.6	2.3	6.2	<MDL	2.8
Radium 228	pCi/L	†	1.4 ±3.0	<1.0	<1.0	0.5	1.4	<MDL	0.7

*Total trihalomethane water quality standard is 100 mg/L.
†Combined Radium 226 and 228 water quality standard is 5 pCi/L.

Source: ECT, 1992.

Table 2.3.2-11. Groundwater Quality Summary for Lower Intermediate Aquifer

Parameter	Units	Groundwater Quality Standard	GW-1S-I1	GW-2S-I1	GW-3S-I1	Mean	Maximum	Minimum	Standard Deviation
pH (*in situ*)	s.u.	6.5-8.5	8.6	8.1	8.5	8.4	8.6	8.1	0.07
Arsenic EPA 206.2	µg/L	50.0	<10.000	<10.000	<10.000	--	--	--	--
Barium	mg/L	1.0	<0.300	<0.300	<0.300	--	--	--	--
Cadmium	µg/L	0.010	1.3	<0.500	<0.800	0.4	1.3	<MDL	0.6
Chromium	mg/L	0.05	<0.050	<0.050	<0.050	--	--	--	--
Lead EPA 239.2	µg/L	50.0	9	<5.000	<5.000	3.0	9	<MDL	4.2
Mercury EPA 245.1	µg/L	0.2	<0.200	<0.200	<0.200	--	--	--	--
Nitrogen, nitrate	mg/L	10.0	<1.000	<1.000	<1.000	--	--	--	--
Silver	µg/L	50.0	<0.070	<0.070	<0.070	--	--	--	--
Chloride	mg/L	250.0	18	23	11	17	23	11	5
Color	Pt-Co	15	15	10	10	12	15	10	2
Copper	mg/L	1.0	<0.030	<0.030	<0.030	--	--	--	--
Fluoride, soluble	mg/L	4.0	1	0.81	1.7	1.17	1.7	0.81	0.38
Iron	mg/L	0.3	<0.300	<0.300	<0.300	--	--	--	--
Manganese	mg/L	0.05	<0.050	<0.050	<0.050	--	--	--	--
Sodium	mg/L	160.0	22	58	22	34	58	22	17
Sulfate	mg/L	250	45	54	5.5	34.8	54	5.5	21.1
Surfactants	mg/L	0.5	0.043	0.04	0.06	0.048	0.06	0.04	0.009
TDS	mg/L	500	280	600	230	370	600	230	164
Endrin	µg/L	0.2	<0.080	<0.080	<0.080	--	--	--	--
Methoxychlor	µg/L	100.0	<100.000	<100.000	<100.000	--	--	--	--
Toxaphene	µg/L	5.0	<3.000	<3.000	<3.000	--	--	--	--
2,4-D	µg/L	100.0	<10.000	<10.000	<10.000	--	--	--	--
2,4,5-Trichlorophenol	µg/L	10.0	<1.000	<1.000	<1.000	--	--	--	--
Benzene	µg/L	1.0	<0.600	<0.600	<0.600	--	--	--	--
Carbon tetrachloride	µg/L	3.0	<0.500	<0.500	<0.500	--	--	--	--
1,2-Dibromoethane	µg/L	0.02	<0.020	<0.020	<0.020	--	--	--	--
Tetrachloroethylene	µg/L	3.0	<5.000	<5.000	<5.000	--	--	--	--
Trichloroethylene	µg/L	3.0	<5.000	<5.000	<5.000	--	--	--	--
Chloroform	µg/L	*	<0.400	<0.400	<0.400	--	--	--	--
Bromodichloromethane	µg/L	*	<0.600	<0.600	<0.600	--	--	--	--

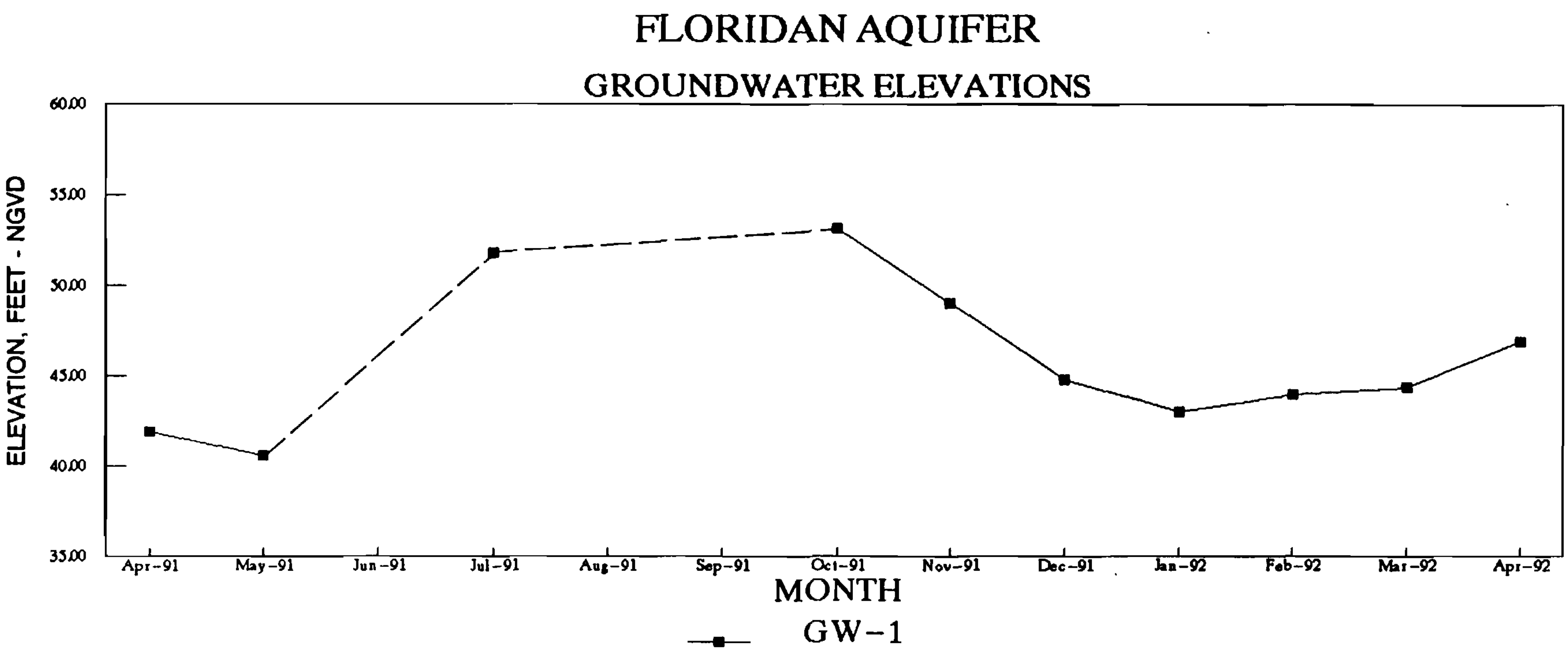
G-TECPPSSCA.9/23-H.8--072592

Table 2.3.2-11. Groundwater Quality Summary for Lower Intermediate Aquifer (Continued, Page 2 of 2)

Parameter	Units	Groundwater Quality Standard	GW-1S-I1	GW-2S-I1	GW-3S-I1	Mean	Maximum	Minimum	Standard Deviation
Dibromochloromethane	µg/L	*	<1.000	<1.000	<1.000	--	--	--	--
Bromoform	µg/L	*	<2.000	<2.000	<2.000	--	--	--	--
Vinyl chloride	µg/L	1.0	<0.800	<0.800	<0.800	--	--	--	--
1,2-Dichloroethane	µg/L	3.0	<1.000	<1.000	<1.000	--	--	--	--
1,1,1-Trichloroethane	µg/L	200.0	<0.800	<0.800	<0.800	--	--	--	--
Turbidity	NTU	1	49	15	8.5	24.2	49	8.5	17.8
Gross alpha	pCi/L	15	<2.0	<2.0	<2.0	--	--	--	--
Radium 226	pCi/L	†	0.7 ±0.3	1.2 ±0.4	1.2 ±0.4	1.0	1.2	0.7	0.2
Radium 228	pCi/L	†	3.4 ±3.2	<1.0	<1.0	1.1	3.4	<MDL	1.6

*Total trihalomethane water quality standard is 100 mg/L.
†Combined Radium 226 and 228 water quality standard is 5 pCi/L.

Source: ECT, 1992.



LEGEND

- DASHED WHEN APPROXIMATE
- SOLID WHEN MONTHLY DATA COLLECTED

FIGURE 2.3.2-7.

HYDROGRAPH FOR FLORIDAN AQUIFER

Source: ECT, 1992.

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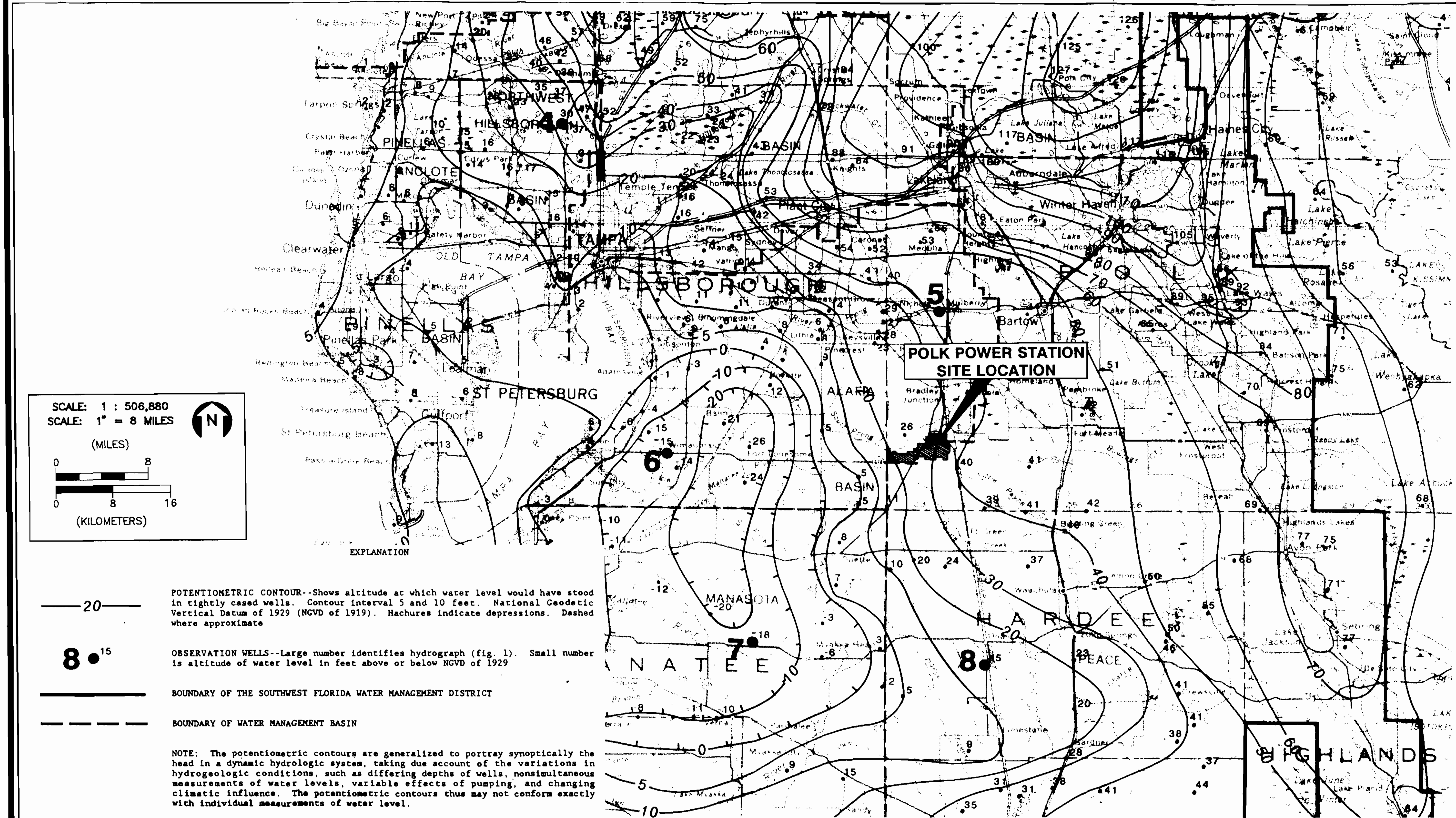

FIGURE 2.3.2-8.

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, MAY, 1990

Source: L.A. Knochenmus, 1990.

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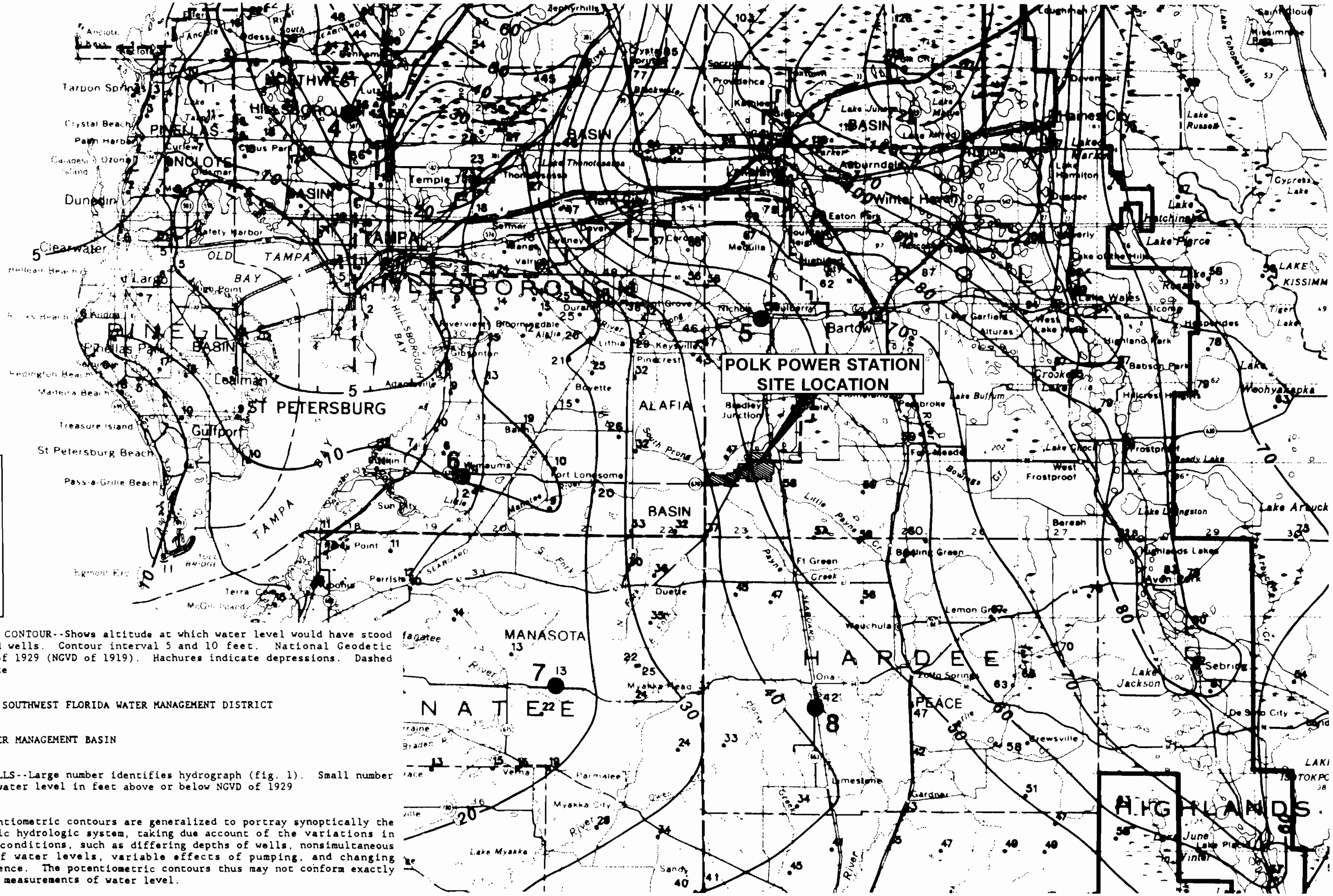

SCALE: 1 : 506,880
SCALE: 1" = 8 MILES

(MILES) 0 8

0 8 16 (KILOMETERS)

N

—— 80 - - - - POTENTIOMETRIC CONTOUR--Shows altitude at which water level would have stood in tightly cased wells. Contour interval 5 and 10 feet. National Geodetic Vertical Datum of 1929 (NGVD of 1919). Hachures indicate depressions. Dashed where approximate

BOUNDARY OF THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

BOUNDARY OF WATER MANAGEMENT BASIN

8 ● 42 • 51 OBSERVATION WELLS--Large number identifies hydrograph (fig. 1). Small number is altitude of water level in feet above or below NGVD of 1929

NOTE: The potentiometric contours are generalized to portray synoptically the head in a dynamic hydrologic system, taking due account of the variations in hydrogeologic conditions, such as differing depths of wells, nonsimultaneous measurements of water levels, variable effects of pumping, and changing climatic influence. The potentiometric contours thus may not conform exactly with individual measurements of water level.

FIGURE 2.3.2-9.

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, SEPTEMBER, 1990

Source: R.A. Mularoni and L.A. Knochenmus, 1990.

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The results of ten aquifer tests for the Floridan aquifer performed within a 15-mile radius of the site are summarized in Table 2.3.2-3. The average aquifer characteristics for the Floridan aquifer are a transmissivity value of approximately 293,000 ft^2/day, a storage coefficient of 0.001, and a leakance value of approximately 0.00021 ft^3/day/ft^3.

The specific capacity of a well is well yield in gallons per minute divided by the amount of drawdown in feet (gpm/ft). This parameter provides a means to estimate the aquifer transmissivity. The average specific capacity for the Floridan aquifer from more than 70 aquifer tests presented by Stewart (1966) was approximately 380 gpm/ft with a range of 31 to greater than 2,500 gpm/ft.

Based on the SWFWMD ambient groundwater quality monitoring program, several background trends are presented (SWFWMD, 1988):

- TDS, 200 to 300 mg/L;
- Total hardness, <120 mg/L;
- Chlorides, <25 mg/L; and
- Sulfates, 25 to 250 mg/L.

Additional background water quality data was obtained from the FDER groundwater monitoring program. The background data for the Floridan aquifer is summarized in Table 2.3.2-12. Site-specific groundwater quality from the upper Floridan aquifer was measured from a sampling event in May 1991. The groundwater quality data is summarized in Table 2.3.2-13, and the laboratory analyses are included in Appendix 11.7.3. The groundwater from the Floridan aquifer meets primary and secondary drinking water standards.

As rainwater percolates through the aquifer systems, the groundwater becomes mineralized as constituents are dissolved into solution. Therefore, the groundwater quality varies between the three aquifer systems (Figure 2.3.2-10). The groundwater quality of the intermediate and Floridan aquifer systems are similar, with the

Table 2.3.2-12. FDER Floridan Aquifer Groundwater Quality Monitoring Program--Polk County

Floridan Aquifer Parameters	Units	Groundwater Quality Standard*	Average Value	Standard Deviation	Range Minimum	Range Maximum
In situ Measurements						
pH	s.u.		7.5749	0.488	6.400	8.300
Classical						
Arsenic	mg/L	0.05	0.0005	0.001	0.000	0.002
Arsenic (dissolved)	μg/L	--	0.0000	0.000	0.000	0.000
Chloride	mg/L	250	8.3770	3.151	4.460	17.500
Fluoride	mg/L	2.0	0.2069	0.150	0.000	0.589
Nitrate	mg/L	10.0	0.0139	0.024	0.000	0.110
Selenium	mg/L	0.01	0.0000	0.000	0.000	0.000
Selenium (dissolved)	μg/L	--	NA			
Sodium	mg/L	160	7.4638	5.652	3.000	32.600
Sulfate	mg/L	250	6.5738	14.434	0.000	81.500
TDS	mg/L	500	152.3439	61.543	58.000	289.000
Other Metals						
Barium	mg/L	1.0	0.0034	0.012	0.000	0.052
Barium (dissolved)	μg/L	--	NA			
Cadmium	mg/L	0.010	0.0005	0.001	0.000	0.003
Cadmium (dissolved)	μg/L	--	NA			
Chromium (total)	mg/L	0.05	0.0000	0.000	0.000	0.002
Chromium (dissolved)	μg/L	--	NA			
Copper	mg/L	1.0	0.0044	0.007	0.000	0.029
Copper (dissolved)	μg/L	--	0.1210	0.000	0.121	0.121
Iron	mg/L	0.3	0.6904	1.106	0.000	4.550
Iron (dissolved)	μg/L	--	0.0565	0.022	0.050	0.140
Lead	mg/L	0.05	0.0147	0.042	0.000	0.190
Manganese	mg/L	0.05	0.0193	0.029	0.000	0.110
Manganese (dissolved)	μg/L	--	12.6667	13.013	0.000	26.000
Mercury	mg/L	0.002	0.0001	0.000	0.000	0.001
Silver	mg/L	0.05	0.0006	0.003	0.000	0.014
Zinc	mg/L	5.0	0.0176	0.021	0.000	0.092
Zinc (dissolved)	μg/L	--	3.1600	5.473	0.000	9.480

Table 2.3.2-12. FDER Floridan Aquifer Groundwater Quality Monitoring Program--Polk County (Continued, Page 2 of 2)

Floridan Aquifer Parameters	Units	Groundwater Quality Standard*	Average Value	Standard Deviation	Range	
					Minimum	Maximum
Organics						
Endrin	μg/L	0.2	0.0000	0.000	0.000	0.000
Methoxychlor	μg/L	100.0	0.0000	0.000	0.000	0.000
Toxaphene	μg/L	5.0	0.0000	0.000	0.000	0.000
2,4-D	μg/L	100	0.0000	0.000	0.000	0.000
2,4,5-TP, silvex	μg/L	10	0.0000	0.000	0.000	0.000
Benzene	μg/L	1.0	0.0649	0.321	0.000	1.900
Carbon tetrachloride	μg/L	3.0	0.0135	0.082	0.000	0.500
Ethylene dibromide	μg/L	0.02	0.0000	0.000	0.000	0.000
Tetrachloroethene	μg/L	3.0	0.0135	0.082	0.000	0.500
Trichloroethene	μg/L	3.0	0.0135	0.082	0.000	0.500
Vinyl chloride	μg/L	1.0	0.0135	0.082	0.000	0.500
1,2-Dichloroethane	μg/L	3.0	0.0135	0.082	0.000	0.500
1,1,1-Trichloroethane	μg/L	0.2	0.0135	0.082	0.000	0.500

Note: -- = no data available.

*Standards from Chapter 17-550, F.A.C.

Source: FDER, 1991.

Table 2.3.2-13. Floridan Aquifer Groundwater Quality at GW-1--Floridan Aquifer

Parameter	Units	Groundwater Quality Standards*	Minimum Detection Limit	GW-1-F1 Floridan Aquifer
pH (*in situ*)	s.u.	6.5-8.5		8.1
Arsenic	μg/L	50.0	10	<10.000
Barium	mg/L	1.0	0.3	<0.300
Cadmium	μg/L	0.010	0.8	<0.800
Chromium	mg/L	0.05	0.05	<0.050
Lead	μg/L	50.0	5	<5.000
Mercury	μg/L	0.2	0.2	<0.200
Nitrogen, nitrate	mg/L	10.0	1	<1.000
Silver	μg/L	50.0	0.07	<0.070
Chloride	mg/L	250.0	1	11.00
Color	Pt-Co	15	5	20.00
Copper	mg/L	1.0	0.03	<0.030
Fluoride, soluble	mg/L	4.0	0.01	0.50
Iron	mg/L	0.3	0.03	<0.300
Manganese	mg/L	0.05	0.05	<0.050
Sodium	mg/L	160.0	1	15.00
Sulfate	mg/L	250	5	34.00
Surfactants	mg/L	0.5	0.02	0.06
Solids, total dissolved	mg/L	500	5	220.00
Endrin	μg/L	0.2	0.08	<0.080
Methoxychlor	μg/L	100.0	100	<100.000
Toxaphene	μg/L	5.0	3	<3.000
2,4-D	μg/L	100.0	10	<10.000
2,4,5-Trichlorophenol	μg/L	10.0	1	<1.000
Benzene	μg/L	1.0	0.6	<0.600
Carbon tetrachloride	μg/L	3.0	0.5	<0.500
1,2-Dibromoethane	μg/L	0.02	0.02	<0.020
Tetrachloroethylene	μg/L	3.0	5	<5.000
Trichloroethylene	μg/L	3.0	5	<5.000
Chloroform	μg/L	*	0.4	<0.400
Bromodichloromethane	μg/L	*	0.6	<0.600
Dibromochloromethane	μg/L	*	1	<1.000
Bromoform	μg/L	*	2	<2.000
Vinyl chloride	μg/L	1.0	0.8	<0.800
1,2-Dichloroethane	μg/L	3.0	1	<1.000
1,1,1-Trichloroethane	μg/L	200.0	0.08	<0.800
Turbidity	NTU	1		20.00
Gross alpha	pCi/L	15	2	<2.0
Radium 226	pCi/L	†	0.6	1.0 ± 0.4
Radium 228	pCi/L	†	1	<1.0

*Total trihalomethane water quality standard is 100 mg/L.
†Combined Radium 226 and 228 water quality standard is 5 pCi/L.

Source: ECT, 1992.

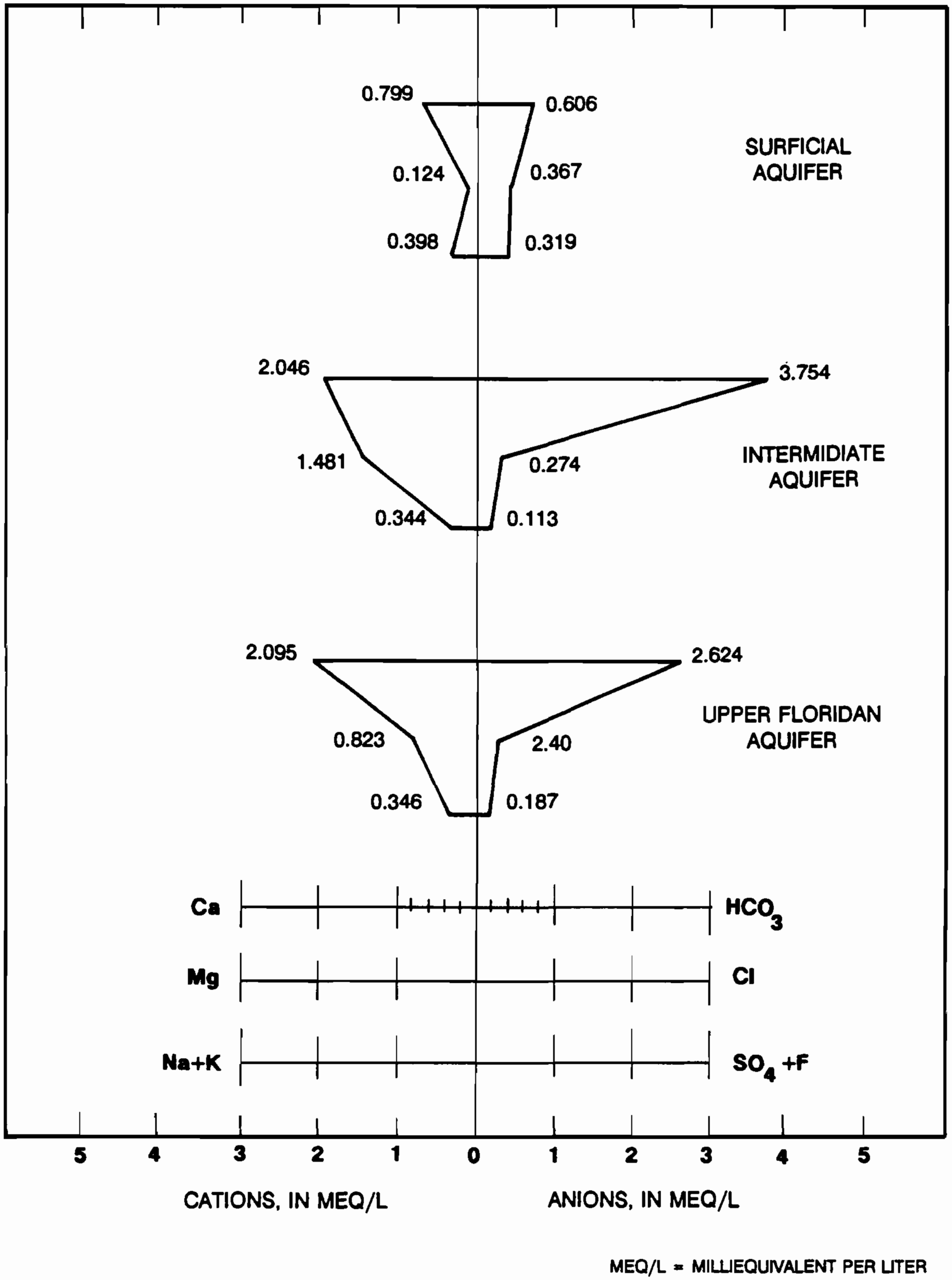

FIGURE 2.3.2-10.

MEDIAN QUALITY OF WATER IN THE SURFICIAL, INTERMEDIATE, AND UPPER FLORIDAN AQUIFERS

Source: Hutchinson, 1978.

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exception that lower concentrations of magnesium occur in the Floridan aquifer. Additionally, elevated sulfate concentrations occur in certain areas of Polk County associated with the deep upper Floridan aquifer. The groundwater within the Floridan aquifer system is considered to be of good quality.

Characteristic Confining Units

As previously discussed, the intermediate aquifer system is divided and bounded on top and bottom by confining units near the Tampa Electric Company Polk Power Station site. The locations of two hydrogeologic cross-sections are provided as Figure 2.3.2-11, and the two hydrogeologic cross-sections are provided as Figures 2.3.2-12 and 2.3.2-13. From these hydrogeologic cross-sections and Figures 2.3.1-6, the approximate thicknesses of the calcareous mudstone/clay confining units can be determined as follows:

- Top confining unit, 20 to 30 ft thick;
- Middle confining unit, 40 to 60 ft thick; and
- Bottom confining unit, 15 to 50 ft thick.

These figures also illustrate the heterogeneous nature of the confining units in southwest Polk County. Hydrographs at each groundwater monitor station GW-1 through GW-5 are illustrated as Figures 2.3.2-14 through 2.3.2-18. By review and comparison of the water level fluctuations between the aquifer systems, the degree of their hydraulic connection and communication can be determined.

Recharge between the surficial and intermediate aquifer is classified as no recharge (0 inches per year) to moderate recharge (10 inches per year). Recharge between the intermediate and Floridan aquifers is also classified as no recharge to moderate recharge. At monitor station GW-1, a soil sample was obtained from the Tampa Clay of the Nocatee member of the Arcadia Formation at a depth of approximately 270 ft bls. A laboratory permeability test on this sample indicated a low permeability of 3×10^{-7} cm/sec (8.5×10^{-4} ft/day).

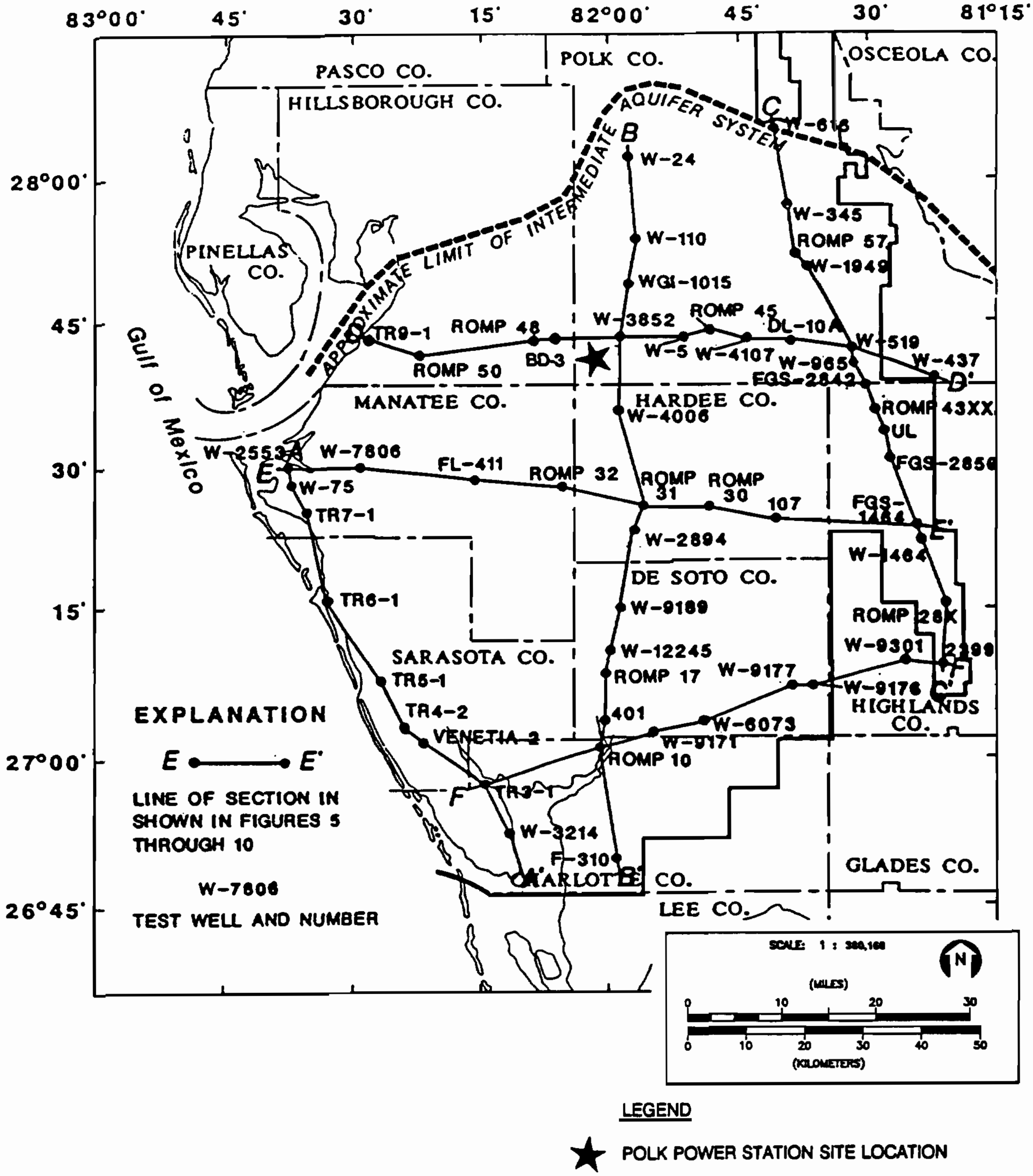

FIGURE 2.3.2-11.

LOCATIONS OF HYDROGEOLOGICAL CROSS SECTIONS

Source: Modified from Duerr, 1988 (Fig. 6); ECT, 1992.

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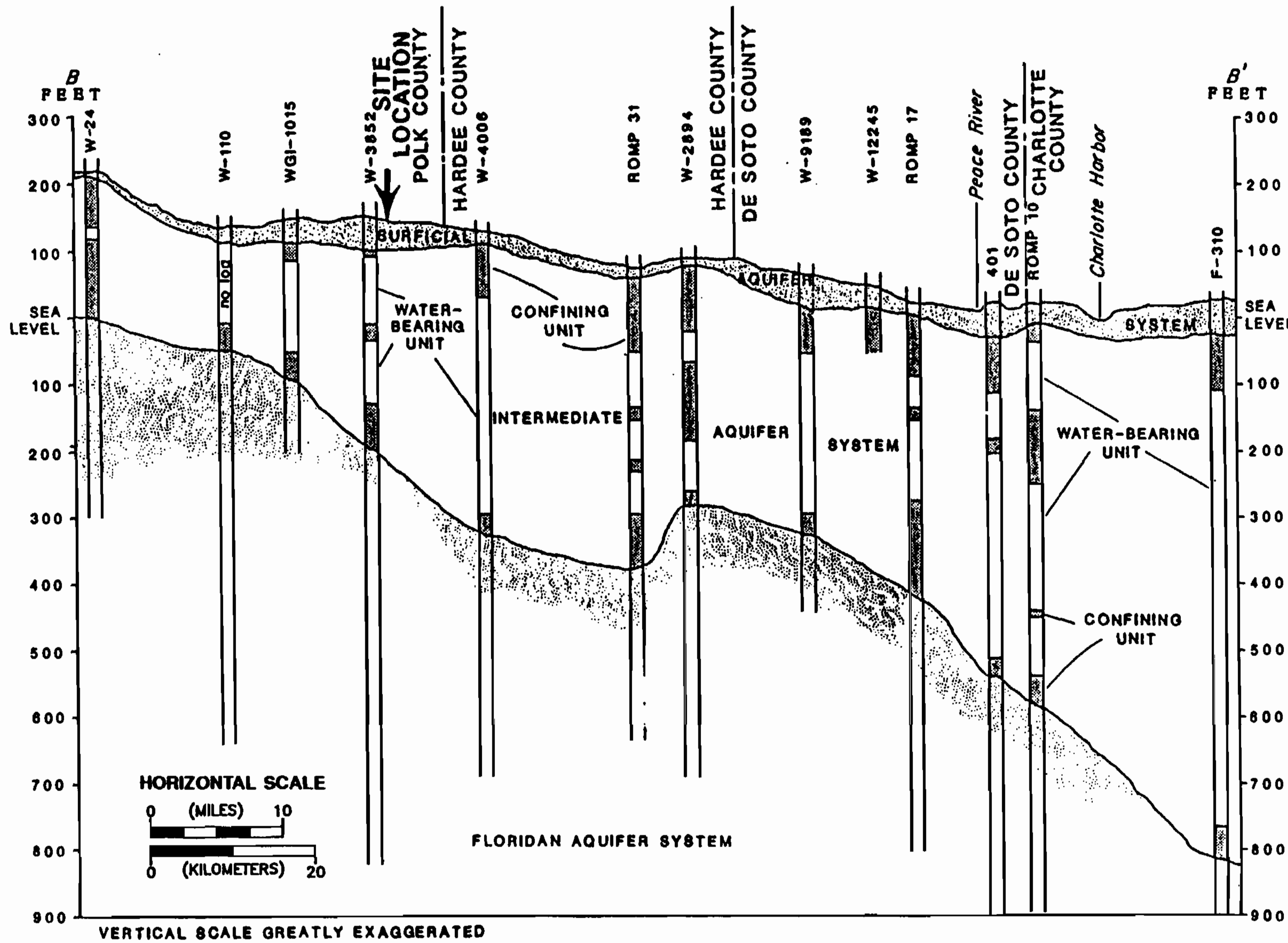

FIGURE 2.3.2-12.

GENERALIZED HYDROGEOLOGIC CROSS SECTION B - B'

Source: Modified from Duerr, 1988 (Fig. 6); ECT, 1992.

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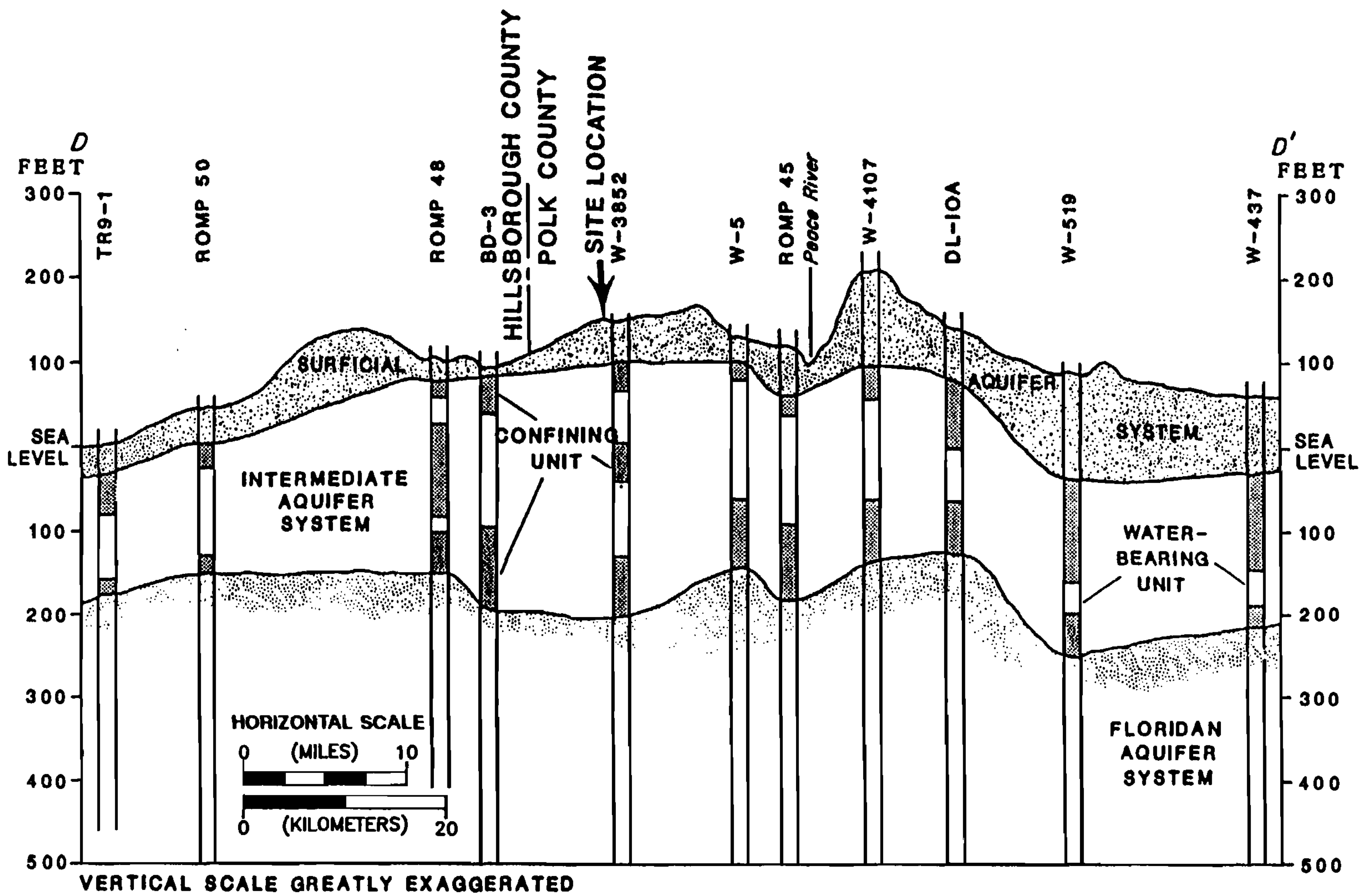

FIGURE 2.3.2-13.

GENERALIZED HYDROGEOLOGIC CROSS SECTION D - D'

Source: Modified from Duerr, 1988 (Fig. 4-5); ECT, 1992.

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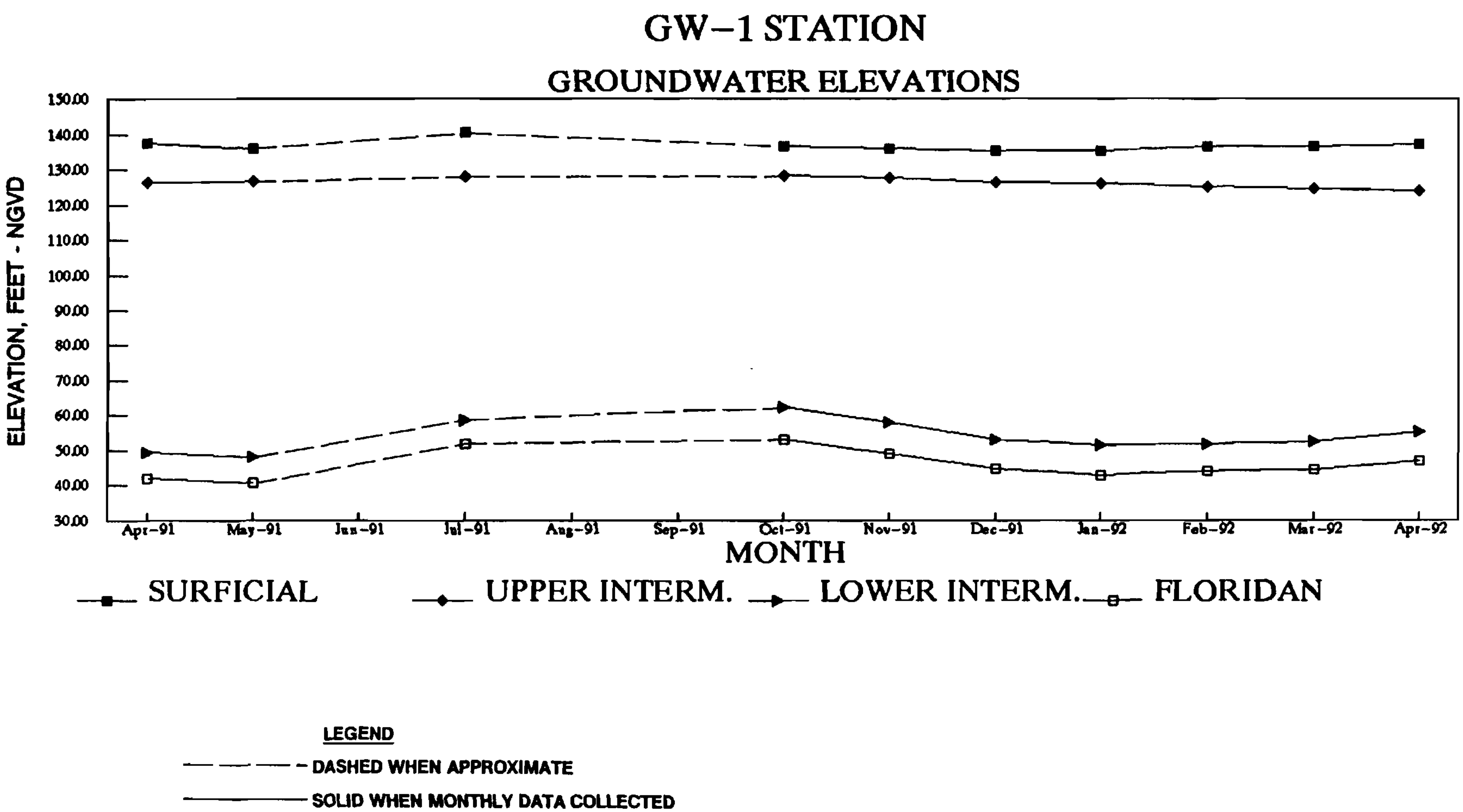

FIGURE 2.3.2-14.

HYDROGRAPH FOR GROUNDWATER MONITOR STATION GW-1

Source: ECT, 1992.

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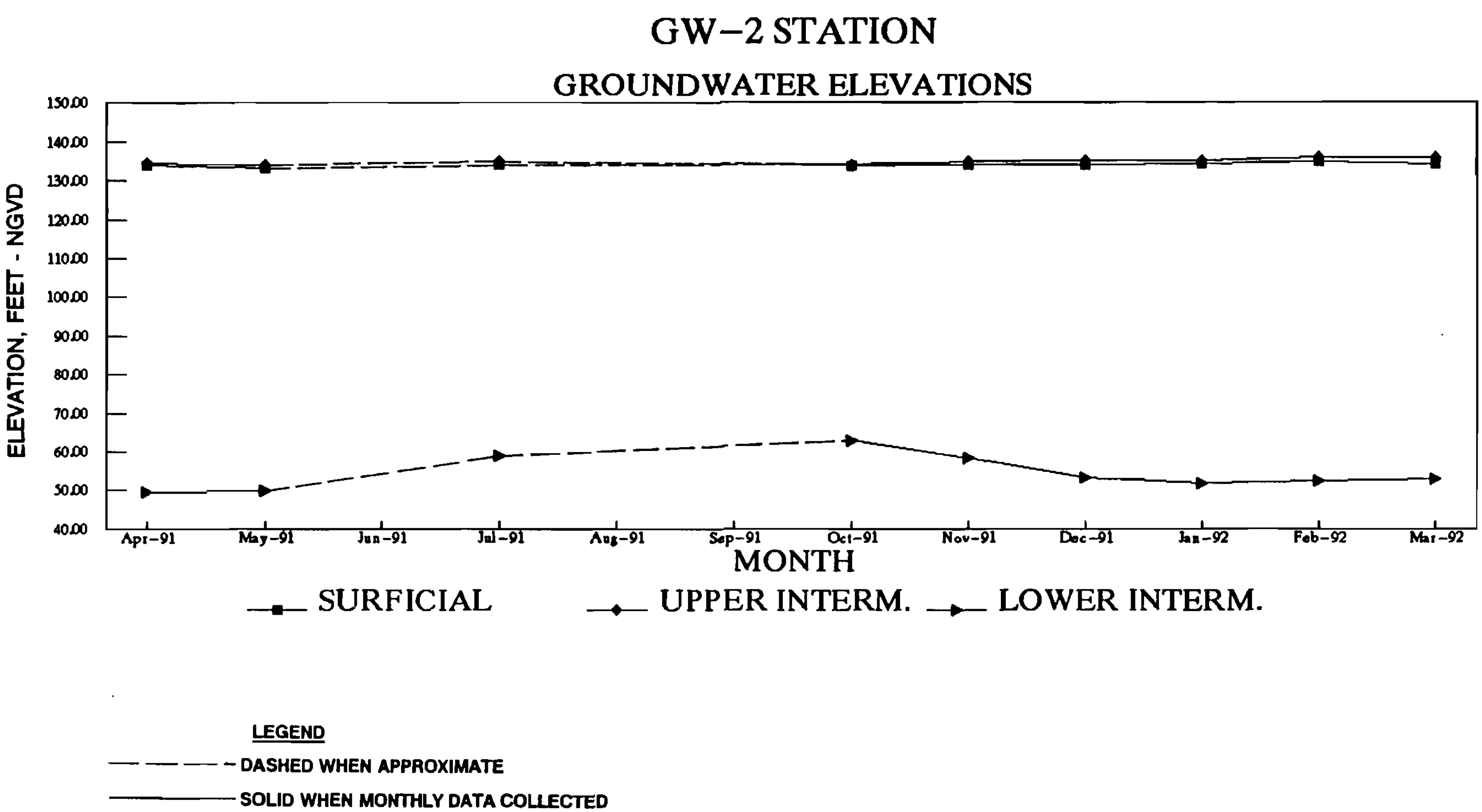

FIGURE 2.3.2-15.

HYDROGRAPH FOR GROUNDWATER MONITOR STATION GW-2

Source: ECT, 1992.

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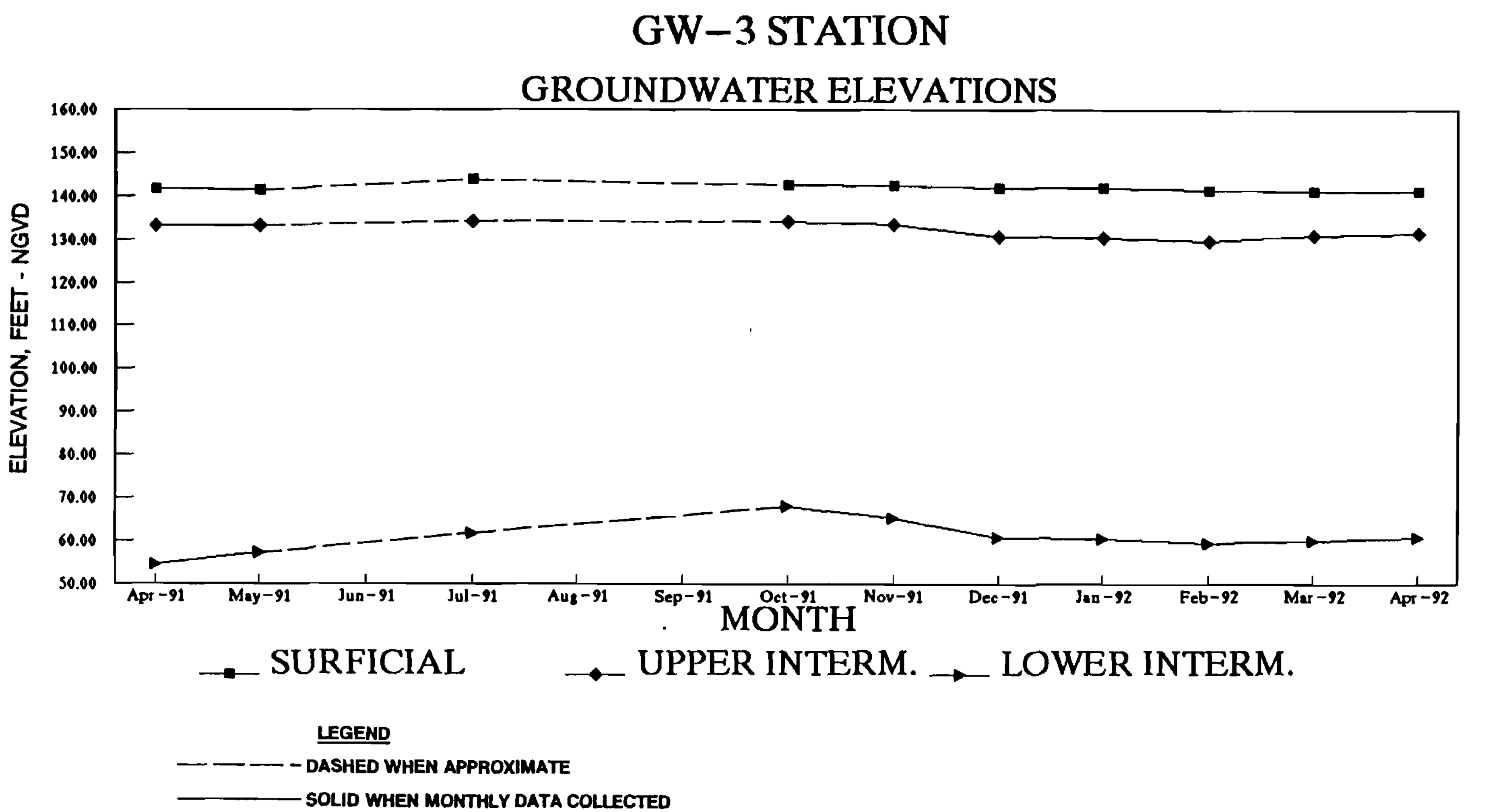

FIGURE 2.3.2-16.

HYDROGRAPH FOR GROUNDWATER MONITOR STATION GW-3

Source: ECT, 1992.

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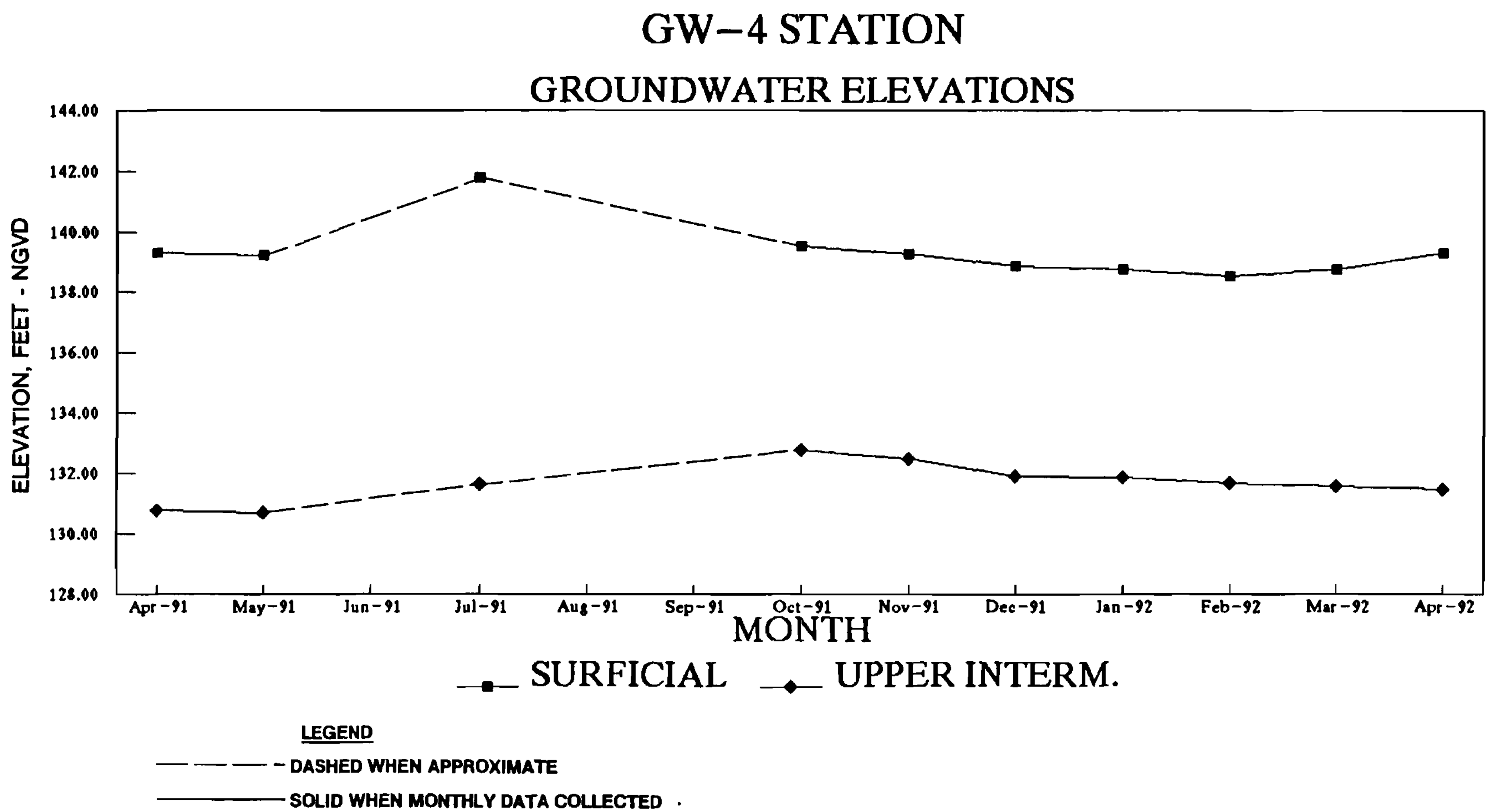

FIGURE 2.3.2-17.

HYDROGRAPH FOR GROUNDWATER MONITOR STATION GW-4

Source: ECT, 1992.

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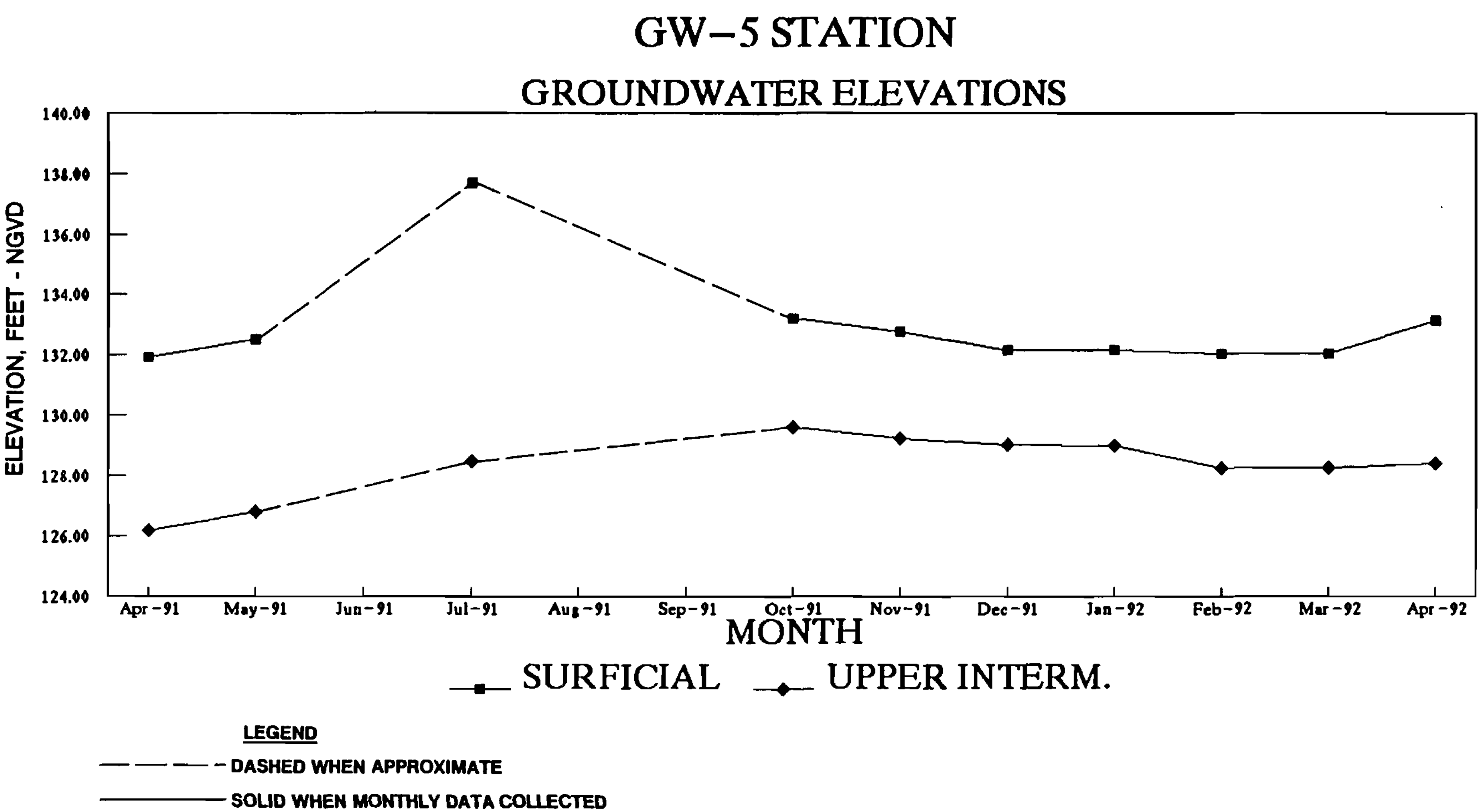

FIGURE 2.3.2-18.

HYDROGRAPH FOR GROUNDWATER MONITOR STATION GW-5

Source: ECT, 1992.

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2.3.2.2 Karst Hydrogeology

The entire state of Florida is underlain by an extensive thickness of carbonate strata. These sedimentary rocks are subject to dissolution by the percolation of naturally occurring and slightly acidic recharge from rainfall. Over time, this process will develop solution cavities and features (secondary porosity) within the rock sequence as recharge infiltrates through the carbonate strata. The irregular surface which eventually results from this process is called *karst topography*. Karst topography is usually recognizable on topographic maps by a high number of circular features, often containing water.

One of the more notable features of such terrain is sinkholes. The circular depressions caused by sinkhole formation are found throughout Florida, including Polk County. Sinkholes may provide an avenue for the surface water, groundwater from an overlying aquifer, and pollutants to rapidly infiltrate into lower stratigraphic units and aquifers. Generally, karst activity occurs at a slow rate resulting with the gradual subsidence of the land surface over a large area. This slow dissolutioning process of the carbonate strata has been estimated to result in subsidence of as much as 1 ft every 5,000 to 6,000 years (Sinclair *et al.*, 1985). The types of sinkholes which develop in Florida are controlled by the geology and hydrogeology of the region. The three major types of sinkholes common throughout Florida include solution sinkholes, cover-collapse sinkholes, and cover-subsidence sinkholes. These sinkholes are readily distinguishable by their mode of formation.

The thickness and type of cover that overlies the carbonate strata has a significant influence on the susceptibility to and the type of karst topography that develops. The presence of a thick clay sequence or other less permeable material with high artesian pressure reduces the recharge potential. Hence, this type of cover results in less susceptibility to the development of karst features and sinkholes. Figure 2.3.2-19 depicts the various zones of the different type of sinkholes for West Central Florida. The Polk Power Station site is located in Zone 7, where sinkhole development is rare, but some cover-collapse sinkholes are known to occur (Sinclair *et al.*, 1985).

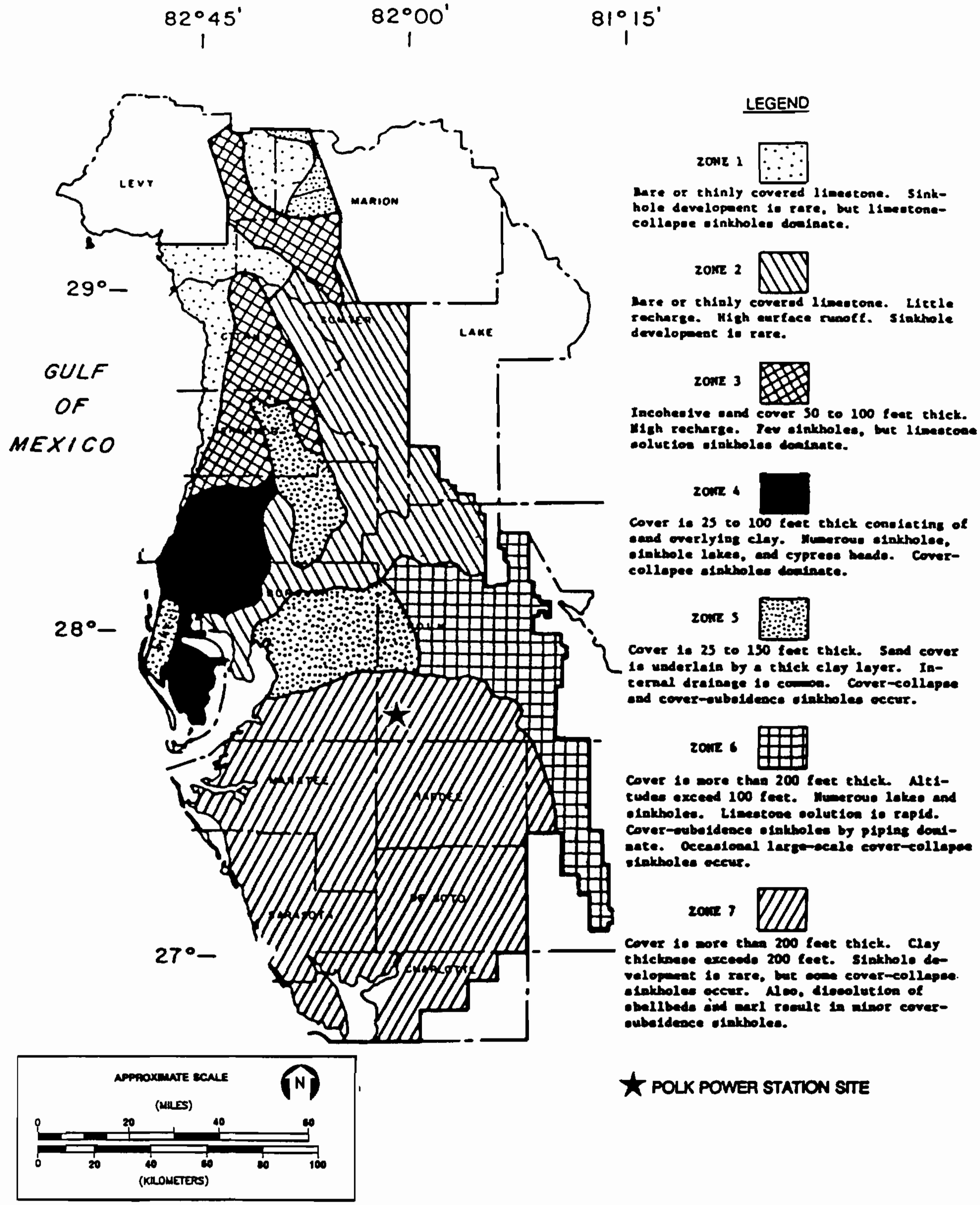

FIGURE 2.3.2-19.

ZONES OF DIFFERENT SINKHOLE TYPES

Source: USGS, Duette NE & Baird Quads.

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The Polk Power Station site is located in the southwest corner of Polk County which appears to have undergone some karst deformation. Through review of two USGS 7.5-minute topographic quadrangles (Duette Northeast and Baird), several closed surface depressions were detected within the site boundaries. Review of the data obtained from the onsite drilling program conducted in support of the Polk Power Station licensing efforts indicates that the surficial depressions investigated have little correlation to the underlying stratigraphy. Thus, it is unlikely that these depressions represent active karst conditions. Much of the area surrounding the site has undergone phosphate mining throughout the 1900s. The mining and reclamation activities have caused irregular landscapes with numerous tailings mounds, clay settling ponds, plus drainage ditches and ponds. These activities limit the usefulness of the topographic maps, so old aerial photographs were also reviewed. The number of sinkholes and circular depressions increases toward the north and northeast of the Polk Power Station site approaching the topographic ridges. These topographic ridges and the gaps between them are believed to be the surface expression of former shoreline terraces and underlying structural features. The clay and dense carbonate sequence of the Hawthorn Group is approximately 250 ft thick beneath the site location. The presence of this thick, relatively impermeable, stratigraphic sequence limits the local recharge to the Floridan aquifer and reduces the potential for sinkhole development.

Significant sea level fluctuations occurred during the Pleistocene epoch at the site location making karst activity possible. The various sea level and shoreline elevations include the Okefenokee Shoreline (150 ft-NGVD), Wicomico Shoreline (100 ft-NGVD), Pamlico Shoreline (30 ft-NGVD), and Silver Bluff Shoreline (8 ft-NGVD). These shorelines and the sea level fluctuations would have the greatest likelihood of impacting any geologic units above this elevation. The drilling program at the site indicates that these elevation ranges are represented by the calcareous deposits within the Hawthorn Group. The Suwannee Limestone was not encountered above an elevation of -145 ft-NGVD. This indicates that the carbonate sequence which comprises the Floridan aquifer is relatively deep and should have been removed from the extensive karst activity and solutioning effects during the Pleistocene epoch.

A sinkhole occurrence assessment included a review of information obtained from the Florida Sinkhole Research Institute (FSRI) and other sinkhole reports. The data indicate that no sinkhole of sufficient size or dimension to be noticed has formed during the site mining activities. Based on the available sinkhole data, only four sinkholes were reported in a 10-mile radius from the site within the past 35 years (Figure 2.3.2-20). Figure 2.3.2-21 illustrates the distance from the site to the reported sinkholes. Table 2.3.2-14 summarizes some pertinent data regarding these four sinkholes.

Thus, through the comparison of the topographic features, structural contours, apparent lineations, and surface-water features, it is evident that geology and structural geology affect the occurrence of sinkholes in Polk County (Sinclair *et al.*, 1985). Based on the available information the potential for sinkhole development at the Tampa Electric Company Polk Power Station site is relatively low, compared to most other areas in Polk County.

Faults, fractures, and lineaments are commonly expressed on aerial photographs and satellite imagery as conspicuous linear features. Features and lineaments are also commonly associated with the presence of sinkholes. Data from available literature and previous studies were reviewed for the identification of linear features in southwest Polk County. A lineament map for Polk and Hillsborough Counties prepared by Ardaman & Associates (1987) is presented as Figure 2.3.2-22. None of the major lineaments identified in this or other studies intersect or pass beneath the Polk Power Station site. In Polk County, the prominent lineations appear to aline with the northwest-southeast trend of the Ocala Platform and the topographic ridges with a series of less prominent lineaments at approximate right angles. The topographic ridges and the gaps between them are believed to be the surface expression of underlying structural features (Sinclair *et al.*, 1985).

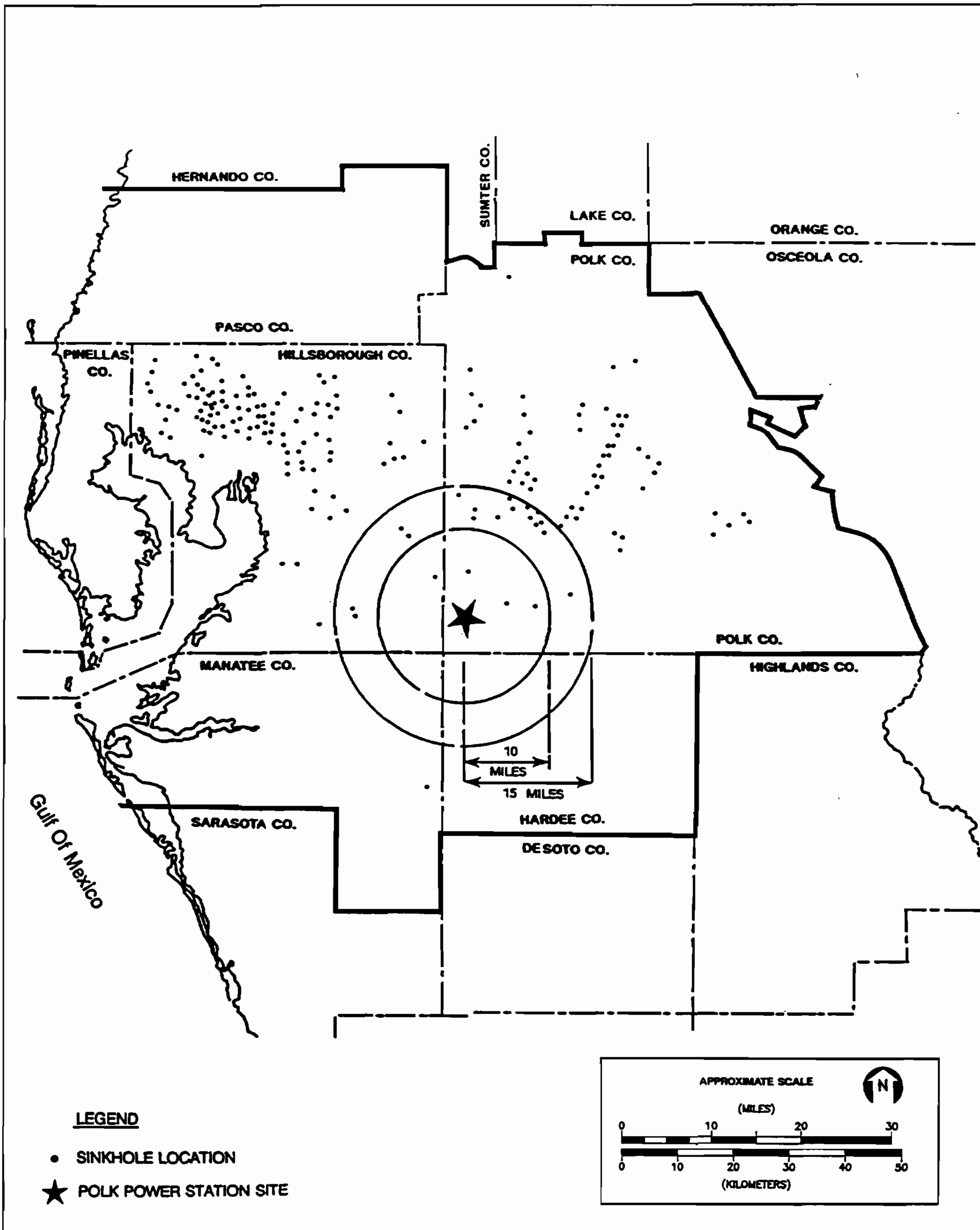

FIGURE 2.3.2-20.

DISTRIBUTION OF REPORTED SINKHOLES IN THE VICINITY OF POLK POWER STATION SITE

Source: Ardaman & Associates, 1987.

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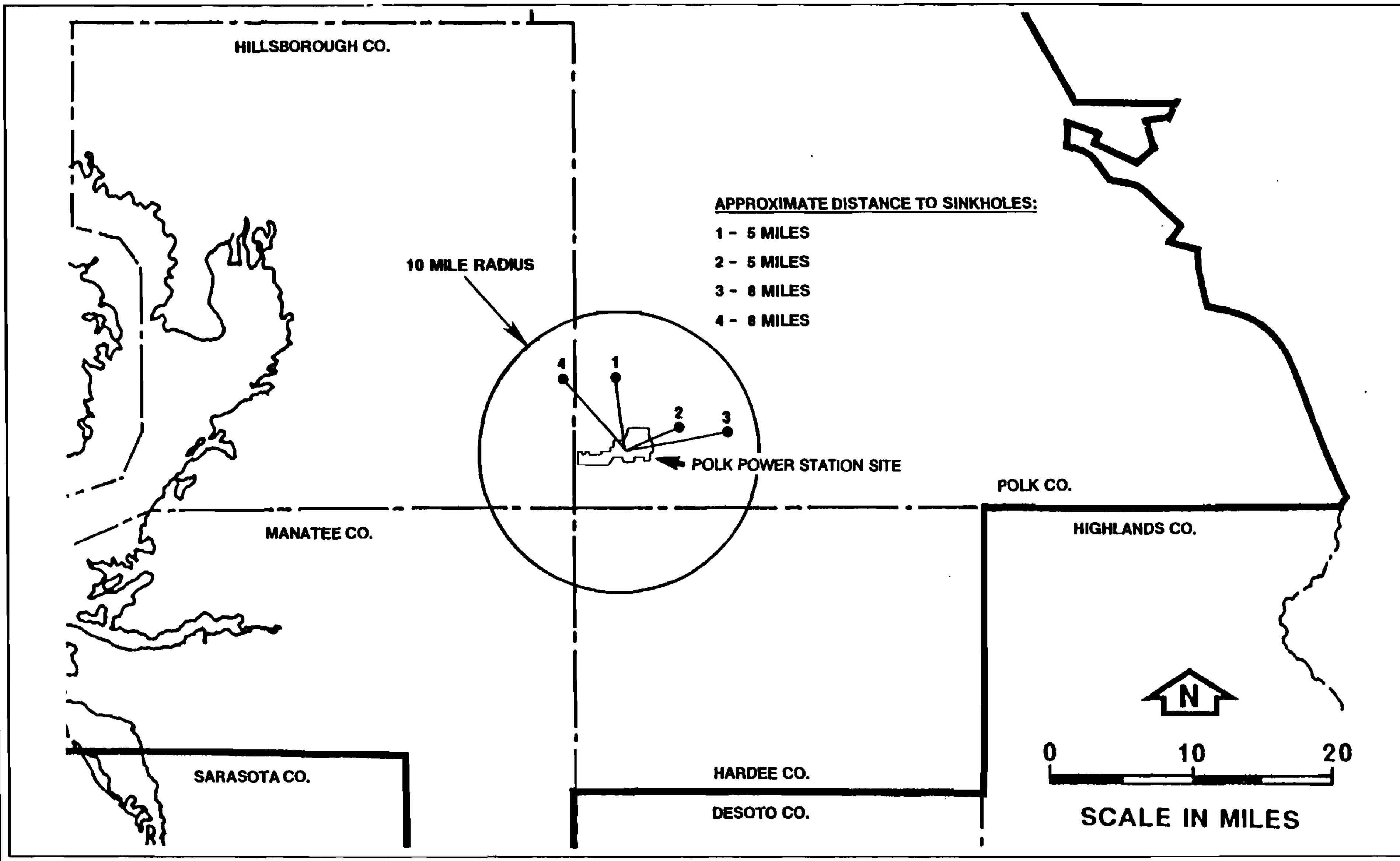

FIGURE 2.3.2-21.

SINKHOLE IDENTIFICATION MAP

Source: FSRI; ECT, 1992.

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Table 2.3.2-14. Available Information on Sinkholes within 10 Miles of the Polk Power Station Site

Sinkhole Number	FSRI Code Number	Year of Occurrence	Location					County	Dimensions (ft)			Elevation (ft-msl)				Rainfall over 90 days before sinkhole developed (inches)
			Longitude	Latitude	Range	Township	Section		Length	Width	Depth	Land Surface	Limestone	Water Table	Potentiometric Surface	
1	16-703	NA	--	--	--	--	--	Polk	--	--	--	--	--	--	--	--
2	16-704	NA	--	--	--	--	--	Polk	--	--	--	--	--	--	--	--
3	16-017	1968	81 50 05	27 44 35	25E	31S	32	Polk	200	200	45	125	-285	NA	55	NA
4	10-648	1989	82 03 24	27 46 16	22E	31S	24	Hillsborough	100	100	15	122	-130	NA	95	8.75

NA = Specific information not available for these sinkholes from FSRI database.

Sources: FSRI, 1989; confirmed through verbal communication with Barry Beck, Ph.D., January 20, 1992.

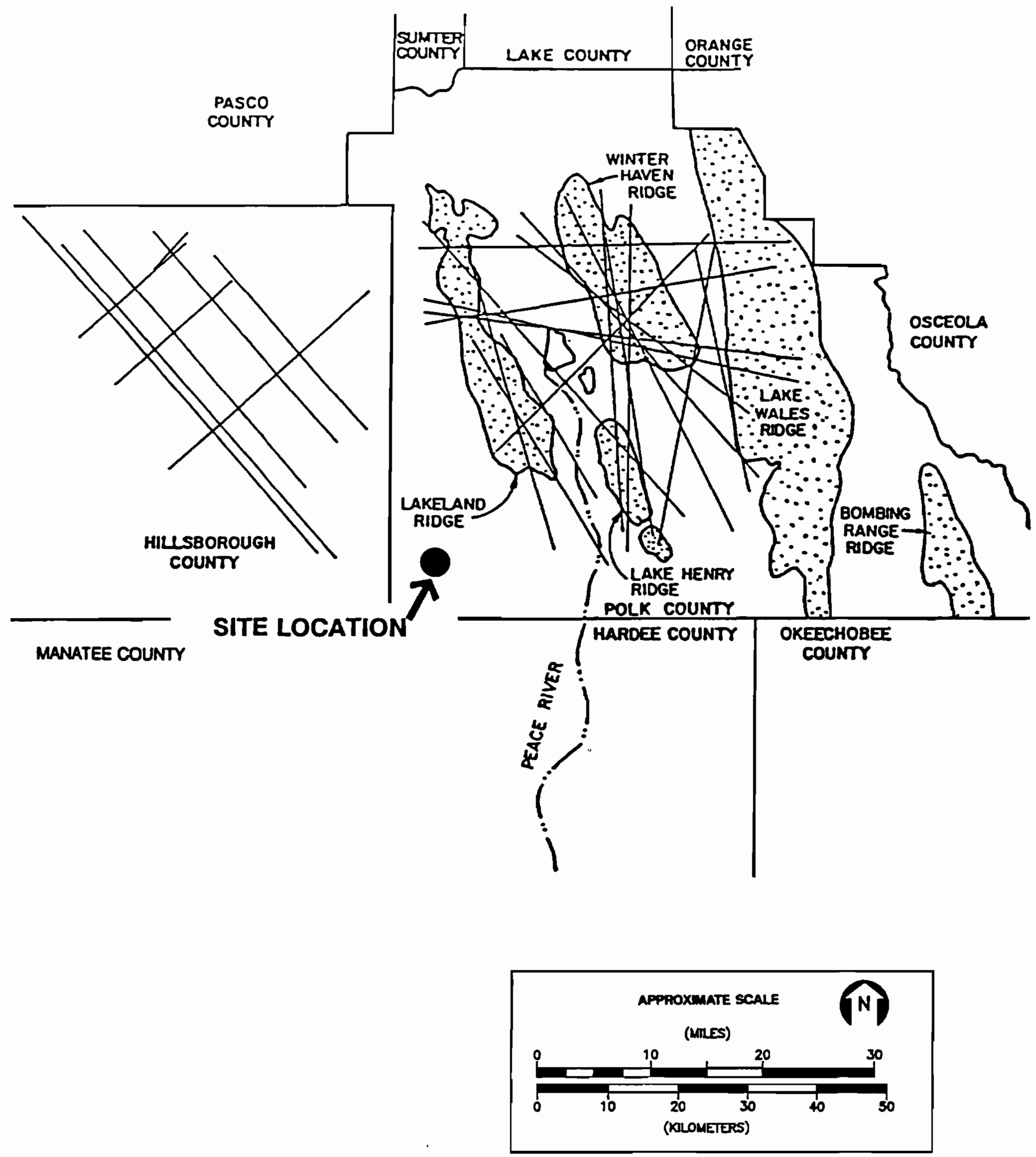

FIGURE 2.3.2-22.

PROMINENT LINEAMENTS IN POLK AND HILLSBOROUGH COUNTIES

Source: Ardaman & Associates, 1987.

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In summary, small surface depressions dot the uplands between the two major stream systems that drain the Tampa Electric Company Polk Power Station area. This area has not been inundated by the sea since pre-Pleistocene time. The scarcity and small size of the depressions suggest that sinkhole activity has been relatively minor in the site area.

Although solution cavities probably exist in the carbonate rocks of the Floridan aquifer, and they may be large, the aquifer is buried beneath approximately 300 ft of unconsolidated clastic and poorly consolidated carbonate rock material. Though possible, it seems highly unlikely that collapse within the deeply-buried Floridan aquifer will have an effect at the land surface.

Carbonate rocks of the intermediate aquifer occur within the surficial clastic sediments at depths of 30 to 50 ft. These are the first carbonate rocks with which water, percolating through the surficial aquifer, makes contact. Solution cavities, particularly in the upper part of the intermediate aquifer, are probably responsible for the small land-surface depressions.

Surface lineations, related to fracture zones in the bedrock, are relatively scarce in the Polk Power Station area, suggesting either than groundwater circulation has not been adequate to develop large solution cavities along fractures, or that the bedrock is too deeply buried for these features to affect the land surface.

Recharge to the intermediate aquifer, and below, is relatively slight. The potential for dissolution of carbonate rocks is, likewise, limited.

The thick section of relatively cohesive sandy clay and clay that overlies the carbonate rocks appears to have sufficient bearing strength to bridge cavities of small to moderate size. When the bearing strength is exceeded, however, collapse at land surface will quickly result. It seems unlikely that sinkholes any larger than the existing small depressions will occur in the area.

A more detailed evaluation and discussion of karst conditions is provided in the Sinkhole Evaluation Report provided in Appendix 11.7.5.

2.3.3 SITE WATER BUDGET AND AREA USES

2.3.3.1 Site Water Budget

Meteorological data representative of the hydrological characteristics of the Polk Power Station site, with the exception of pan evaporation data, were obtained from the National Weather Service (NWS) station at Bartow, Florida, for the years 1941 through 1990. Annual precipitation for the period of record varies from 37.19 to 83.44 inches with an average of 53.42 inches. July has the highest monthly average with 8.48 inches, while November has the lowest with 2.13 inches. The annual average temperature is 72.5°F with extreme low and high temperatures of 18°F and 103°F, respectively, recorded for this region. Table 2.3.3-1 presents a summary of the meteorological data. Appendices 11.8.1, 11.8.2, and 11.8.3 contain the detailed meteorological data.

Pan evaporation data were obtained from the Lake Alfred Experiment Station at Lake Alfred, Florida, for the years 1965 through 1990. Annual pan evaporation for the period of record varies from 66.8 to 86.3 inches with a mean of 73.4 inches. The highest monthly mean occurs in May with 8.7 inches, while December has the lowest monthly mean with 3.3 inches. The pan evaporation rates may be adjusted to indicate lake evaporation rates by multiplying by a pan coefficient of 0.70. The average annual lake evaporation is, therefore, 51.4 inches. Dohrenwend (1976) estimated the evapotranspiration rates for the State of Florida and determined that the general evapotranspiration rate for the project area is approximately 36 inches per year.

The estimated annual runoff from the proposed site for the pre-mining condition was derived from discharge data collected at nearby USGS stream gauging stations (USGS, 1991). The USGS station on the South Prong Alafia River near Lithia, Florida, drains a 107-square-mile (mi^2) area and records an average discharge of 101 cubic feet per second (cfs). This is equivalent to 12.82 inches of annual surface and sub-surface runoff for the watershed. The South Prong Alafia River drainage basin lying within the project site boundaries covers 816 acres. Therefore, the estimated average annual discharge from the project site to the South Prong Alafia

Table 2.3.3-1. Meteorological Data from Bartow and Lake Alfred, Florida

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Total Monthly Precipitation (inches)													
Average	2.27	2.97	3.53	2.51	4.57	7.30	8.48	7.39	6.62	2.83	2.13	2.17	53.42
Maximum	7.79	8.42	11.53	8.40	13.05	15.03	17.58	14.39	15.59	9.10	7.40	11.38	83.44
Minimum	0.03	0.24	0.05	0.00	0.02	0.73	2.91	2.60	1.04	0.20	0.00	0.15	37.19
Maximum Daily Precipitation (inches)													
Average	1.00	1.44	1.31	1.24	1.61	2.34	2.07	1.86	2.10	1.23	1.10	1.05	
Extreme	3.36	4.07	4.72	3.56	4.30	9.82	4.00	4.64	6.75	5.06	4.57	3.49	
Monthly Average Temperature (°F)													
	60.9	62.2	67.5	72.3	77.4	80.7	82.1	82.2	80.6	74.6	67.3	62.0	72.5
Monthly Average of Daily Maximum Temperature (°F)													
Maximum	83.1	82.3	87.3	90.3	94.4	95.4	94.9	95.3	93.5	88.6	85.0	79.9	89.1
Average	73.3	75.3	79.9	84.8	89.4	91.7	92.3	92.6	90.4	85.4	79.3	74.4	84.1
Monthly Average of Daily Minimum Temperature (°F)													
Minimum	37.0	43.5	49.4	53.5	60.7	66.8	69.3	68.3	66.5	59.2	48.8	44.5	55.5
Average	49.2	50.7	55.2	59.8	65.3	70.4	71.8	72.1	71.1	64.3	56.7	51.1	61.4
Monthly Pan Evaporation (inches)													
Average	3.5	4.3	6.4	7.7	8.7	7.8	7.7	7.4	6.5	5.7	4.0	3.3	73.4
Maximum	5.4	6.3	8.5	9.7	10.5	9.9	8.9	8.5	8.6	7.1	4.7	4.2	86.3
Minimum	2.8	2.6	5.1	6.9	7.4	6.4	6.4	6.3	5.4	4.1	3.1	2.5	66.8

Source: NWS, 1990.

River is approximately 1.20 cfs. The USGS station on Payne Creek near Bowling Green, Florida, drains 121 mi^2 and records an average discharge of 96.6 cfs, which is equivalent to 10.84 inches of annual surface and sub-surface runoff for the watershed. The Payne Creek and Little Payne Creek drainage basins lying within the proposed site boundaries cover 716 and 2,816 acres, respectively. Therefore, the estimated average annual discharges from the project site to Payne Creek and Little Payne Creek are 0.89 and 3.51 cfs, respectively. The site hydrology is more extensively discussed in Section 2.3.4.

The peak discharge resulting from the 25-year, 24-hour storm event was computed for the pre-mining condition using the HEC-1 Flood Hydrograph Package. The total precipitation for this event is 9 inches. The peak discharges were computed to be 541 cfs to the South Prong Alafia River, 1,063 cfs to Little Payne Creek, and 506 cfs to Payne Creek. Section 2.3.4 provides additional discussions of the hydrologic modeling and Appendix 11.8.9 provides the detailed pre-mining modeling results.

Groundwater recharge rates for Polk County were examined by SWFWMD for the intermediate and upper Floridan aquifers (SWFWMD, 1988). Stewart (1980) was cited as using the vertical hydraulic conductivity and thickness of the overlying confining layer to calculate recharge to the upper Floridan aquifer in the project area as being less than 2 inches per year. Ryder (1985), using a two-layered, steady-state, digital model, reported the recharge as being 2 to 5 inches per year. SWFWMD staff, using head differences and leakance values, calculated a recharge rate of 2 to 10 inches per year for the area of the proposed site. Using the same technique, SWFWMD staff also estimated the recharge to the intermediate system in the southern west-central Florida groundwater basin as being 0 to 2 inches per year.

Hutchinson (1978) developed a hydrologic budget for the upper Peace and eastern Alafia River basins. Annual average values for inputs and outputs to the zone of shallow groundwater were calculated as follows: precipitation, 48.0 inches (1966-1975); input from streams, 0.3 inches; input by return flow of groundwater pumpage, 5.6 inches; evapotranspiration, 41.2 inches; runoff from Alafia River, 4.1 inches; runoff from Peace River, 5.9 inches; pumpage from the shallow groundwater zone, 0.1 inches; and leakage from the shallow groundwater zone to the lower unit of the Floridan aquifer, 2.6 inches. Although these values cannot be rigidly applied to the proposed site, they agree favorably with the values obtained from other sources.

2.3.3.2 Area Uses

Water use projections have been estimated by SWFWMD (1992) through the year 2020 for its jurisdictional areas. The municipal and other potable water uses in Polk County within the district are expected to increase from a mean rate of 75.0 million gallons per day (MGD) in 1990 to 108.4 MGD in 2020. Increases are expected in agricultural water use, from 140.4 to 224.6 MGD, industrial use, from 67.7 to 128.2 MGD, and recreational use, from 7.6 to 11.3 MGD. Mining related water use is expected to decrease from 90.7 to 37.1 MGD. Overall, the projected average daily water use for Polk County is expected to increase from 381.4 MGD in 1990 to 509.6 MGD in 2020, equivalent to an average annual increase of approximately one percent.

Regional groundwater users with average permitted withdrawal rates exceeding 0.5 MGD are shown in Figure 2.3.3-1 which is accompanied by Table 2.3.3-2. The 36- by 42-mile superimposed grid is the range considered in the regional groundwater modeling of the project and is believed to encompass all influenced areas. The map includes wells used for water supply, industrial, and mining purposes and two water supply well fields.

Table 2.3.3-3 lists the permitted groundwater users located within 5 miles of the proposed site. Of these users, only the facilities operated by Agrico, IMC Fertilizer, Inc., and Seminole Fertilizer Corporation have been permitted for average withdrawal rates exceeding 500,000 gallons per day (gpd). The total average withdrawal rate for the industries listed is approximately 63 MGD. There are no major surface water users within 5 miles of the site.

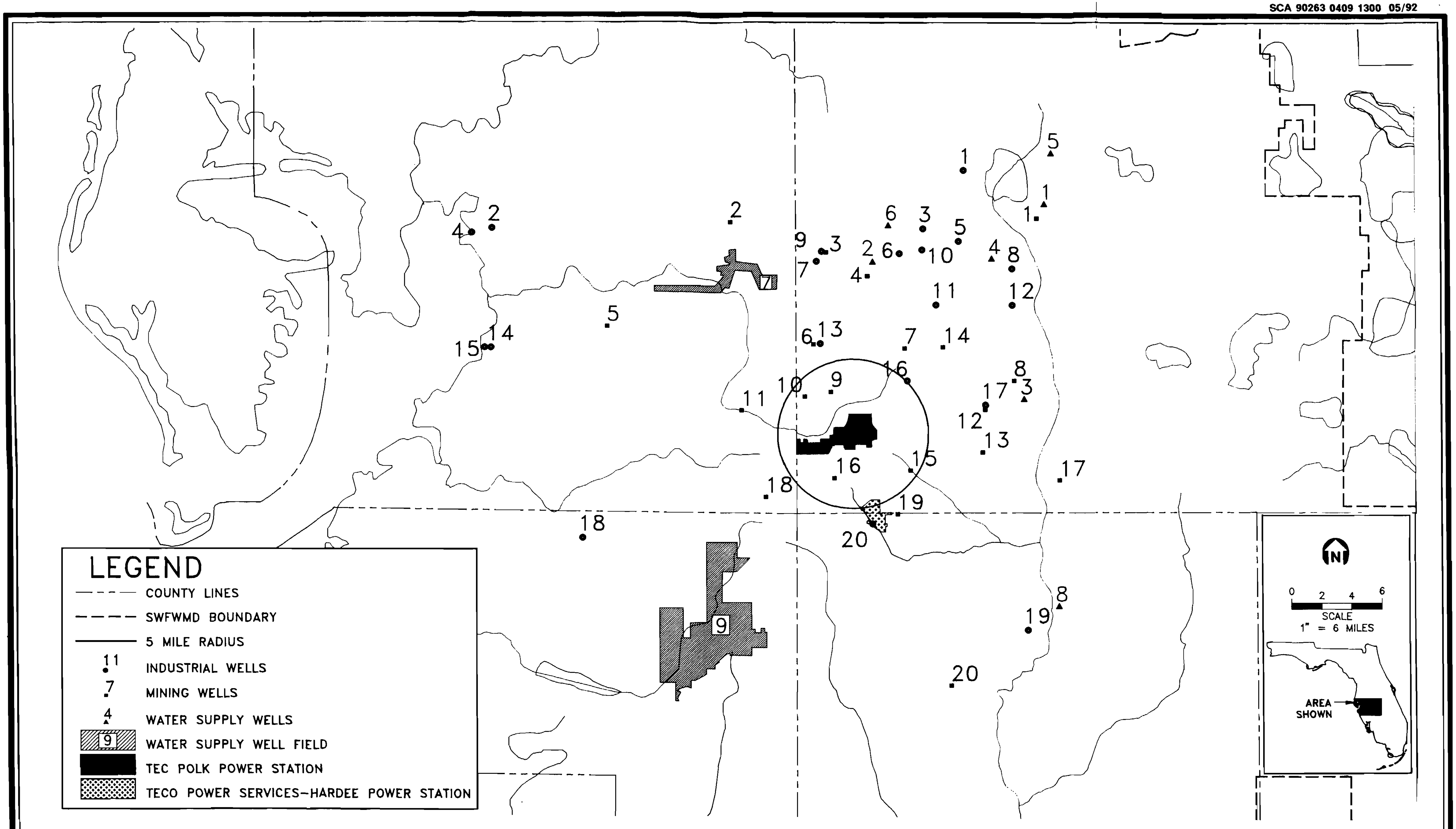

FIGURE 2.3.3-1.

MAJOR GROUNDWATER USERS ADJACENT TO TAMPA ELECTRIC POLK POWER STATION SITE

Source: ECT, 1992.

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Table 2.3.3-2. Water Use Permits (WUP) with Average Permitted Quantities Above 0.5 MGD as of August 1990

Map Number	Name	WUP Number	Latitude	Longitude	Total Average Permitted (MGD)	Total Maximum Permitted (MGD)
Water Supply Wells						
1	City of Mulberry	06124	--	--	1.3	1.8
2	City of Fort Meade	00645	--	--	1.7	3.3
3	City of Bartow	00341	--	--	3.5	6.3
4	Polk County Board of County Commissioners/ Lake Garfield	06507	--	--	1.3	2.8
5	Polk County Board of County Commissioners/ Lake Garfield	06506	--	--	1.6	2.5
6	City of Winter Haven	04607	--	--	7.6	13.1
7	South Central Hillsborough Regional	04352	--	--	24.1	44.6
8	City of Wauchula	04461	--	--	0.9	1.5
9	MCPWD-East County Wellfield	07470	--	--	12.0	13.5
Industrial Wells						
1	Allsun Products	0022602	275810	815246	0.7	1.0
2	Nitram, Inc.	0193004	275437	822338	0.6	0.9
3	W.R. Grace & Company	0222401	275441	815521	7.5	8.6
4	IMC Fertilizer, Inc.	0305003	275419	822454	3.7	4.6
5	U.S. Agri-chemicals	0044001	275400	815258	7.4	9.7
6	Royster Company	0319502	275314	815650	2.0	2.5
7	Conserv, Inc.	0376702	275243	820223	6.3	10.5

Table 2.3.3-2. Water Use Permits (WUP) with Average Permitted Quantities Above 0.5 MGD as of August 1990 (Continued, Page 2 of 3)

Map Number	Name	WUP Number	Latitude	Longitude	Total Average Permitted (MGD)	Total Maximum Permitted (MGD)
8	Orange-Co of Florida, Inc.	0283402	275224	814941	0.7	--
9	Mobil Mining & Minerals Company	0231702	275317	820200	13.3	15.1
10	CF Chemical, Inc.	0061003	275333	815528	7.8	18.5
11	Farmland Industries, Inc.	0153902	275022	815435	9.5	15.0
12	Kaplan Industries, Inc.	0240703	275020	814942	1.0	--
13	IMC Fertilizer, Inc.	0305302	274800	820201	20.7	32.0
14	Tampa Electric Company	0623301	274739	822347	1.0	1.9
15	Tampa Electric Company	0537900	274740	822356	8.6	10.8
16	Agrico Chemical Company	0067802	274550	815615	2.3	8.2
17	U.S. Agri-Chemicals	0043802	274437	815108	8.6	12.0
18	Florida Power & Light Company	0542304	273621	821735	1.9	8.6
19	American Orange Corporation	0011201	273059	814826	1.3	2.6
20	TECO Power Services--Hardee Power Station	0209731	273816	815752	3.8	8.6
<u>Mining Wells</u>						
1	IMC Fertilizer, Inc.	0083801	275539	814757	0.5	0.7
2	IMC Fertilizer, Inc.	0103903	275452	820755	2.7	3.6
3	Mobil Mining & Minerals Company	0231702	275317	820200	13.2	15.1
4	IMC Fertilizer, Inc.	0304902	275153	814851	23.3	27.0
5	Phillips & Jordan, Inc. (Corporation)	0636601	274851	821557	0.5	2.2

Table 2.3.3-2. Water Use Permits (WUP) with Average Permitted Quantities Above 0.5 MGD as of August 1990 (Continued, Page 3 of 3)

Map Number	Name	WUP Number	Latitude	Longitude	Total Average Permitted (MGD)	Total Maximum Permitted (MGD)
6	IMC Fertilizer, Inc.	0305302	274800	820201	20.7	32.0
7	Seminole Fertilizer, Inc.	0002904	274645	815628	5.8	7.2
8	Mobil Mining & Minerals Company	0231802	274559	814923	14.0	15.0
9	IMC Fertilizer, Inc.	0078102	274513	820118	7.5	14.8
10	Mobil Oil Corporation	0033202	274453	820353	6.4	7.9
11	IMC Fertilizer, Inc.	0020302	274403	820708	6.0	7.7
12	U.S. Agri-Chemicals	0147704	274429	815119	9.3	15.3
13	Gardinier, Inc.	0229704	274145	815121	12.0	15.0
14	Estech, Inc.	0384102	274752	815358	6.5	13.7
15	Agrico Mining Company	0107801	274029	815605	9.0	12.0
16	Agrico Mining Company	0108101	273957	820100	13.8	17.3
17	Mobil Mining & Minerals Company	0540301	273958	814616	16.5	19.0
18	IMC Fertilizer, Inc.	0357303	273847	820530	10.8	15.0
19	CF Industries, Inc.	0366902	273755	815653	7.7	10.3
20	Nu-Gulf Industries, Inc.	0374001	273014	820827	8.0	12.9
21	Farmland Industries, Inc.	0526402	272654	815216	9.2	18.0

Note: -- = no data available.

Source: SWFWMD, 1992.

Table 2.3.3-3. Summary of Permitted Wells Within a 5-Mile Radius of the Tampa Electric Company Polk Power Station Site

WPI No.	CUP Permittee	Total Permitted Average (gpd)	Total Permitted Maximum (gpd)	Permitted Average Daily (gpd)	Section	Township	Range	Use	Number of Wells
03053-03	IMC Fertilizer, Inc.	20,736,000	32,000,000	0	8,9,10,11,13	31	23	Mining	32
10298-00	Polk County Board of Commissioners	175,000	0	0	11	31	23	Public supply	2
00781-03	IMC Fertilizer, Inc.	9,320,000	18,600,000	0	14,20,25,26,27,28,29,34,36	31	23	Mining	14
					30,31	31	24	Mining	
00029-05	Seminole Fertilizer Corporation	6,380,000	720,000	0	12,13,23,24,36	31	23	Mining	9
					7,18,17,19,21,28,30,31,32,33	31	24	Mining	9
					12	32	23	Mining	9
					4,5,6,7,8,9,16,17,18	32	24	Mining	9
10564-00	Jerry M. Holt	4,400	0	0	14	31	23	Irrigation	1
01078-01	Agrico Chemical Company	9,000,000	12,000,000	8,089,500	36	31	23	Mining	1
					14,23,24,25,26,30	32	23	Mining	2
					30	32	24	Mining	1
01081-01	Agrico Chemical Company	13,804,000	17,284,000	12,406,550	10,15,16,17,20,21,27,28,33	32	23	Mining	12
06670-03	Agrico Chemical Company	327,000	4,710,000	217,000	16,17,28,29	32	23	Irrigation	5
01884-03	Isham M. Sharpe	161,000	2,460,000	155,000	5,7,8	32	23	Irrigation	2
02514-02	Isham M. Sharpe	83,600	840,000	0	4	32	23	Irrigation	1
04547-01	Guy A. Lamb	20,000	260,000	17,600	1	32	23	Irrigation	1
05757-01	Richard Clark	41,300	1,152,000	33,419	5	32	23	Irrigation	1
06377-01	Claude E. Mann, Inc.	38,000	420,000	0	6	32	23	Irrigation	1
06987-01	Charles G. Robinson	95,700	1,590,000	71,800	5	32	23	Irrigation	1
08459-01	Polk County Board of Commissioners	25,000	0	0	9	32	23	Irrigation	4
01915-02	Hubert A. Walker	28,000	310,000	0	18	32	23	Irrigation	1
06143-01	Imperial Phosphates, Inc.	62,400	96,000	60,800	25	31	23	Industrial	1
08647-00	William Dobbs	16,800	165,000	16,800	27	31	23	Irrigation	1
00678-02	Agrico Chemical Company	2,330,000	8,160,000	1,820,000	20,29,30	31	24	Industrial	5
09836-00	John C. Barnett	14,000	165,000	0	33	31	24	Irrigation	1

Source: SWFWMD, 1992.

A local survey was conducted to identify non-permitted wells located within 2 miles of the perimeter of the site. Approximately 110 wells, primarily residential, were found concentrated along Albritton and Bethlehem Roads. Table 2.3.3-4 lists these wells. Of those wells in which information is available, the casing diameter is generally 2 or 4 inches, and the depth of the well is between 25 and 420 ft. Figures 2.3.3-2 and 2.3.3-3 illustrate the residence locations; the number of these figures correlates to the data provided in Table 2.3.3-4.

Table 2.3.3-4. Summary of Non-Permitted Residential Wells Within 2 Miles of the Tampa Electric Company Polk Power Station Site Boundaries

Number	Name	County	Quarter	Quarter	Section	Town-ship	Range	Casing Diameter (inches)	Casing Depth (ft)	Well Depth (ft)	Wells Present
1,2	Mulberry Welding	P	SW	NW	3	32S	23E	4	90	--	1
3	Mr. Sharpe	P	SE	NE	5	32S	23E	4	--	--	1
3A	Mr. Sharpe	P	SE	NE	5	32S	23E	4	--	--	1
4	Ray Albritton	P	SW	NE	5	32S	23E	2	46	156	1
5	N/A	P	NW	SE	5	32S	23E	--	--	--	1
6	David Wheeler	P	NW	SE	5	32S	23E	4	--	240	1
6A	David Wheeler	P	NW	SE	5	32S	23E	2	--	25	1
7	N/A	P	NW	SE	5	32S	23E	--	--	--	1
8	C. Perry	P	NW	SE	5	32S	23E	4	--	200	1
9	T. Morris	P	NW	SE	5	32S	23E	4	--	--	1
9A	T. Morris	P	NW	SE	5	32S	23E	2	--	--	1
10	N/A	P	NW	SE	5	32S	23E	--	--	--	--
11	N/A	P	NW	SE	5	32S	23E	--	--	--	--
12	N/A	P	NW	SE	5	32S	23E	--	--	--	--
13	Mark Spivey	P	NW	SE	5	32S	23E	2	--	88	1
14	Milla	P	NW	SE	5	32S	23E	--	--	--	--
15	Simpsons	P	NW	SE	5	32S	23E	2	--	30	1
16	N/A	P	SW	SE	5	32S	23E	2	--	--	1
17	Cochran	P	SW	SE	5	32S	23E	--	--	--	--
20	N/A	P	SE	NW	5	32S	23E	--	--	--	--
21	N/A	P	SE	NW	5	32S	23E	--	--	--	--
22	N/A	P	NE	NW	5	32S	23E	--	--	--	--
23	N/A	P	NE	SW	5	32S	23E	--	--	--	1
24	N/A	P	SW	NW	5	32S	23E	--	--	--	--
25	N/A	P	SW	NW	5	32S	23E	--	--	--	--
26	McNeil	P	SW	NW	5	32S	23E	2	--	87	1
26A	McNeil	P	SW	NW	5	32S	23E	2	--	35	1

Table 2.3.3-4. Summary of Non-Permitted Residential Wells Within 2 Miles of the Tampa Electric Company Polk Power Station Site Boundaries (Continued, Page 2 of 5)

Number	Name	County	Quarter	Quarter	Section	Town-ship	Range	Casing Diameter (inches)	Casing Depth (ft)	Well Depth (ft)	Wells Present
27	James Gant	P	SE	NW	5	32S	23E	2	--	--	1
28	N/A	P	SW	NW	5	32S	23E	--	--	--	--
29	N/A	P	NW	SW	5	32S	23E	--	--	--	1
30	N/A	P	NW	SW	5	32S	23E	--	--	--	--
31	Rick Strawbridge	P	NW	SW	5	32S	23E	2	--	--	1
32	N/A	P	NW	SW	5	32S	23E	--	--	--	--
33	N/A	P	SW	NW	5	32S	23E	--	--	--	--
34	Fowler	P	NE	SE	6	32S	23E	2	--	--	1
35	Borden Pearce	P	SE	NE	6	32S	23E	2	--	84	1
35A	Borden Pearce	P	SE	NE	6	32S	23E	1.5	--	94	1
38	N/A	P	SE	NE	6	32S	23E	--	--	--	--
39	N/A	P	NE	SE	6	32S	23E	--	--	--	--
40	N/A	P	SE	NE	6	32S	23E	--	--	--	--
41	N/A	P	NW	NE	6	32S	23E	--	--	--	--
42	N/A	P	NW	SE	6	32S	23E	--	--	--	--
43	N/A	P	SW	NE	6	32S	23E	--	--	--	--
44	N/A	P	SW	NE	6	32S	23E	--	--	--	--
45	N/A	P	SW	NE	6	32S	23E	--	--	--	--
46	N/A	P	NW	SE	6	32S	23E	4	--	--	1
47	N/A	P	NW	SE	6	32S	23E	2	--	--	1
48	Nancy Walls	P	SW	NE	6	32S	23E	4	--	--	1
49	N/A	P	SW	NE	6	32S	23E	--	--	--	--
50	N/A	P	NW	SE	6	32S	23E	--	--	--	--
51	N/A	P	NE	SW	6	32S	23E	2	--	--	1
52	N/A	P	NE	SW	6	32S	23E	2	--	--	1
53	N/A	P	NE	SW	6	32S	23E	4	--	--	1
54	Starling	P	SW	NW	6	32S	23E	--	--	--	1

Table 2.3.3-4. Summary of Non-Permitted Residential Wells Within 2 Miles of the Tampa Electric Company Polk Power Station Site Boundaries (Continued, Page 3 of 5)

Number	Name	County	Quarter	Quarter	Section	Town-ship	Range	Casing Diameter (inches)	Casing Depth (ft)	Well Depth (ft)	Wells Present
55	N/A	P	NW	SW	6	32S	23E	--	--	--	--
56	N/A	P	NW	SW	6	32S	23E	2	--	--	1
57	N/A	P	SW	NW	6	32S	23E	--	--	--	--
58	Cochran	P	SW	NW	6	32S	23E	2	--	--	1
58A	Cochran	P	SW	NW	6	32S	23E	2	--	--	1
59	George Pope	P	SW	NW	6	32S	23E	4	--	80	1
60	Carmin Howell	P	NW	SW	6	32S	23E	4	--	--	1
61	N/A	P	NW	SW	6	32S	23E	2	--	--	1
62	O'Neal	P	NW	SW	6	32S	23E	2	--	--	1
63	Simmons	P	SW	NW	6	32S	23E	4	--	230	1
64	N/A	P	SW	NW	6	32S	23E	2	--	--	1
65	N/A	P	SW	NW	6	32S	23E	4	--	--	1
66	N/A	H	NE	SE	1	32S	22E	--	--	--	--
68	N/A	H	NW	SE	1	32S	22E	2	--	--	1
69	N/A	H	NE	NE	12	32S	22E	2	--	--	1
70	N/A	P	SW	SW	6	32S	23E	--	--	--	
71	N/A	P	SW	SW	6	32S	23E	2	--	--	1
72	N/A	P	SE	SW	6	32S	23E	--	--	--	--
73	N/A	P	NE	NW	7	32S	23E	--	--	--	--
74	N/A	P	SE	SW	6	32S	23E	2	--	--	1
75	Alderman	P	SW	SE	6	32S	23E	--	--	--	1
75A	Alderman	P	SW	SE	6	32S	23E	--	--	--	1
76	N/A	P	NW	NE	7	32S	23E	--	--	--	--
77	N/A	P	NE	NE	7	32S	23E	--	--	--	--
78	N/A	P	NE	NW	8	32S	23E	--	--	--	--
79	N/A	P	SE	SW	5	32S	23E	--	--	--	--
80	N/A	P	NE	NW	8	32S	23E	--	--	--	--

Table 2.3.3-4. Summary of Non-Permitted Residential Wells Within 2 Miles of the Tampa Electric Company Polk Power Station Site Boundaries (Continued, Page 4 of 5)

Number	Name	County	Quarter	Quarter	Section	Town-ship	Range	Casing Diameter (inches)	Casing Depth (ft)	Well Depth (ft)	Wells Present
81	N/A	P	SW	SE	5	32S	23E	--	--	--	--
83	N/A	P	SW	SE	5	32S	23E	--	--	--	--
84	N/A	P	SW	SW	4	32S	23E	--	--	--	--
85	N/A	P	SW	SW	4	32S	23E	--	--	--	--
86	N/A	P	SW	SW	4	32S	23E	--	--	--	--
87	N/A	P	SE	SW	4	32S	23E	--	--	--	--
88	N/A	P	SE	SW	4	32S	23E	--	--	--	--
89	N/A	P	SE	SW	4	32S	23E	--	--	--	--
90	N/A	P	SE	SW	4	32S	23E	--	--	--	--
91	N/A	H	NE	NE	12	32S	22E	--	--	--	--
92	N/A	H	SE	NE	12	32S	22E	--	--	--	--
93	N/A	H	SE	NE	12	32S	22E	--	--	--	--
94	N/A	H	NE	SE	12	32S	22E	4	--	--	1
95	N/A	H	NE	SE	12	32S	22E	4	--	--	1
96	Rick Jackson	H	NE	SE	12	32S	22E	4	--	380	1
96A	Rick Jackson	H	NE	SE	12	32S	22E	4	--	420	1
97	N/A	H	SW	SE	12	32S	22E	4	--	--	1
98	N/A	H	SW	SE	12	32S	22E	4	--	--	1
99	N/A	H	SW	SE	12	32S	22E	2	--	--	1
100	Tucker	H	SE	SW	12	32S	22E	4	--	--	1
100A	Tucker	H	SE	SW	12	32S	22E	2	--	--	1
101	N/A	H	SE	SW	12	32S	22E	2	--	--	1
102	N/A	H	SW	SW	12	32S	22E	2	--	--	1
103	N/A	H	SW	SW	12	32S	22E	4	--	--	1
104	N/A	H	SW	SW	12	32S	22E	--	--	--	--
105	N/A	H	SW	SW	12	32S	22E	--	--	--	--
106	N/A	H	SW	SW	12	32S	22E	--	--	--	--

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Table 2.3.3-4. Summary of Non-Permitted Residential Wells Within 2 Miles of the Tampa Electric Company Polk Power Station Site Boundaries (Continued, Page 5 of 5)

Number	Name	County	Quarter	Quarter	Section	Town-ship	Range	Casing Diameter (inches)	Casing Depth (ft)	Well Depth (ft)	Wells Present
107	N/A	H	SW	SW	12	32S	22E	4	--	--	1
110	N/A	H	SE	NE	14	32S	22E	--	--	--	--
112	N/A	H	SE	NE	14	32S	22E	--	--	--	--
113	Thornto (or) Lamb	P	--	--	35	31S	23E	4	68	240	1
114	Thornto (or) Lamb	P	--	--	35	31S	23E	4	--	--	--
115	Wayne Lamb	P	SE	SE	1	32S	23E	4	76	224	1
116	Guy Lamb	P	--	--	--	32S	23E	4	73	228	1
117	J. Bennett	P	--	--	11	32S	23E	8	--	--	--

Note: Retained, but questionable:
20 - Gate locked, no mail box, no visible structure.
21 - Gate locked, no mail box, no visible structure.
22 - Gate locked, no mail box, no visible structure.
39 - No one home, windows broken out.
NA = name not available, residence with no individual home during survey.
-- = no data available.
P = Polk County.
H = Hillsborough County.

Source: ECT, 1992.

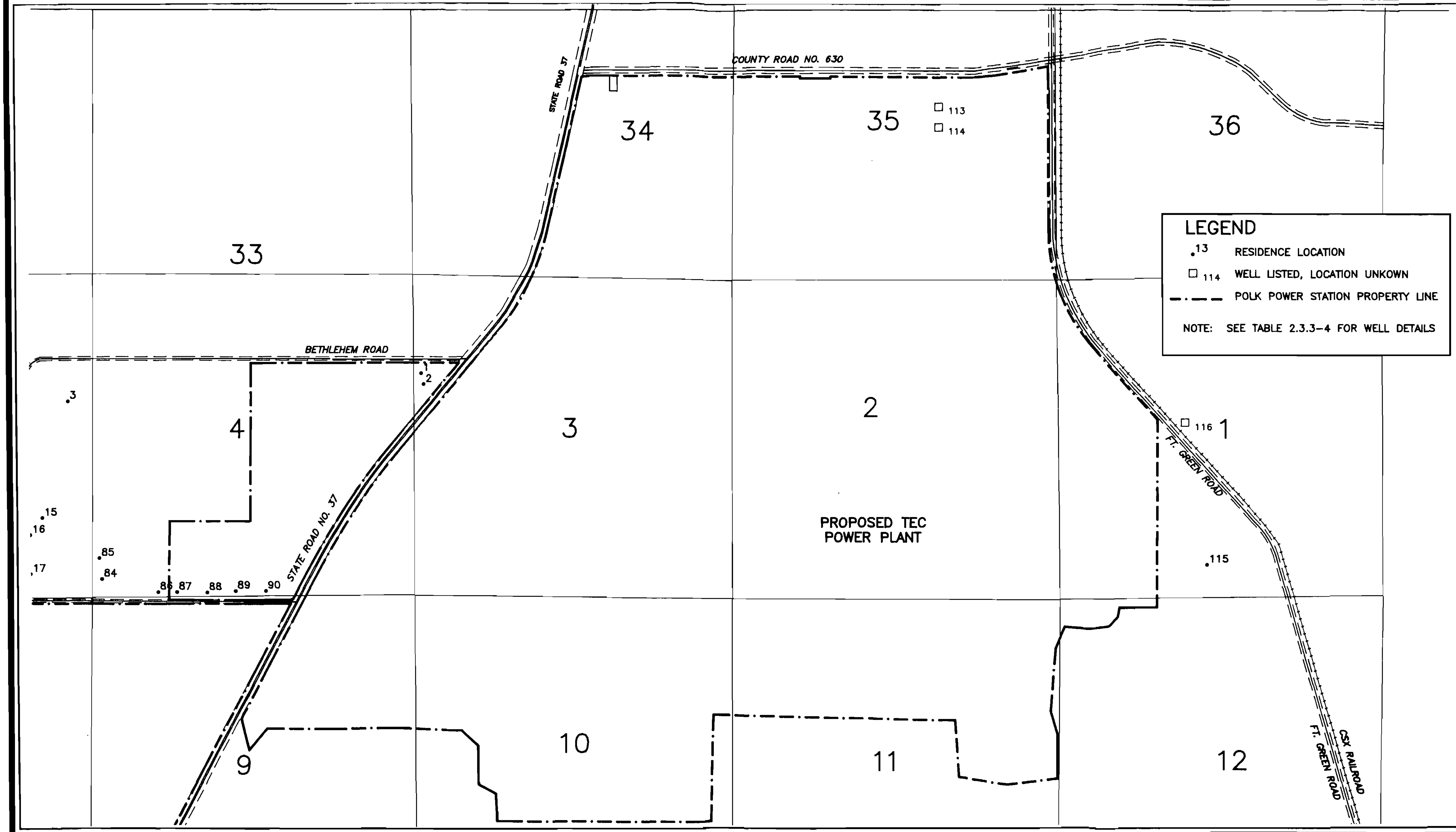

FIGURE 2.3.3-2.

RESIDENTIAL WELL SURVEY MAP (EAST)

Source: ECT, 1992.

TAMPA ELECTRIC
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POLK POWER STATION

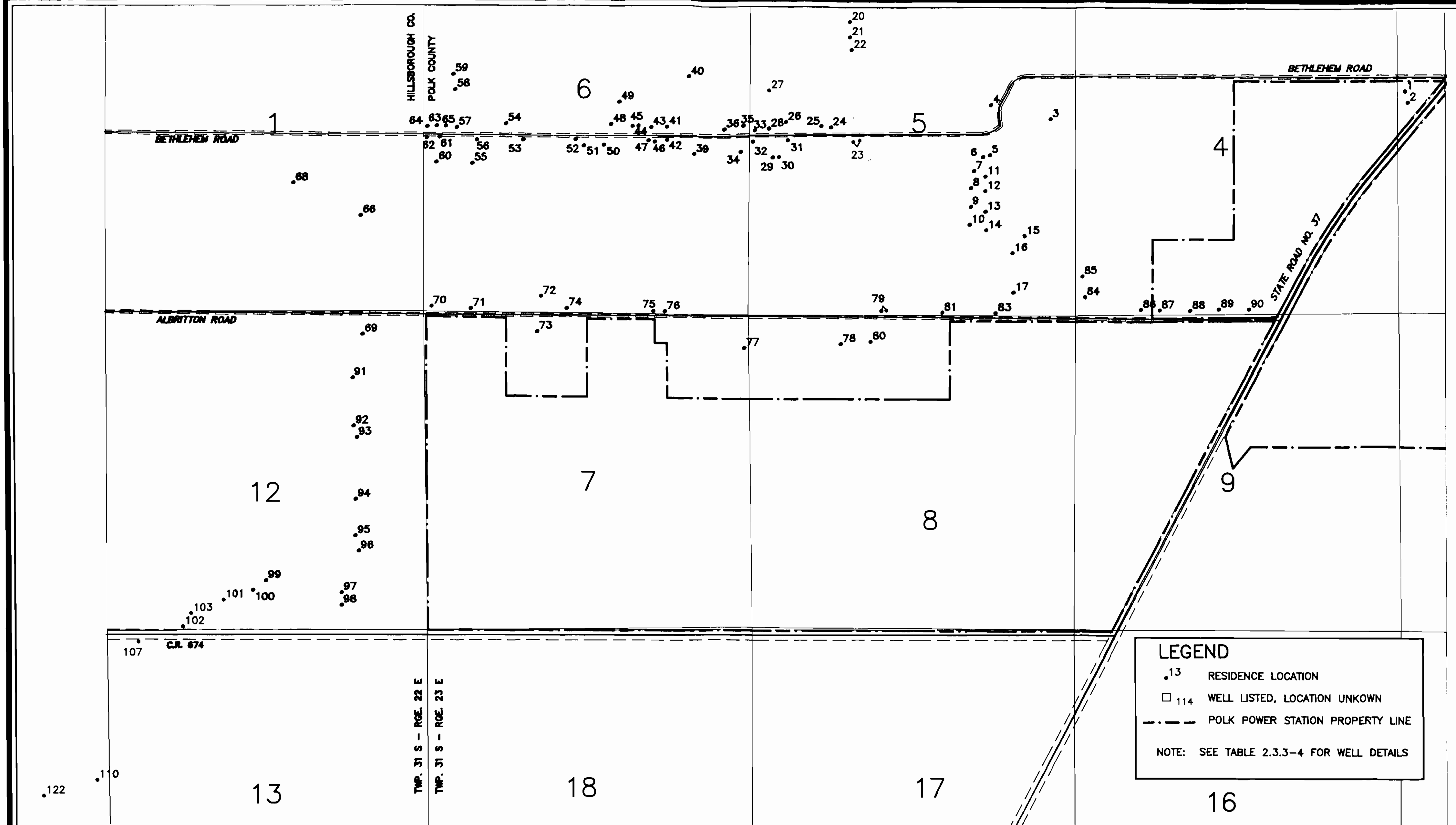

FIGURE 2.3.3-3.

RESIDENTIAL WELL SURVEY MAP (WEST)

Source: ECT, 1992.

TAMPA ELECTRIC
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POLK POWER STATION

2.3.4 SURFICIAL HYDROLOGY

2.3.4.1 Hydrologic Characterization

Surface Water Quantity

The field measurement program conducted in support of the Polk Power Station project is described in Section 2.3.4.2 This information augmented the substantial quantity of existing water quantity and quality data available from various sources such as USGS, EPA STORET, and FDER. The following hydrologic characterization is based on the aforementioned data.

The portion of the Polk Power Station site to the east of SR 37 consists primarily of mined-out lands with water-filled mine cuts between spoil piles surrounding an unmined parcel of land and old mined and unreclaimed lands. The area to the west of SR 37 is currently being mined for phosphate matrix and these operations are scheduled to continue into 1994. In general, lands surrounding the site and in the region have also been impacted by previous and ongoing phosphate mining operations. Most of the project site is located within the Fort Green Mine operated by Agrico.

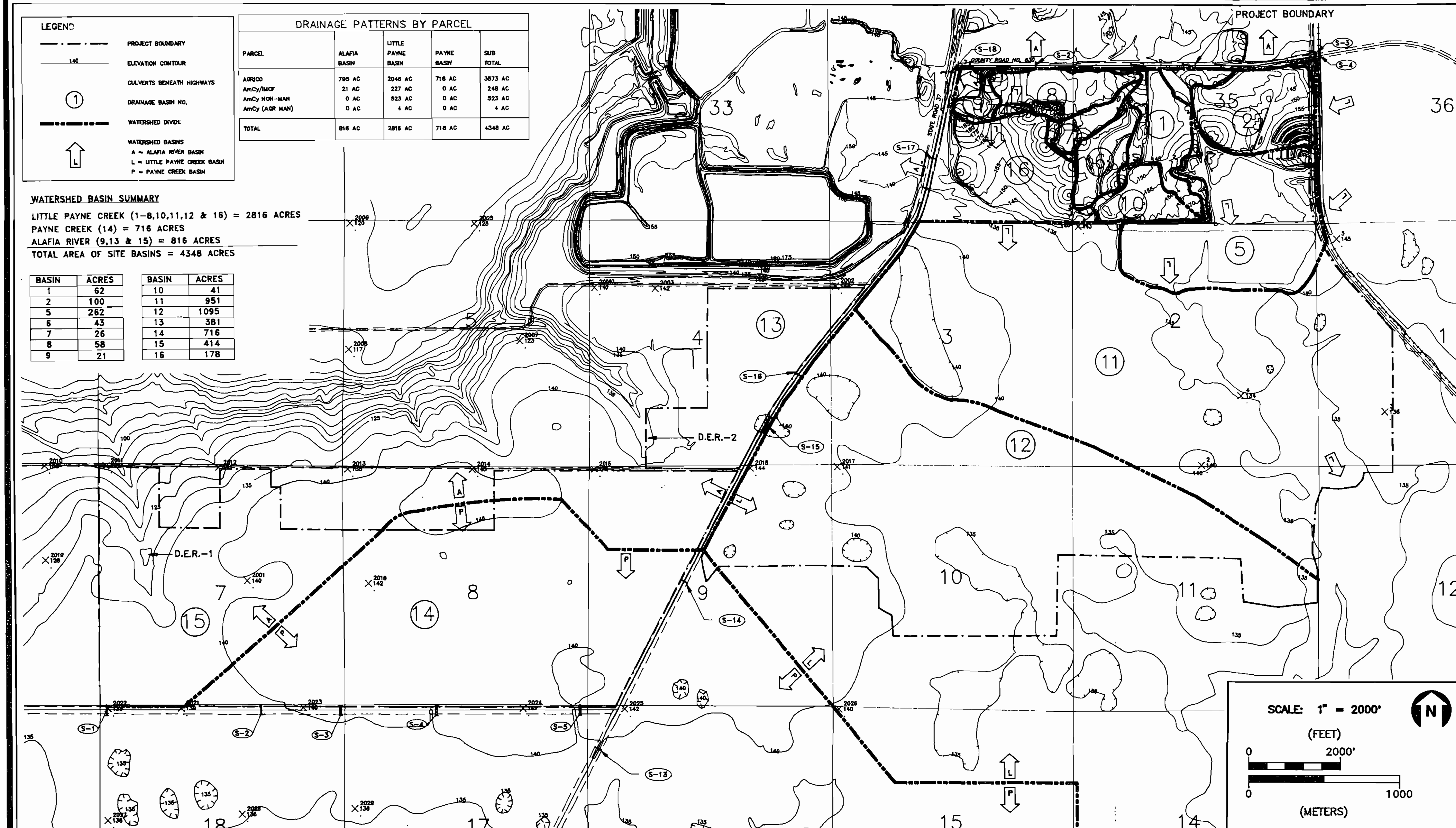
The area within the site boundaries is drained by three streams: the South Prong Alafia River, Payne Creek, and Little Payne Creek. The South Prong Alafia River is a tributary of the Alafia River which flows into Hillsborough Bay; Payne Creek and Little Payne Creek are tributaries of the Peace River which flows into Charlotte Harbor.

Before mining operations in the site area, hereafter referred to as the pre-mining condition, the project site included 816 acres in the South Prong Alafia River watershed located in the north and northwest portions of the property to the west of SR 37 and the extreme northwest corner of the property to the east of SR 37. The Payne Creek watershed included 716 acres located in the southeast portion of the tract lying to the west of SR 37, and the Little Payne Creek watershed included 2,816 acres all located to the east of SR 37. The pre-mining watershed boundaries within the project site are shown in Figure 2.3.4-1. The total drainage areas, including offsite areas, at selected locations along the streams for the pre-mining condition are presented in Table 2.3.4-1.

According to the SCS soil survey of Polk County (SCS, 1990), the soils of the project site have been classified in the general soil groups Smyrna-Myakka, which is described as nearly level poorly drained sandy soils, some underlain by loamy material, and Arents-Water, which are soils that have been strip mined for phosphate or silica sand. More specifically, the western and northern portions of the site are primarily represented by the Smyrna-Myakka soil complex and the southeastern portion mostly Arents-Water complex.

USGS has maintained two stream gauging stations located near the proposed project site with long-term water-stage records. The gauge on the South Prong Alafia River near Lithia, Florida [Station No. 02301300 at latitude 27° 47' 47" north and longitude 82° 07' 04" west (Section 9, Township 31 South, Range 22 East)], is located approximately 8 miles northwest of the Polk Power Station site and approximately 10 miles downstream from the project boundary (see Figure 2.3.4-2). The total drainage area at this station is 107 mi^2 and the average discharge is 101 cfs for the period of record from December 1962 through September 1990. Another gauge on Payne Creek near Bowling Green, Florida [Station No. 02295420 at latitude 27° 37' 13" north and longitude 81° 49' 33" west (Section 9, Township 33 South, Range 25 East)], is approximately 12 miles southeast of the site and approximately 16 miles downstream from the project boundary. The drainage area at this station is 121 mi^2 and the average discharge is 96.6 cfs for the period of record from October 1963 to September 1968 and from October 1979 through September 1990. The mean monthly discharges at both gauging stations are listed in Appendix 11.8.4.

The average flows and drainage areas of five USGS gauging stations in west-central Florida are shown in Table 2.3.4-2. The discharge per square mile was calculated for each station. The values for the gauges along the Alafia River system range from



DRAINAGE PATTERNS BY PARCEL

PARCEL	ALAFIA BASIN	LITTLE PAYNE BASIN	PAYNE BASIN	SUB TOTAL
AGRICO	795 AC	2046 AC	716 AC	3573 AC
AmCy/IMCF	21 AC	227 AC	0 AC	248 AC
AmCy NON-MAN	0 AC	523 AC	0 AC	523 AC
AmCy (AGR MAN)	0 AC	4 AC	0 AC	4 AC
TOTAL	816 AC	2816 AC	716 AC	4348 AC

WATERSHED BASIN SUMMARY

LITTLE PAYNE CREEK (1-8,10,11,12 & 16) = 2816 ACRES
PAYNE CREEK (14) = 716 ACRES
ALAFIA RIVER (9,13 & 15) = 816 ACRES
TOTAL AREA OF SITE BASINS = 4348 ACRES

BASIN	ACRES
1	62
2	100
5	262
6	43
7	26
8	58
9	21

BASIN	ACRES
10	41
11	951
12	1095
13	381
14	716
15	414
16	178

FIGURE 2.3.4-1.

PREMINING TOPOGRAPHY AND DRAINAGE MAP

Source: ECT, 1992.

TOPOGRAPHY SOURCES: I.F. ROOKS – 6/13/91 (SECTIONS 3, 4, 8 & 9)
U.S.G.S./AGRICO – 1972 (SECTIONS 1, 2, 3, 7, 9, 10 11 & 12)
SWFWMD – 1975 (SECTIONS 33, 34, 35 & 36)

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POLK POWER STATION

Table 2.3.4-1. Pre-Mining Drainage Areas for Selected Locations (acres)

Location	Onsite	Offsite	Total
Alafia River Drainage Basin			
South Prong Alafia River at Hillsborough/ Polk County Line	816	20,219	21,035
South Prong Alafia River near Lithia	816	67,231	68,047
Alafia River at Lithia	816	213,151	213,967
Alafia River near Riverview	816	257,951	258,767
Little Payne Creek Drainage Basin			
At Fort Green Road	2,816	3,751	6,567
4.5 miles downstream from Fort Green Road	2,816	15,751	18,567
At Route 665 near Bowling Green	2,816	21,877	24,693
Payne Creek Basin Drainage Basin			
At SR 37	716	2,957	3,673
4.2 miles downstream from SR 37	716	12,953	13,669
At Fort Green Road	716	25,635	26,351
Payne Creek and Little Payne Creek Drainage Basin			
At U.S. Highway 17 near Bowling Green (including Little Payne Creek Basin)	3,532	74,342	77,874

Sources: USGS, 1990.
ECT, 1992.

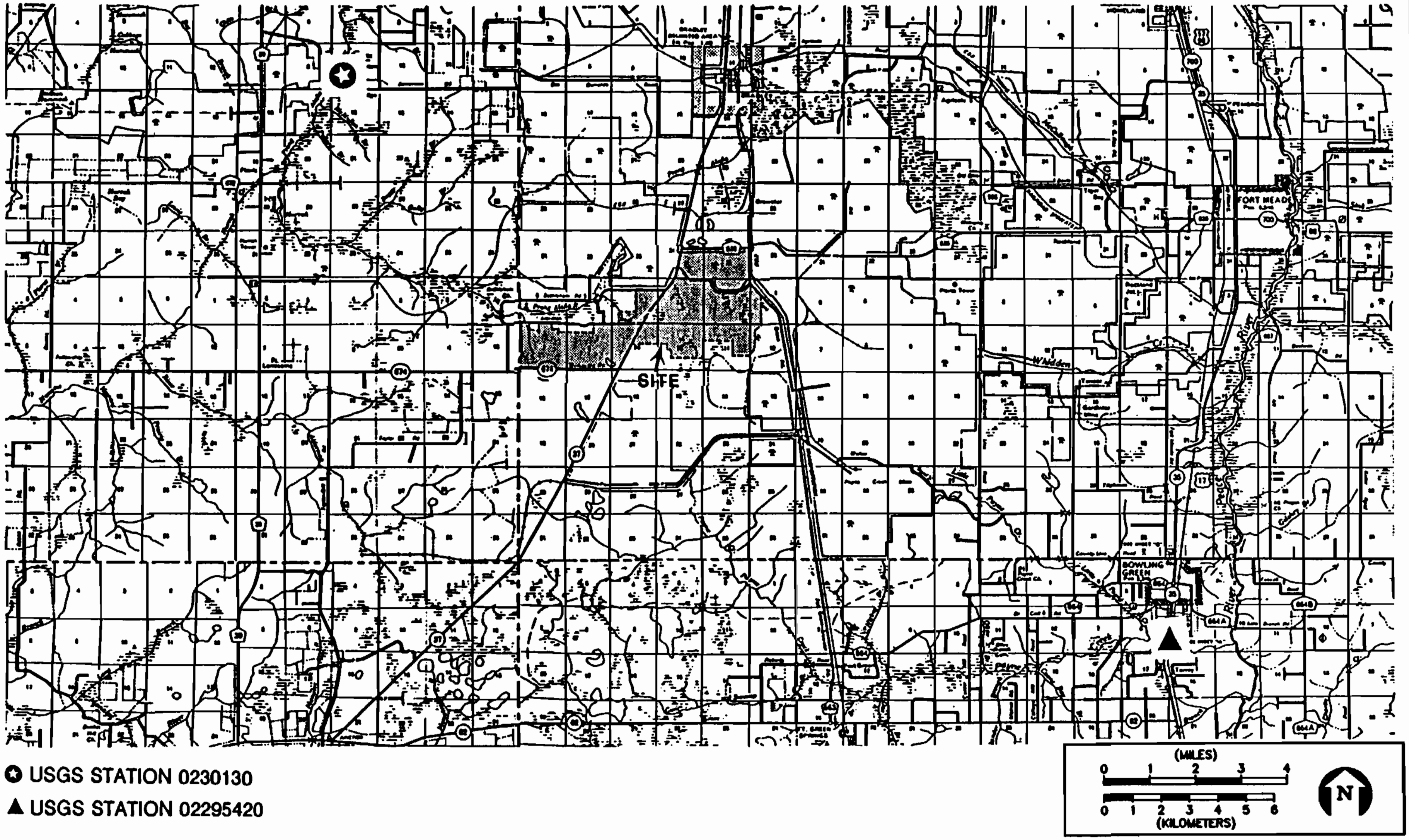

FIGURE 2.3.4-2.

LOCATION OF USGS SURFACE WATER STATIONS

Source: USGS, 1990.

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Table 2.3.4-2. Annual Average Discharge at Selected Gauging Stations

Station	Drainage Area (mi^2)	Average Discharge (cfs)	CSM
South Prong Alafia River near Lithia	107	101.0	0.944
North Prong Alafia River at Keysville	135	156.0	1.156
Alafia River at Lithia	335	346.0	1.033
Payne Creek near Bowling Green	121	96.6	0.798
Peace River at Zolfo Springs	826	632.0	0.765

Source: USGS, 1990.

0.94 to 1.16 cfs per square mile (CSM). The contribution per square mile from the Peace River basin is somewhat less, having values in the range of 0.77 to 0.80 CSM. These values are typical for the terrain and soils of Florida. To estimate the average flow contributed by the areas located within the project site boundaries, the values for discharge per square mile (0.94 CSM) for the South Prong Alafia River and Payne Creek were applied to the onsite drainage basin areas. The Payne Creek gauging station near Bowling Green (0.80 CSM) is located downstream of the confluence of the Little Payne Creek and Payne Creek and was, therefore, applicable to both the Payne Creek and Little Payne Creek subwatersheds. Consequently, the pre-mining average discharges from the Polk Power Station site to the South Prong Alafia River, Payne Creek, and Little Payne Creek were calculated to be 1.20, 0.89, and 3.51 cfs, respectively.

USGS, using the log-Pearson type III frequency distribution, has calculated the 7-day, 10-year (7Q10) low-flow rates for the South Prong Alafia River and Payne Creek gauging stations using gauge data through 1981 (USGS, 1985). The 7Q10 low-flows for the South Prong Alafia River and Payne Creek are 3.0 and 1.6 cfs, respectively; additional statistics are presented in Table 2.3.4-3.

To obtain site-specific information on the surface water resources surrounding the Polk Power Station site, Tampa Electric Company established and implemented a comprehensive surface water monitoring program consisting of seven monitoring stations. The locations of the seven stations are shown in Figure 2.3.4-3, and a description of the program is provided in Section 2.3.4.2. The monitoring period extended from February to August 1991 encompassing both dry and wet season conditions. Monthly stage discharge and water quality measurements were taken at all stations. Stations SW-2, SW-5, and SW-6 incorporated continuous stage measurements as well. The recorded water level data for these stations with continuous stage recorders are shown in Figures 2.3.4-4 through 2.3.4-6.

Table 2.3.4-3. Low-Flow Frequency Analysis

Period of Consecutive Days	Lowest Average Flow (cfs) for Indicated Recurrence Interval (years)			
	2	5	10	20
South Prong Alafia River near Lithia				
1	10	4.0	2.3	1.4
3	11	4.4	2.6	1.6
7	12	5.0	3.0	1.9
14	14	6.0	3.6	2.3
30	19	9.0	5.8	4.0
60	27	14	9.9	7.2
90	34	18	13	9.3
120	44	24	17	12
183	54	32	25	20
Payne Creek near Bowling Green				
1	3.2	1.6	1.2	1.0
3	3.7	1.8	1.4	1.1
7	4.8	2.2	1.6	1.3
14	5.8	2.5	1.7	1.3
30	7.9	3.3	2.1	1.5
60	13	5.0	2.9	1.9
90	18	8.3	5.5	3.8
120	23	12	9.1	7.2
183	36	18	12	8.2

Source: USGS, 1985a.

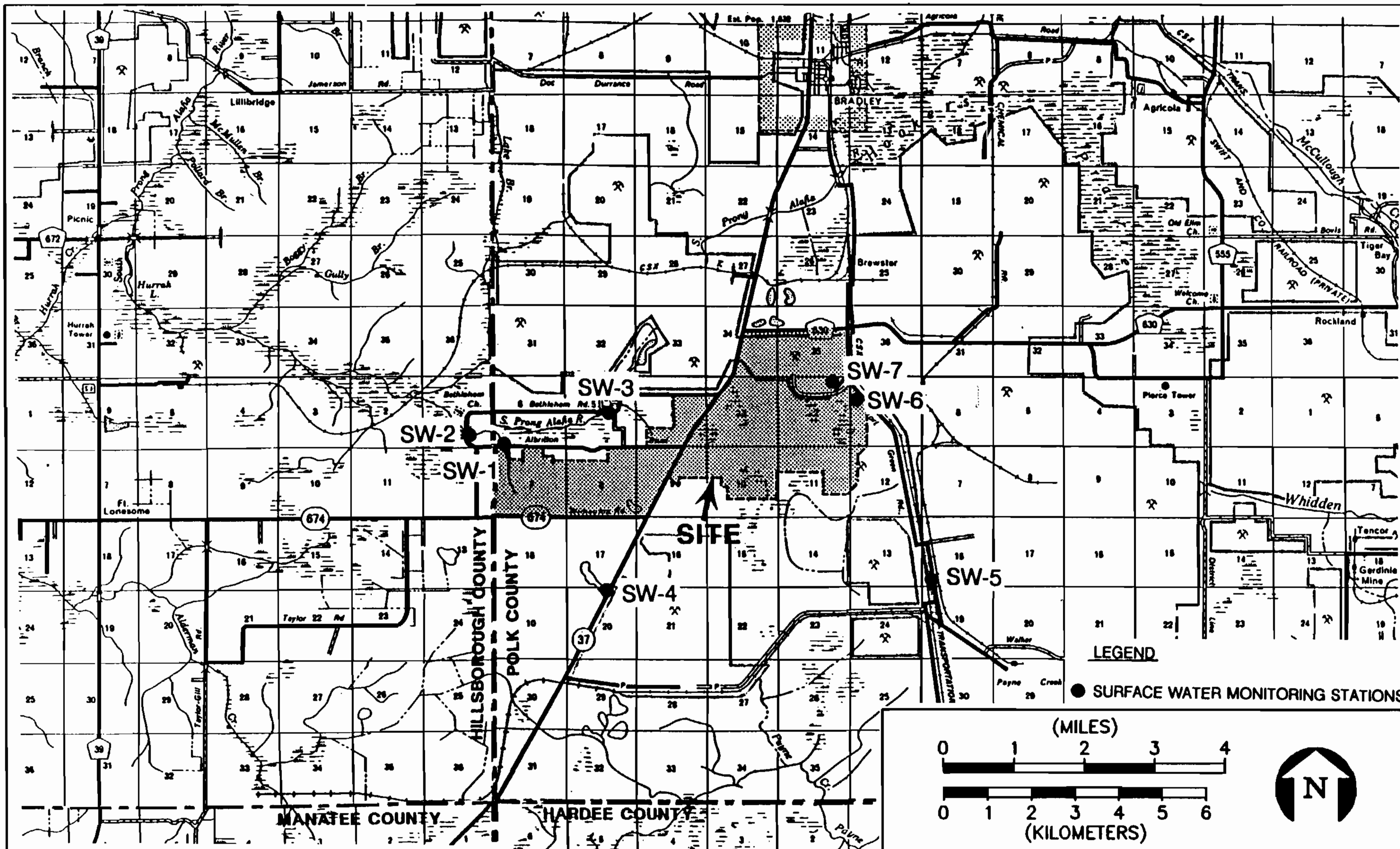

FIGURE 2.3.4-3.

SURFACE WATER MONITORING STATIONS

Sources: FDOT, 1976, 1977. ECT, 1991.

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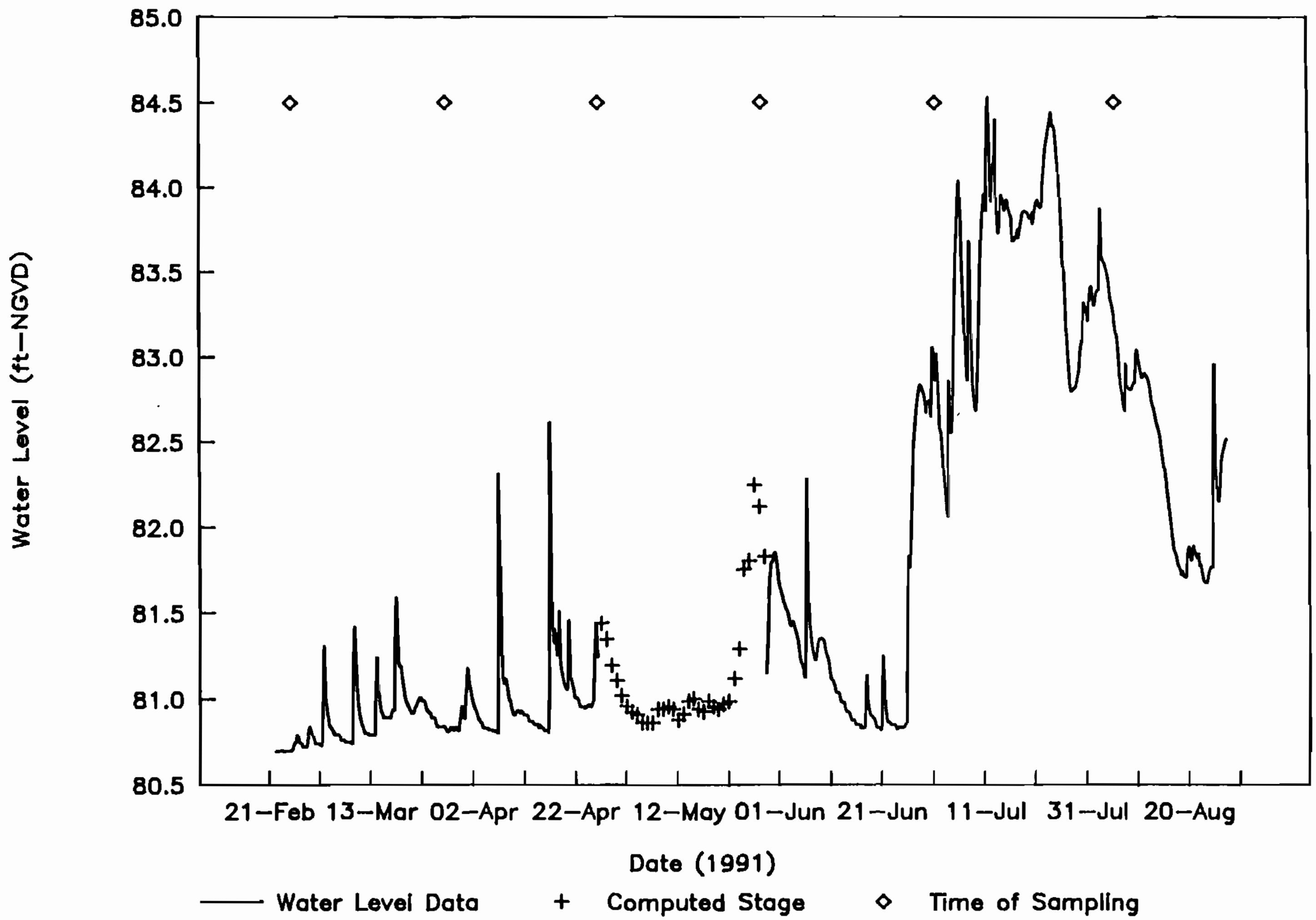

FIGURE 2.3.4-4.

WATER LEVEL DATA AT STATION SW-2

Source: ECT, 1992

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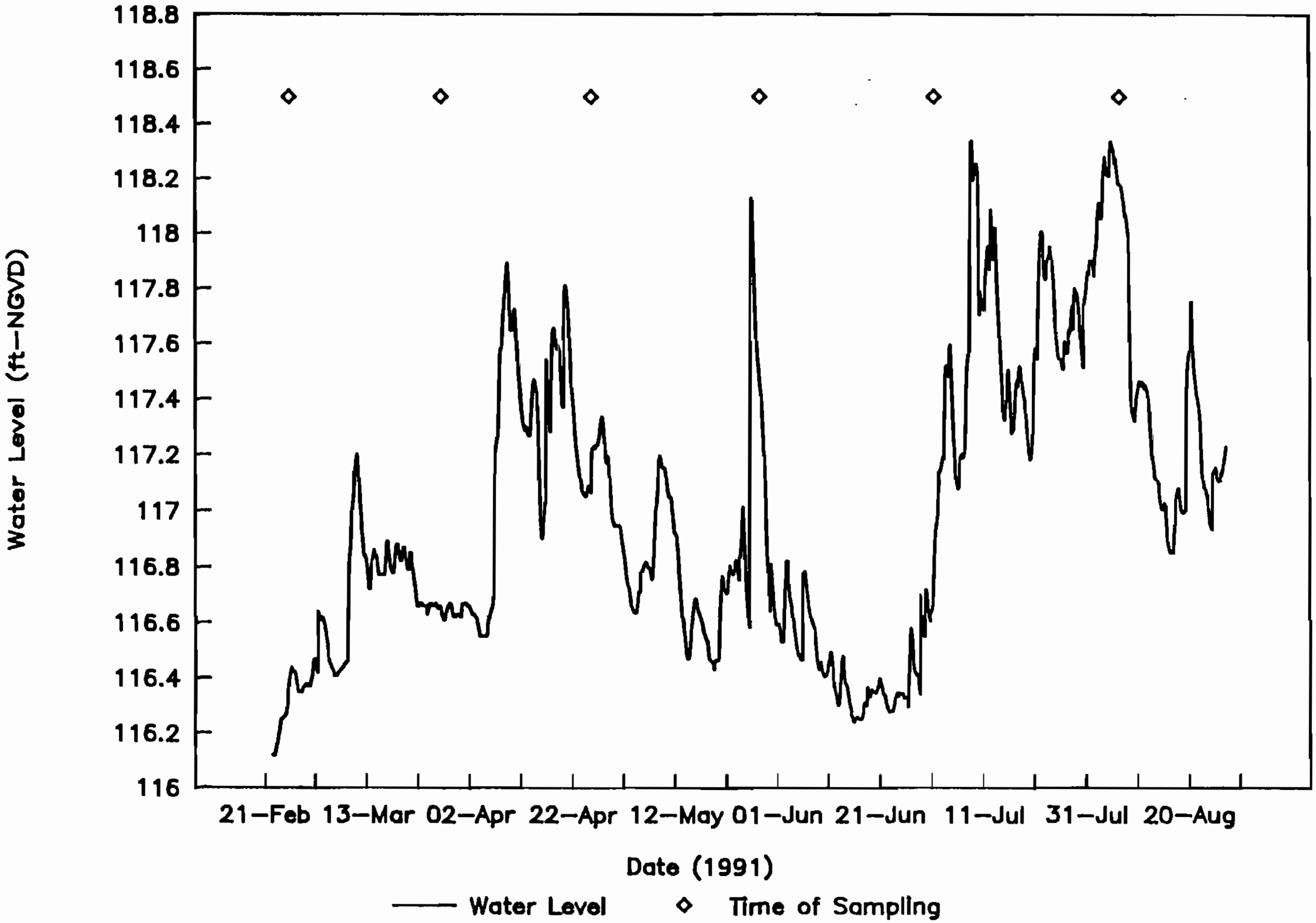

FIGURE 2.3.4-5.

WATER LEVEL DATA AT STATION SW-5

Source: ECT, 1992

TAMPA ELECTRIC
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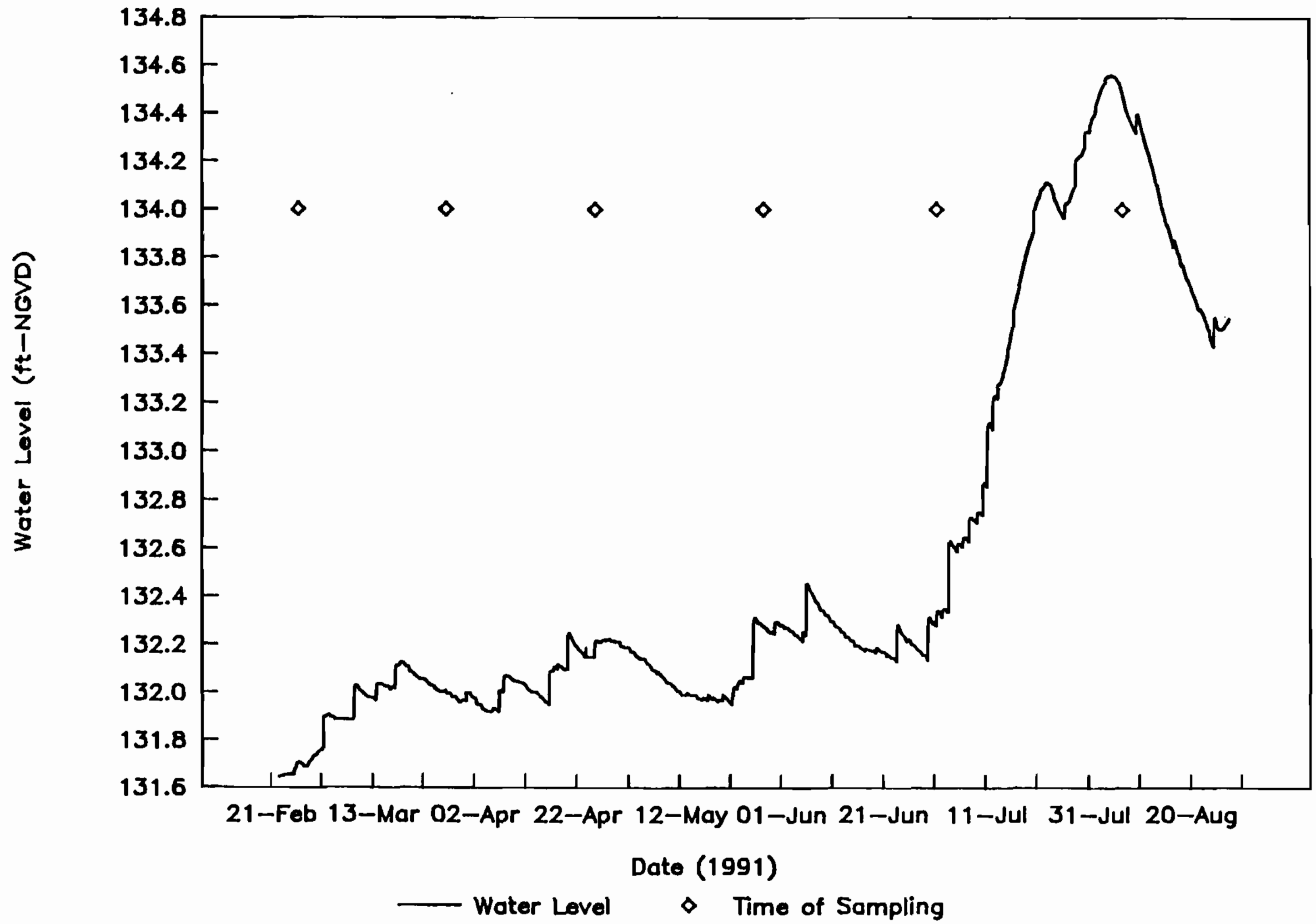

FIGURE 2.3.4-6.

WATER LEVEL DATA AT STATION SW-6

Source: ECT, 1992

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The stage at SW-2 fluctuated between a low level of 80.70 ft-NGVD on February 22, 1991, and a high level of 84.53 ft-NGVD on July 12, 1991. The stage at SW-5 fluctuated between a low level of 116.12 ft-NGVD on February 22, 1991, and a high level of 118.34 ft-NGVD on August 4, 1991. The stage at SW-6, located in a reclaimed lake, fluctuated much less erratically and had a low level of 131.65 ft-NGVD on February 22, 1991, and a high level of 134.56 ft-NGVD on August 4, 1991. All three records exhibit a rise in stage in late June and early July as a result of the seasonal increase in precipitation.

The average monthly stage discharge measurements at SW-1, SW-3, SW-4, and SW-7 were 103.00, 94.61, 128.80, and 133.58 ft-NGVD, respectively, during the monitoring period.

Because of a water level recorder malfunction at SW-2, water level data were not recorded between April 12 and May 29, 1991. To reconstruct the missing data, a correlation analysis was conducted using the following procedure:

- The daily average flows at SW-2 were calculated using the daily average stage data measurements based on an established stage-discharge relationship (see Fig. 2.3.4-7) established by the stage and discharge data;
- The daily flow data at SW-2 were compared with the daily flow data at the USGS gauging station on the South Prong Alafia River near Lithia. A correlation function was then established between the discharge at SW-2 and the USGS station;
- The daily discharges at SW-2 were computed for the period of equipment malfunction based on the correlation function using the daily discharges at the USGS station on the South Prong Alafia River near Lithia; and
- The daily stage data at SW-2 were computed for the period of equipment malfunction based on the stage-discharge relationship.

The reconstructed stage data are represented by +'s in Figure 2.3.4-4.

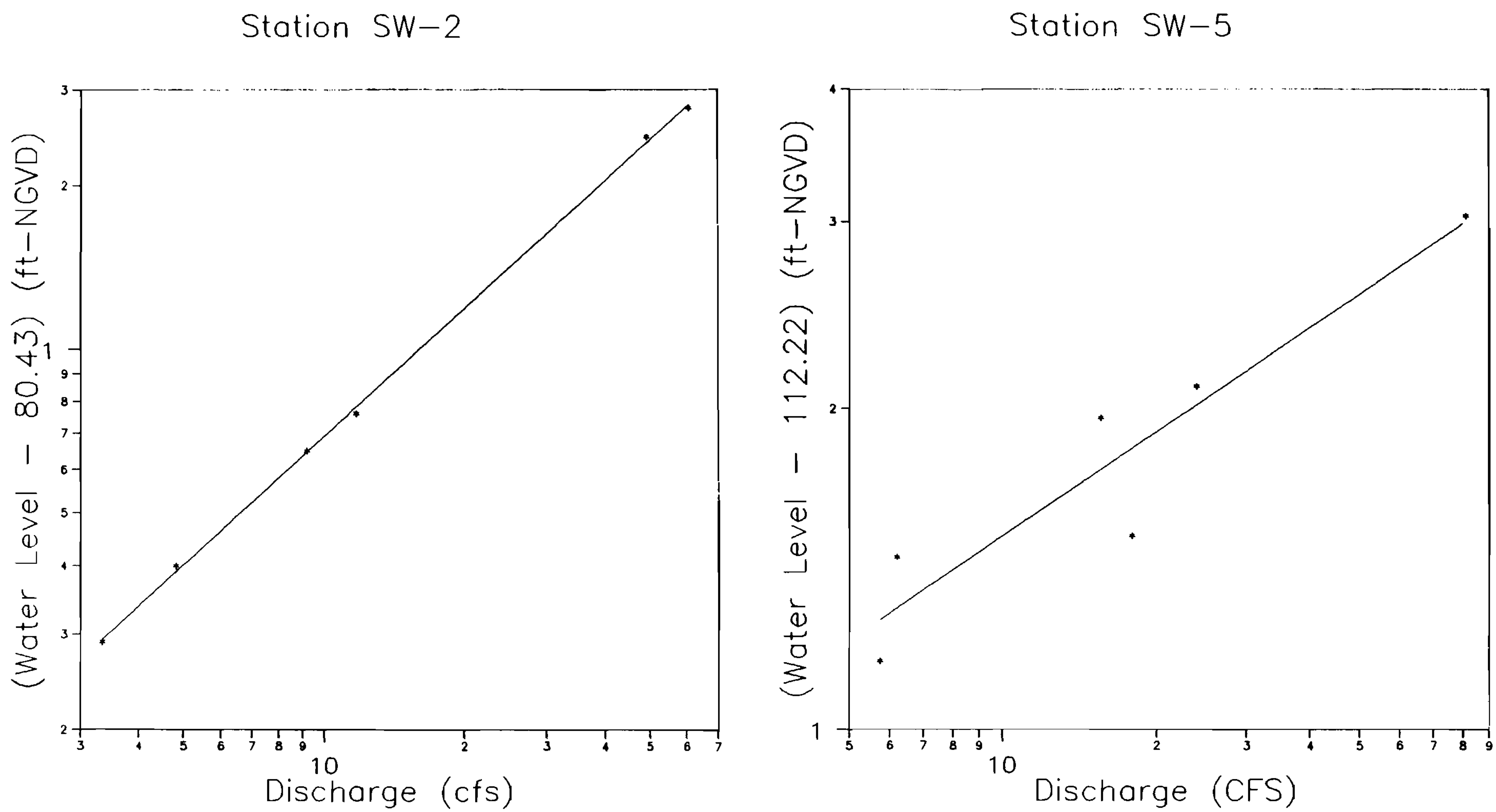

FIGURE 2.3.4-7.

STAGE/DISCHARGE CURVES FOR MONITORING STATIONS SW-2 AND SW-5

Source: ECT, 1992

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Instantaneous stream velocity measurements were taken monthly at Stations SW-2, SW-3, and SW-5 with a current meter across the stream. Flow was not measurable at SW-4 due to apparent stagnation. SW-6 and SW-7 were located in reclaimed lake and mine cuts; therefore, there were no flow data for these stations. Flow at SW-1 was too low to be measured with a flow meter; therefore, it was determined by measuring a timed volume of water as it exited a culvert under SR-674 (Albritton Road). Instantaneous discharge was calculated for Stations SW-2, SW-3, and SW-5 using standard USGS integration techniques. Stage-discharge relationships for SW-2, SW-3, and SW-5 were developed using these data. Examples of the stage-discharge curves are shown in Figure 2.3.4-7. Average daily water levels for the continuous recorders and the corresponding average daily discharges for Stations SW-2, SW-3, and SW-5 are provided in Appendix 11.8.5. The measured monthly water level and discharge data for all the surface water stations are also provided in Appendix 11.8.5.

Flood frequency information for Florida streams is provided by USGS (1982). Flood estimates are reported at selected gauging stations in the Peace River and Alafia River basins for 2- to 100-year recurrence intervals as shown in Table 2.3.4-4. These values were computed using a log-Pearson Type III distribution with long-term historical discharge data. The 100-year peak flow was estimated to be 4,330 cfs for the South Prong Alafia River gauging station near Lithia and 4,810 cfs for the Peace River at the Bartow gauging station.

Ardaman & Associates, Inc. conducted a hydrologic analysis of a 19,936-acre area (Ardaman, 1991) for the Agrico Fort Green Mine Reclamation Plan which included the majority of the proposed Polk Power Station project site area. The HEC-1 Flood Hydrograph Package was used to simulate the runoff hydrographs of the pre-mining watershed resulting from to a design storm. For the 24-hour, 25-year design storm, the pre-mining peak flow for the South Prong Alafia River basin (889 acres) was reported to be 514 cfs, that for Payne Creek basin (13,142 acres) was 2,503 cfs, and that for Little Payne Creek basin (3,711 acres) was 1,146 cfs. The peak discharge per square mile with the design storm was calculated to be 370 CSM for the South Prong

Table 2.3.4-4. Peak Flow (cfs) Frequency Analysis

Station	Years of Record	Drainage Area (mi^2)	Return Period (year) 2	5	10	25	50	100
South Prong Alafia River near Lithia	15	107	825	1,510	2,070	2,890	3,580	4,330
Alafia River at Lithia	46	335	3,060	6,580	10,000	15,900	21,700	28,800
Peace River at Bartow	39	390	978	1,740	2,350	3,240	3,990	4,810
Peace River at Zolfo Springs	46	826	4,830	8,370	11,300	15,600	19,400	23,600

Source: USGS, 1982.

Alafia River, 122 CSM for Payne Creek, and 198 CSM for Little Payne Creek, according to Ardaman's analysis.

Tampa Electric Company has also conducted hydrologic analyses and modeling to determine the runoff hydrograph resulting from a 24-hour, 25-year storm using the HEC-1 model. The results of the hydrologic modeling for pre-mining and post-reclamation stormwater runoff are discussed in Sections 3.8 and 5.3.1, and the detailed modeling results are provided in Appendix 11.8.9.

The 100-year floodplains on the site for the pre-mining condition were documented by FEMA (1983) and are shown in Figure 2.1.0-1. Only a small portion of the area lying to the west of SR 37 is located within the 100-year floodplain; and most of it has been or will be mined prior to Tampa Electric Company's use of the site. Most of the floodplain areas to the east of SR 37 were associated with the headwaters of Little Payne Creek where mining activities have also occurred. These mined areas were not the passageway of any other upstream stormwater runoff since they were located at the headwaters of the drainage basin. Therefore, the onsite mining activities did not increase the downstream flooding potential. A hydrological analysis conducted by Ardaman & Associates, Inc., also substantiated that the post-reclamation peak runoff would not exceed the pre-mining runoff due to the detention capacity of the reclaimed areas according to Agrico's approved reclamation plan for the site area.

Currently, the proposed site does not contribute to flood hazard potential because the existing conditions resulting from the mining operations (reclaimed lake, mine pits, etc.) provide for significant water retention.

<u>Surface Water Quality</u>

According to Chapter 17-302, F.A.C., the surface waters on and around the Polk Power Station site are classified to be Class III waters and the designated uses are recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The nearest Outstanding Florida Water is the Little Manatee River. The nearest portion of this river designated as such is approximately 11.5 miles west of the Polk Power Station site.

Water quality of the South Prong Alafia River is considered *fair* by FDER (1990). Although better than the North Prong Alafia River, the South Prong is affected to some degree by the phosphate mining industry as well as agriculture development. Elevated nutrients and total suspended solids and depressed dissolved oxygen (DO) values remain a problem on the South Prong Alafia River. FDER (1990) considers the water quality in Payne Creek and Little Payne Creek to be *good*, nevertheless, DO concentrations occasionally below 5.0 mg/L and elevated nutrient level have been observed on these streams as well.

Data used to prepare the following description of surface water quality in the vicinity of the Polk Power Station site were obtained from a variety of sources, the most extensive being Tampa Electric Company's site-specific comprehensive monitoring program; EPA's STORET data; FDER Point Source Evaluation Section's (FDER/PSES's) intensive survey of the Alafia River Basin; and USGS' routine water quality data, much of which are reported in EPA's STORET system.

In the following paragraphs, the water quality of these waters is described in detail based on the aforementioned sources. Site-specific water quality data collected by Tampa Electric Company during 1991 include both the historically dry and wet seasons in this area of Florida. These data are compared with the longer-term historical data from EPA, FDER/PSES, and USGS by water body groups. For discussion purposes, the Tampa Electric Company surface water monitoring stations have been grouped according to distinct surface water systems as follows: (1) SW-1 through SW-3 (South Prong Alafia River and its tributary on the site); (2) SW-4 and SW-5 (Payne Creek and its tributary, Little Payne Creek); and (3) SW-6 (reclaimed lake) and SW-7 (old mine cut), which are also located in the pre-mining headwater area of Little Payne Creek.. All of these Tampa Electric Company water quality monitoring stations are shown in Figure 2.3.4-3.

Further, rather than discuss each water quality parameter for each station, a number of tables and figures are presented that summarize the water quality data. These data include data collected by Tampa Electric Company and data from other sources such as EPA and FDER/PSES.

Mean values for all parameters at the Tampa Electric Company monitoring stations (SW-1 through SW-7) are presented in Table 2.3.4-5. Statistical summaries including the mean, maximum, minimum, standard deviation, and number of samples for the monitoring data are presented by station in Tables 2.3.4-6 through 2.3.4-12. These tables do not include those parameters which have not been detected during the course of the monitoring program. All monthly water quality data for the seven stations collected by Tampa Electric Company are presented in Appendix 11.8.8.

Extensive historical water quality data are available for the South Prong Alafia River and its tributaries. Specific sources include EPA's data from the South Prong Alafia River at Bethlehem Road and FDER/PSES, stations S3, S6 Tampa Electric Company monitoring Station SW-3), and S9 (coincide with Tampa Electric Company Monitoring Station SW-2). Basic water quality statistics for the South Prong Alafia River at Bethlehem Road (Tampa Electric Company Monitoring Station SW-2) obtained from FDER/ PSES and EPA are presented in Tables 2.3.4-13 and 2.3.4-14, respectively. EPA water quality statistics for Payne Creek near Bowling Green are presented in Table 2.3.4-15

In the following discussions, parameters of particular interest, either because they are engineering parameters or they represent historical water quality problems, are discussed in greater detail.

Table 2.3.4-5. Average Water Quality for Stations SW-1 through SW-7 Grouped by Basin or Water Body Type

Analyte	Units	South Prong Alafia River			Payne Creek/ Little Payne Creek		Lake and Mine Cut	
		SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7
In Situ Measurements								
Temperature	°C	26.2	25.5	26.4	25.6	27.0	27.5	27.6
Specific Conductance	umhos/cm	143	351	383	201	377	307	333
Hydrogen Ion Activity (pH)		5.9	7.0	6.7	6.9	6.5	8.9	8.7
Dissolved Oxygen (DO)	mg/L	4.9	5.4	4.3	0.9	4.9	9.3	11.2
DO Saturation	%	59	65	52	12	60	115	140
Oxidation-Reduction Potential	V	0.103	0.033	0.110	0.068	0.082	0.044	0.013
Classical								
Alkalinity, Total as CaCO3	mg/L	10	75	84	66	92	82	67
Alkalinity, Bicarbonate	mg/L	10	75	84	66	92	60	55
Alkalinity, Carbonate	mg/L	0	0	0	0	0	0	10
Acidity, Total	mg/L	10	5	8	18	11	1	3
Hardness, Total as CaCO3	mg/L	44	138	153	81	117	104	108
Color	Pt-Co	144	77	89	263	43	48	111
Solids, Total	mg/L	122	252	287	167	242	227	270
Solids, Total Dissolved	mg/L	111	228	245	145	227	198	230
Solids, Total Suspended	mg/L	5	10	31	17	5	23	33
Turbidity	NTU	2.4	4.5	4.3	1.9	3.7	9.2	22
Chloride	mg/L	15	15	15	12	13	16	14
Fluoride, Soluble	mg/L	0.44	1.57	1.85	0.71	1.83	1.97	1.58
Sulfate	mg/L	21.2	61.2	68.7	0.8	63.0	38.2	58.0
Cyanide	mg/L	0	0.0	0.0	0.0	0.0	0.0	0.0
Sodium	mg/L	7	14	15	7	29	20	25
Calcium	mg/L	11	32	35	15	26	23	22
Magnesium	mg/L	3.1	15.0	16.2	10.6	12.3	12.2	13.5
Arsenic	ug/L	0	0	0	0	0	0	0
Selenium	ug/L	0	0	0	0	0	0	0
Total Anions	meq/L	0.85	2.06	2.29	0.67	2.49	1.65	2.02
Total Cations	meq/L	1.11	3.46	3.73	2.00	3.45	2.89	3.14
Ammonia (un-ionized)	mg/L	0	0	0	0	0	0.00	0.09
Nitrogen, Nitrate	mg/L	0	0.6	0.2	0	0	0	0
Nitrogen, Nitrite	mg/L	0	0.01	0.28	0	0	0	0
Nitrogen, Total Organic	mg/L	0.68	0.93	0.97	1.34	1.01	1.64	2.73
Nitrogen, Kjeldahl	mg/L	0.72	0.97	1.14	1.38	1.37	1.75	2.97
Phosphorus, Total	mg/L	0.82	1.17	1.28	0.71	0.49	0.47	4.52
Total Rec. Oil & Grease	mg/L	0	0	0	0	0	0	0
Surfactants	mg/L	0.02	0.02	0.03	0.02	0.01	0.01	0.01
5-day BOD	mg/L	2	2	4	4	7	9	14
Chemical Oxygen Demand	mg/L	51	41	49	82	40	58	72
Hydrogen Sulfide	mg/L	0.2	0.2	0.2	0.3	0.1	0.1	0.1
Other Metals								
Antimony	mg/L	0	0	0	0	0	0	0
Barium	mg/L	0	0	0	0	0	0	0
Beryllium	ug/L	0	0	0	0	0	0	0
Cadmium	ug/L	0	0	0	0	0	0	0
Chromium	mg/L	0	0	0	0	0	0	0
Chromium, Hexavalent	mg/L	0	0	0	0	0	0	0
Copper	mg/L	0	0	0	0	0	0	0
Iron	mg/L	0.3	0	0.2	1.2	0	0	0

Table 2.3.4-5. Average Water Quality for Stations SW-1 through SW-7 Grouped by Basin or Water Body Type (Continued, Page 2 of 5)

		South Prong Alafia River			Payne Creek/ Little Payne Creek		Lake and Mine Cut	
Analyte	Units	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7
Lead	ug/L	2	2	2	2	2	2	2
Manganese	mg/L	0	0	0	0.01	0	0	0
Mercury	ug/L	0	0	0	0	0	0	0
Nickel	mg/L	0	0	0	0	0	0	0
Silver	ug/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Thallium	mg/L	0	0	0	0	0	0	0
Vanadium	mg/L	0	0	0	0	0	0	0
Zinc	mg/L	0	0	0.003	0	0.003	0	0
Radioactive Substances								
Radium 226	pCi/L	0	0.3	0.6	0	0.3	1.2	0.4
Radium 228	pCi/L	0	1.0	0.9	0.9	0.6	0	0.6
Gross Alpha	pCi/L	1.6	1.9	3.3	1.2	2.3	1.6	1.3
Organics (Phenols, Phthalates, PCBs)								
Phenol	ug/L	0	0	0	0	0	0	0
2-Chlorophenol	ug/L	0	0	0	0	0	0	0
2-Nitrophenol	ug/L	0	0	0	0	0	0	0
4-Nitrophenol	ug/L	0	0	0	0	0	0	0
2-Methylphenol	ug/L	-	0	0	0	0	-	-
4-Methylphenol	ug/L	-	0	0	0	0	-	-
2,4-Dimethylphenol	ug/L	0	0	0	0	0	0	0
2,4-Dichlorophenol	ug/L	0	0	0	0	0	0	0
4-Chloro-3-methylphenol	ug/L	0	0	0	0	0	0	0
2,4,5-Trichlorophenol	ug/L	-	0	0	0	0	-	-
2,4,6-Trichlorophenol	ug/L	0	0	0	0	0	0	0
2,4-Dinitrophenol	ug/L	0	0	0	0	0	0	0
2-Methyl-4,6-dinitrophenol	ug/L	0	0	0	0	0	0	0
Pentachlorophenol	ug/L	0	0	0	0	0	0	0
Di-n-butyl Phthalate	ug/L	0	0	0	0	0	0	0
bis(2-Ethyl hexyl) Phthalate	ug/L	0	0	0	0	0	0	0
Di-n-octyl Phthalate	ug/L	0	0	0	0	0	0	0
Butyl Benzyl Phthalate	ug/L	0	0	0	0	0	0	0
Diethyl Phthalate	ug/L	0	0	0	0	0	0	0
Dimethyl Phthalate	ug/L	0	0	0	0	0	0	0
PCB-1016	ug/L	0	0	0	0	0	0	0
PCB-1221	ug/L	0	0	0	0	0	0	0
PCB-1232	ug/L	0	0	0	0	0	0	0
PCB-1242	ug/L	0	0	0	0	0	0	0
PCB-1248	ug/L	0	0	0	0	0	0	0
PCB-1254	ug/L	0	0	0	0	0	0	0
PCB-1260	ug/L	0	0	0	0	0	0	0
Pesticides								
Aldrin	ug/L	0	0	0	0	0	0	0
Dieldrin	ug/L	0	0	0	0	0	0	0
Chlordane	ug/L	0	0	0	0	0	0	0
4,4-DDT	ug/L	0	0	0	0	0	0	0
4,4-DDD	ug/L	-	0	0	0	0	0	-
4,4-DDE	ug/L	-	0	0	0	0	0	-
Demeton	ug/L	0	0	0	0	0	0	0

Table 2.3.4-5. Average Water Quality for Stations SW-1 through SW-7 Grouped by Basin or Water Body Type (Continued, Page 3 of 5)

		South Prong Alafia River			Payne Creek/ Little Payne Creek		Lake and Mine Cut	
Analyte	Units	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7
Endosulfan	ug/L	0	0	0	0	0	0	0
Endosulfan I	ug/L	-	0	0	0	0	0	-
Endosulfan II	ug/L	-	0	0	0	0	0	-
Endosulfan Sulfate	ug/L	-	0	0	0	0	0	-
Endrin	ug/L	0	0	0	0	0	0	0
Endrin Aldehyde	ug/L	-	0	0	0	0	0	-
Guthion	ug/L	0	0	0	0	0	0	0
Heptachlor	ug/L	0	0	0	0	0	0	0
Heptachlor Epoxide	ug/L	-	0	0	0	0	0	-
a-BHC	ug/L	-	0	0	0	0	0	-
b-BHC	ug/L	-	0	0	0	0	0	-
g-BHC	ug/L	-	0	0	0	0	-	-
d-BHC	ug/L	-	0	0	0	0	-	-
Lindane	ug/L	0	0	0	0	0	0	0
Malathion	ug/L	0	0	0	0	0	0	0
Methoxychlor	ug/L	0	0	0	0	0	0	0
Mirex	ug/L	0	0	0	0	0	0	0
Parathion	ug/L	0	0	0	0	0	0	0
Toxaphene	ug/L	0	0	0	0	0	0	0
Other Priority Pollutants								
Acrolein	ug/L	-	0	0	0	0	-	-
Acrylonitrile	ug/L	-	0	0	0	0	-	-
Benzene	ug/L	-	0	0	0	0	-	-
Bromodichloromethane	ug/L	-	0	0	0	0	-	-
Bromoform	ug/L	-	0	0	0	0	-	-
Bromomethane	ug/L	-	0	0	0	0	-	-
Carbon Tetrachloride	ug/L	-	0	0	0	0	-	-
Chlorobenzene	ug/L	-	0	0	0	0	-	-
Chloroethane	ug/L	-	0	0	0	0	-	-
2-Chloroethylvinyl Ether	ug/L	-	0	0	0	0	-	-
Chloroform	ug/L	-	0	0	0	0	-	-
Chloromethane	ug/L	-	0	0	0	0	-	-
Dibromochloromethane	ug/L	-	0	0	0	0	-	-
1,1-Dichloroethane	ug/L	-	0	0	0	0	-	-
1,2-Dichloroethane	ug/L	-	0	0	0	0	-	-
1,1-Dichloroethylene	ug/L	-	0	0	0	0	-	-
trans-1,2-Dichloroethylene	ug/L	-	0	0	0	0	-	-
1,2-Dichloropropane	ug/L	-	0	0	0	0	-	-
cis-1,3-Dichloropropene	ug/L	-	0	0	0	0	-	-
trans-1,3-Dichloropropene	ug/L	-	0	0	0	0	-	-
Ethyl Benzene	ug/L	-	0	0	0	0	-	-
Methylene Chloride	ug/L	-	0	0	0	0	-	-
1,1,2,2-Tetrachloroethane	ug/L	-	0	0	0	0	-	-
Tetrachloroethylene	ug/L	-	0	0	0	0	-	-
Toluene	ug/L	-	0	0	0	0	-	-
1,1,1-Trichloroethane	ug/L	-	0	0	0	0	-	-
1,1,2-Trichloroethane	ug/L	-	0	0	0	0	-	-
Trichloroethylene	ug/L	-	0	0	0	0	-	-
Trichlorofluoromethane	ug/L	-	0	0	0	0	-	-
Vinyl Chloride	ug/L	-	0	0	0	0	-	-

Table 2.3.4-5. Average Water Quality for Stations SW-1 through SW-7 Grouped by Basin or Water Body Type (Continued, Page 4 of 5)

Analyte	Units	South Prong Alafia River			Payne Creek/ Little Payne Creek		Lake and Mine Cut	
		SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7
Acenaphthene	ug/L	-	0	0	0	0	-	-
Acenaphthylene	ug/L	-	0	0	0	0	-	-
Anthracene	ug/L	-	0	0	0	0	-	-
Benzoic Acid	ug/L	-	0	0	0	0	-	-
Benzo(a)anthracene	ug/L	-	0	0	0	0	-	-
Benzo(a)pyrene	ug/L	-	0	0	0	0	-	-
Benzo(b)fluoranthene	ug/L	-	0	0	0	0	-	-
Benzo(k)fluoranthene	ug/L	-	0	0	0	0	-	-
Benzo(g,h,i)perylene	ug/L	-	0	0	0	0	-	-
Benzyl Alcohol	ug/L	-	0	0	0	0	-	-
bis(2-Chloroethoxy) Methane	ug/L	-	0	0	0	0	-	-
bis(2-Chloroethyl) Ether	ug/L	-	0	0	0	0	-	-
bis(2-Chloroisopropyl) Ether	ug/L	-	0	0	0	0	-	-
4-Bromophenyl Phenyl Ether	ug/L	-	0	0	0	0	-	-
2-Chloronaphthalene	ug/L	-	0	0	0	0	-	-
4-Chlorophenyl Phenyl Ether	ug/L	-	0	0	0	0	-	-
4-Chloroaniline	ug/L	-	0	0	0	0	-	-
Chrysene	ug/L	-	0	0	0	0	-	-
Dibenzo(a,h)anthracene	ug/L	-	0	0	0	0	-	-
1,2-Dichlorobenzene	ug/L	-	0	0	0	0	-	-
1,3-Dichlorobenzene	ug/L	-	0	0	0	0	-	-
1,4-Dichlorobenzene	ug/L	-	0	0	0	0	-	-
3,3-Dichlorobenzidine	ug/L	-	0	0	0	0	-	-
Dibenzofuran	ug/L	-	0	0	0	0	-	-
2,4-Dinitrotoluene	ug/L	-	0	0	0	0	-	-
2,6-Dinitrotoluene	ug/L	-	0	0	0	0	-	-
Fluoranthene	ug/L	-	0	0	0	0	-	-
Fluorene	ug/L	-	0	0	0	0	-	-
Hexachlorobenzene	ug/L	-	0	0	0	0	-	-
Hexachlorobutadiene	ug/L	-	0	0	0	0	-	-
Hexachloroethane	ug/L	-	0	0	0	0	-	-
Indeno(1,2,3-c,d)pyrene	ug/L	-	0	0	0	0	-	-
Isophorone	ug/L	-	0	0	0	0	-	-
2-Methylnaphthalene	ug/L	-	0	0	0	0	-	-
Naphthalene	ug/L	-	0	0	0	0	-	-
2-Nitroaniline	ug/L	-	0	0	0	0	-	-
3-Nitroaniline	ug/L	-	0	0	0	0	-	-
4-Nitroaniline	ug/L	-	0	0	0	0	-	-
Nitrobenzene	ug/L	-	0	0	0	0	-	-
N-Nitrosodimethylamine	ug/L	-	0	-	0	0	-	-
N-Nitrosodi-n-propylamine	ug/L	-	0	0	0	0	-	-
N-Nitrosodiphenylamine	ug/L	-	0	0	0	0	-	-
Phenanthrene	ug/L	-	0	0	0	0	-	-
Pyrene	ug/L	-	0	0	0	0	-	-
1,2,4-Trichlorobenzene	ug/L	-	0	0	0	0	-	-
Hexachlorocyclopentadiene	ug/L	-	0	0	0	0	-	-
cis-1,2-Dichloroethene	ug/L	-	0	-	0	0	-	-
2-Hexanone	ug/L	-	0	-	0	0	-	-
Methyl tert-butyl Ether	ug/L	-	0	-	0	0	-	-
4-Methyl-2-pentanone (MIBK)	ug/L	-	0	-	0	0	-	-
Vinyl Acetate	ug/L	-	0	-	0	0	-	-

Table 2.3.4-5. Average Water Quality for Stations SW-1 through SW-7 Grouped by Basin or Water Body Type (Continued, Page 5 of 5)

Analyte	Units	South Prong Alafia River			Payne Creek/ Little Payne Creek		Lake and Mine Cut	
		SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7
Xylenes	ug/L	-	0	-	0	0	-	-
2-Butanone (MEK)	ug/L	-	0	-	0	0	-	-
Carbon Disulfide	ug/L	-	0	-	0	0	-	-
Benzidine	ug/L	-	0	-	0	0	-	-
1,2-Diphenylhydrazine	ug/L	-	0	-	0	0	-	-
Dibromomethane	ug/L	-	0	-	0	0	-	-

Note: umhos/cm = micrograms per centimeter.
V = volt.
meq/L = milliequivalents per liter.
Unless otherwise noted, all concentrations represent the total concentration.

Source: ECT, 1992.

Table 2.3.4-6. Statistical Summary–Surface Water Quality: SW-1

Analyte	Units	Class III Standard	Mean	Maxi-mum	Mini-mum	Standard Deviation	No.
In Situ Measurements							
Temperature	°C		26.2	28.6	20.1	3.1	5
Specific Conductance	umhos/cm		143	169	113	18	5
Hydrogen Ion Activity (pH)	su	from 6-8.5	5.2	6.7	4.5	–	5
Dissolved Oxygen (DO)	mg/L	≥ 5.0	4.9	6.4	3.3	1.2	5
DO Saturation	%		59	80	41	14	5
Oxidation-Reduction Potential	V		0.103	0.139	0.082	0.023	4
Classical							
Alkalinity, Total as CaCO3	mg/L	≥ 20	10	17	3	4	5
Alkalinity, Bicarbonate	mg/L		10	17	3	4	5
Alkalinity, Carbonate	mg/L		0	–	–	–	6
Acidity, Total	mg/L		10	18	5	4	6
Hardness, Total as CaCO3	mg/L		44	52	38	5	6
Color	Pt-Co		144	350	60	100	6
Solids, Total	mg/L		122	180	92	28	6
Solids, Total Dissolved	mg/L		111	160	83	25	6
Solids, Total Suspended	mg/L		4.8	10	0.0	5	6
Turbidity	NTU	≤ 29	2.4	5.9	1.4	1.6	6
Chloride	mg/L		15	21	12	3	6
Fluoride, Soluble	mg/L	≤ 10	0.44	0.61	0.38	0.08	6
Sulfate	mg/L		21.2	29.0	15.0	5.0	6
Sodium	mg/L		7	8	6	1	6
Calcium	mg/L		11	15	10	2	6
Magnesium	mg/L		3.1	3.4	2.7	0.2	6
Total Anions	meq/L		0.85	1.25	0.51	0.22	6
Total Cations	meq/L		1.11	1.40	0.98	0.15	6
Ammonia (un-ionized)	mg/L	≤ 0.02	0	–	–	–	6
Nitrogen, Nitrate	mg/L		0	–	–	–	6
Nitrogen, Nitrite	mg/L		0	–	–	–	6
Nitrogen, Total Organic	mg/L		0.68	1.00	0.43	0.20	6
Nitrogen, Kjeldahl	mg/L		0.72	1.10	0.50	0.21	6
Phosphorus, Total	mg/L		0.82	0.94	0.67	0.09	6
Surfactants	mg/L	≤ 0.5	0.02	0.08	0	0.03	6
5-day BOD	mg/L		2.33	7	0	3	6
Chemical Oxygen Demand	mg/L		51	110	25	32	5
Hydrogen Sulfide	mg/L		0.15	0.3	0	0.2	2
Other Metals							
Iron	mg/L	≤ 1.0	0.30	0.6	0	0.2	6
Lead	ug/L	≤ 0.9-1.4*	1.50	9	0	3	6
Manganese	mg/L		0	–	–	–	6
Silver	ug/L	≤ 0.07	0.01	0.06	0	0.02	6
Zinc	mg/L	≤ 0.05-0.06*	0.01	0.03	0	0.01	6
Radioactive Substances							
Radium 226	pCi/L	≤ 5	0	–	–	–	6
Radium 228	pCi/L	≤ 5	0	–	–	–	6
Gross Alpha	pCi/L	≤ 15	1.6	6.3	0.0	2.6	6

Note: Zero is used to compute mean value for <MDL.
Analytes not detected during the monitoring program are not included in the table.

*Standard range is calculated using the hardness from each sampling period at the station from data collected by Tampa Electric Company.

Source: ECT, 1992.

Table 2.3.4-7. Statistical Summary--Surface Water Quality: SW-2

Analyte	Units	Class III Standard	Mean	Maxi-mum	Mini-mum	Standard Deviation	No.
In Situ Measurements							
Temperature	°C		25.5	29.4	19.4	3.4	6
Specific Conductance	umhos/cm		351	398	323	28	6
Hydrogen Ion Activity (pH)	su	from 6-8.5	6.7	7.4	6.2	--	6
Dissolved Oxygen (DO)	mg/L	≥ 5.0	5.4	7.5	2.6	1.7	6
DO Saturation	%		65	81	33	18	6
Oxidation-Reduction Potential	V		0.033	0.085	-0.010	0.043	4
Classical							
Alkalinity, Total as CaCO3	mg/L	≥ 20	75	81	69	5	5
Alkalinity, Bicarbonate	mg/L		75	81	69	5	5
Alkalinity, Carbonate	mg/L		0	--	--	--	6
Acidity, Total	mg/L		5	6	2	1	6
Hardness, Total as CaCO3	mg/L		138	150	120	12	6
Color	Pt-Co		77	120	30	30	6
Solids, Total	mg/L		252	280	220	21	6
Solids, Total Dissolved	mg/L		228	250	210	13	6
Solids, Total Suspended	mg/L		10.3	30	0	9	6
Turbidity	NTU	≤ 29	4.5	9.6	2.0	2.7	6
Chloride	mg/L		15	17	14	1	6
Fluoride, Soluble	mg/L	≤ 10	1.57	2.00	1.00	0.39	6
Sulfate	mg/L		61.2	79.0	50.0	8.7	6
Sodium	mg/L		14	16	12	1	6
Calcium	mg/L		32	36	29	3	6
Magnesium	mg/L		15.0	22.0	11.0	3.4	6
Total Anions	meq/L		2.06	3.30	1.60	0.58	6
Total Cations	meq/L		3.46	4.20	3.00	0.38	6
Ammonia (un-ionized)	mg/L	≤ 0.02	0	--	--	--	6
Nitrogen, Nitrate	mg/L		0.60	2.2	0	0.9	6
Nitrogen, Nitrite	mg/L		0.01	0.03	0	0.01	6
Nitrogen, Total Organic	mg/L		0.93	1.37	0.60	0.29	6
Nitrogen, Kjeldahl	mg/L		0.97	1.40	0.60	0.32	6
Phosphorus, Total	mg/L		1.17	1.70	0.77	0.31	6
Surfactants	mg/L	≤ 0.5	0.02	0.08	0.00	0.03	6
5-day BOD	mg/L		2.33	6	0.00	2	6
Chemical Oxygen Demand	mg/L		41	53	25	9	5
Hydrogen Sulfide	mg/L		0	0.3	0	0.2	2
Other Metals							
Iron	mg/L	≤ 1.0	0	--	--	--	6
Lead	ug/L	≤ 4.0-5.3*	2	12	0	4	6
Manganese	mg/L		0	--	--	--	6
Silver	ug/L	≤ 0.07	0.01	0.06	0	0.02	6
Zinc	mg/L	≤ 0.12-0.15*	0.01	0.03	0	0.01	6
Radioactive Substances							
Radium 226	pCi/L	≤ 5	0.3	1.1	0	0.5	6
Radium 228	pCi/L	≤ 5	1.0	5.7	0	2.3	6
Gross Alpha	pCi/L	≤ 15	1.9	6.5	0	2.6	6

Note: Zero is used to compute mean value for <MDL.
Analytes not detected during the monitoring program are not included in the table.

*Standard range is calculated using the hardness from each sampling period at the station from data collected by Tampa Electric Company.

Source: ECT, 1992.

Table 2.3.4-8. Statistical Summary--Surface Water Quality: SW-3

Analyte	Units	Class III Standard	Mean	Maxi- mum	Mini- mum	Standard Deviation	No.
In Situ Measurements							
Temperature	°C		26.4	30.4	19.6	3.4	6
Specific Conductance	umhos/cm		383	428	329	40	6
Hydrogen Ion Activity (pH)	su	from 6-8.5	6.5	7.6	6.0	--	6
Dissolved Oxygen (DO)	mg/L	≥ 5.0	4.3	5.5	2.8	1.1	6
DO Saturation	%		52	67	35	12	6
Oxidation-Reduction Potential	V		0.110	0.220	0.030	0.071	4
Classical							
Alkalinity, Total as CaCO3	mg/L	≥ 20	84	100	70	10	5
Alkalinity, Bicarbonate	mg/L		84	100	70	.10	5
Alkalinity, Carbonate	mg/L		0	--	--	--	6
Acidity, Total	mg/L		8	12	5	3	6
Hardness, Total as CaCO3	mg/L		153	170	130	14	6
Color	Pt-Co		89	150	40	39	6
Solids, Total	mg/L		287	390	260	47	6
Solids, Total Dissolved	mg/L		245	270	230	13	6
Solids, Total Suspended	mg/L		31	120	0	41	6
Turbidity	NTU	≤ 29	4.3	7.0	1.9	1.5	6
Chloride	mg/L		15	17	12	2	6
Fluoride, Soluble	mg/L	≤ 10	1.85	2.20	1.40	0.30	6
Sulfate	mg/L		68.7	79.0	54.0	8.7	6
Sodium	mg/L		15	17	13	1	6
Calcium	mg/L		35	39	29	4	6
Magnesium	mg/L		16.2	22.0	11.0	3.4	6
Total Anions	meq/L		2.29	3.80	1.80	0.68	6
Total Cations	meq/L		3.73	4.30	3.00	0.44	6
Ammonia (un-ionized)	mg/L	≤ 0.02	0	--	--	--	6
Nitrogen, Nitrate	mg/L		0.22	1.3	0	0.5	6
Nitrogen, Nitrite	mg/L		0.28	1.60	0	0.59	6
Nitrogen, Total Organic	mg/L		0.97	1.40	0.41	0.34	6
Nitrogen, Kjeldahl	mg/L		1.14	1.50	0.41	0.36	6
Phosphorus, Total	mg/L		1.28	1.60	0.97	0.24	6
Surfactants	mg/L	≤ 0.5	0.03	0.09	0	0.03	6
5-day BOD	mg/L		4.00	10	0	3	6
Chemical Oxygen Demand	mg/L		49	68	41	10	5
Hydrogen Sulfide	mg/L		0.15	0.3	0	0.2	2
Other Metals							
Iron	mg/L	≤ 1.0	0.18	0.4	0	0.2	6
Lead	ug/L	≤ 4.4-6.3*	1.83	11	0	4	6
Manganese	mg/L		0	--	--	--	6
Silver	ug/L	≤ 0.07	0.01	0.07	0	0.03	6
Zinc	mg/L	≤ 0.13-0.17*	0.00	0.02	0	0.01	6
Radioactive Substances							
Radium 226	pCi/L	≤ 5	0.6	1.4	0	0.6	6
Radium 228	pCi/L	≤ 5	0.9	5.3	0	2.2	6
Gross Alpha	pCi/L	≤ 15	3.3	9.4	0	3.6	6

Note: Zero is used to compute mean value for <MDL.
Analytes not detected during the monitoring program are not included in the table.

*Standard range is calculated using the hardness from each sampling period at the station from data collected by Tampa Electric Company.

Source: ECT, 1992.

Table 2.3.4-9. Statistical Summary--Surface Water Quality: SW-4

Analyte	Units	Class III Standard	Mean	Maxi-mum	Mini-mum	Standard Deviation	No.
In Situ Measurements							
Temperature	°C		25.6	30.1	19.4	3.2	6
Specific Conductance	umhos/cm		201	278	126	55	6
Hydrogen Ion Activity (pH)	su	from 6-8.5	6.5	7.8	6.0	--	6
Dissolved Oxygen (DO)	mg/L	≥ 5.0	0.9	2.4	0.0	0.8	6
DO Saturation	%		12	29	0	9	6
Oxidation-Reduction Potential	V		0.068	0.138	0.031	0.041	4
Classical							
Alkalinity, Total as CaCO3	mg/L	≥ 20	66	93	26	26	5
Alkalinity, Bicarbonate	mg/L		66	93	26	26	5
Alkalinity, Carbonate	mg/L		0	--	--	--	6
Acidity, Total	mg/L		18	26	10	5	6
Hardness, Total as CaCO3	mg/L		81	110	40	23	6
Color	Pt-Co		263	400	130	103	6
Solids, Total	mg/L		167	230	120	39	6
Solids, Total Dissolved	mg/L		145	210	110	35	6
Solids, Total Suspended	mg/L		17	60	0	21	6
Turbidity	NTU	≤ 29	2	4.5	0	1.4	6
Chloride	mg/L		12	23	5	6	6
Fluoride, Soluble	mg/L	≤ 10	0.71	1.00	0.48	0.16	6
Sulfate	mg/L		0.83	5.0	0	1.9	6
Sodium	mg/L		7	13	3	4	6
Calcium	mg/L		15	20	7	5	6
Magnesium	mg/L		10.6	14.0	5.2	3.3	6
Total Anions	meq/L		0.67	2.40	0.22	0.78	6
Total Cations	meq/L		2.00	3.00	0.69	0.90	6
Ammonia (un-ionized)	mg/L	≤ 0.02	0	--	--	--	6
Nitrogen, Nitrate	mg/L		0	--	--	--	6
Nitrogen, Nitrite	mg/L		0	--	--	--	6
Nitrogen, Total Organic	mg/L		1.34	1.68	1.10	0.21	6
Nitrogen, Kjeldahl	mg/L		1.38	1.70	1.10	0.19	6
Phosphorus, Total	mg/L		0.71	1.20	0.17	0.34	6
Surfactants	mg/L	≤ 0.5	0.02	0.03	0	0.02	6
5-day BOD	mg/L		3.83	8	0	2	6
Chemical Oxygen Demand	mg/L		82	96	56.00	14	5
Hydrogen Sulfide	mg/L		0.25	0.5	0	0.3	2
Other Metals							
Iron	mg/L	≤ 1.0	1.2	1.7	0.6	0.4	6
Lead	ug/L	≤ 1.0-4.0*	2.3	14	0	5	6
Manganese	mg/L		0.01	0.07	0	0.03	6
Silver	ug/L	≤ 0.07	0.01	0.08	0	0.03	6
Zinc	mg/L	≤ 0.05-0.11*	0.00	--	--	--	6
Radioactive Substances							
Radium 226	pCi/L	≤ 5	0	--	--	--	6
Radium 228	pCi/L	≤ 5	0.9	5.5	0.0	2.2	6
Gross Alpha	pCi/L	≤ 15	1.2	2.9	0.0	1.4	6

Note: Zero is used to compute mean value for <MDL.
Analytes not detected during the monitoring program are not included in the table.

*Standard range is calculated using the hardness from each sampling period at the station from data collected by Tampa Electric Company.

Source: ECT, 1992.

Table 2.3.4-10. Statistical Summary--Surface Water Quality: SW-5

Analyte	Units	Class III Standard	Mean	Maxi-mum	Mini-mum	Standard Deviation	No.
In Situ Measurements							
Temperature	°C		27.0	30.3	21.0	3.4	6
Specific Conductance	umhos/cm		377	432	308	45	6
Hydrogen Ion Activity (pH)	su	from 6-8.5	6.3	7.7	6.0	--	6
Dissolved Oxygen (DO)	mg/L	≥ 5.0	4.9	7.2	2.2	1.8	6
DO Saturation	%		60	90	29	21	6
Oxidation-Reduction Potential	V		0.082	0.122	0.053	0.026	4
Classical							
Alkalinity, Total as CaCO3	mg/L	≥ 20	92	97	87	3	5
Alkalinity, Bicarbonate	mg/L		92	97	87	3	5
Alkalinity, Carbonate	mg/L		0	--	--	--	6
Acidity, Total	mg/L		11	15	5	3	6
Hardness, Total as CaCO3	mg/L		117	140	100	17	6
Color	Pt-Co		43	75	30	15	6
Solids, Total	mg/L		242	280	220	20	6
Solids, Total Dissolved	mg/L		227	270	190	27	6
Solids, Total Suspended	mg/L		5	20	0	8	6
Turbidity	NTU	≤ 29	3.7	5.7	2.5	1.1	6
Chloride	mg/L		13	14	12	1	6
Fluoride, Soluble	mg/L	≤ 10	1.83	2.60	1.50	0.38	6
Sulfate	mg/L		63.0	81.0	42.0	12.8	6
Sodium	mg/L		29	33	23	3	6
Calcium	mg/L		26	33	21	5	6
Magnesium	mg/L		12.3	15.0	10.0	1.7	6
Total Anions	meq/L		2.49	6.70	1.20	1.90	6
Total Cations	meq/L		3.45	4.20	2.00	0.74	6
Ammonia (un-ionized)	mg/L	≤ 0.02	0	--	--	--	6
Nitrogen, Nitrate	mg/L		0	--	--	--	6
Nitrogen, Nitrite	mg/L		0.23	1.20	0.02	0.44	6
Nitrogen, Total Organic	mg/L		1.01	1.28	0.68	0.21	6
Nitrogen, Kjeldahl	mg/L		1.37	1.80	0.79	0.30	6
Phosphorus, Total	mg/L		0.49	0.61	0.37	0.07	6
Surfactants	mg/L	≤ 0.5	0.01	0.04	0	0.02	6
5-day BOD	mg/L		7	11	4	2	6
Chemical Oxygen Demand	mg/L		40	53	31	7	5
Hydrogen Sulfide	mg/L		0.10	0.2	0	0.1	2
Other Metals							
Iron	mg/L	≤ 1.0	0	--	--	--	6
Lead	ug/L	≤ 3.2-4.9*	2.33	14	0	5	6
Manganese	mg/L		0	--	--	--	6
Silver	ug/L	≤ 0.07	0.01	0.07	0	0.03	6
Zinc	mg/L	≤ 0.11-0.14*	0.00	0.02	0	0.01	6
Radioactive Substances							
Radium 226	pCi/L	≤ 5	0.3	1.0	0	0.5	6
Radium 228	pCi/L	≤ 5	0.6	3.4	0	1.4	6
Gross Alpha	pCi/L	≤ 15	2.3	5.2	0	2.0	6

Note: Zero is used to compute mean value for <MDL.
Analytes not detected during the monitoring program are not included in the table.

*Standard range is calculated using the hardness from each sampling period at the station from data collected by Tampa Electric Company.

Source: ECT, 1992.

Table 2.3.4-11. Statistical Summary--Surface Water Quality: SW-6

Analyte	Units	Class III Standard	Mean	Maxi- mum	Mini- mum	Standard Deviation	No.
In Situ Measurements							
Temperature	°C		27.5	32.6	21.2	3.8	5
Specific Conductance	umhos/cm		307	328	269	21	5
Hydrogen Ion Activity (pH)	su	from 6-8.5	8.5	9.4	7.9	–	5
Dissolved Oxygen (DO)	mg/L	≥ 5.0	9.3	12.7	4.7	2.7	5
DO Saturation	%		115	159	64	34	5
Oxidation-Reduction Potential	V		0.044	0.063	0.017	0.017	4
Classical							
Alkalinity, Total as CaCO3	mg/L	≥ 20	82	91	75	6	5
Alkalinity, Bicarbonate	mg/L		60	91	31	24	5
Alkalinity, Carbonate	mg/L		22	50	1	17	6
Acidity, Total	mg/L		1	5	1	2	6
Hardness, Total as CaCO3	mg/L		104	110	94	6	6
Color	Pt-Co		48	67	35	10	6
Solids, Total	mg/L		227	260	190	24	6
Solids, Total Dissolved	mg/L		198	220	180	15	6
Solids, Total Suspended	mg/L		23	50	0	16	6
Turbidity	NTU	≤ 29	9.2	18	5.7	4.3	6
Chloride	mg/L		16	17	13	2	6
Fluoride, Soluble	mg/L	≤ 10	1.97	2.90	1.40	0.45	6
Sulfate	mg/L		38.2	45.0	30.0	5.2	6
Sodium	mg/L		20	21	19	1	6
Calcium	mg/L		23	26	21	2	6
Magnesium	mg/L		12.2	14.0	11.0	1.1	6
Total Anions	meq/L		1.65	2.70	1.10	0.52	6
Total Cations	meq/L		2.89	3.30	1.90	0.47	6
Ammonia (un-ionized)	mg/L	≤ 0.02	0.00	0.02	0	0.01	6
Nitrogen, Nitrate	mg/L		0	–	–	–	6
Nitrogen, Nitrite	mg/L		0	–	–	–	6
Nitrogen, Total Organic	mg/L		1.64	2.80	0.78	0.71	6
Nitrogen, Kjeldahl	mg/L		1.75	2.80	0.80	0.63	6
Phosphorus, Total	mg/L		0.47	0.81	0.25	0.19	6
Surfactants	mg/L	≤ 0.5	0.01	0.03	0	0.01	6
5-day BOD	mg/L		9	10	8	1	6
Chemical Oxygen Demand	mg/L		58	70	47	8	5
Hydrogen Sulfide	mg/L		0	0.2	0	0.1	2
Other Metals							
Iron	mg/L	≤ 1.0	0	–	–	–	6
Lead	ug/L	≤ 2.9-3.6*	2.17	13	0	5	6
Manganese	mg/L		0	–	–	–	6
Silver	ug/L	≤ 0.07	0.01	0.07	0	0.03	6
Zinc	mg/L	≤ 0.10-0.11*	0	–	–	–	6
Radioactive Substances							
Radium 226	pCi/L	≤ 5	1.2	7.1	0	2.9	6
Radium 228	pCi/L	≤ 5	0	–	–	–	6
Gross Alpha	pCi/L	≤ 15	1.6	4.0	0	1.9	6

Note: Zero is used to compute mean value for <MDL.
Analytes not detected during the monitoring program are not included in the table.

*Standard range is calculated using the hardness from each sampling period at the station from data collected by Tampa Electric Company.

Source: ECT, 1992.

Table 2.3.4-12. Statistical Summary–Surface Water Quality: SW-7

Analyte	Units	Class III Standard	Mean	Maxi- mum	Mini- mum	Standard Deviation	No.
In Situ Measurements							
Temperature	°C		27.6	33.2	21.9	3.8	5
Specific Conductance	umhos/cm		333	363	279	35	5
Hydrogen Ion Activity (pH)	su	from 6-8.5	8.4	9.4	8.0	–	5
Dissolved Oxygen (DO)	mg/L	≥ 5.0	11.2	14.5	8.5	2.2	5
DO Saturation	%		140	164	104	22	5
Oxidation-Reduction Potential	V		0.013	0.071	-0.054	0.044	4
Classical							
Alkalinity, Total as CaCO3	mg/L	≥ 20	67	84	39	16	5
Alkalinity, Bicarbonate	mg/L		55	80	33	15	5
Alkalinity, Carbonate	mg/L		10	26	0	9	6
Acidity, Total	mg/L		4	15	0	5	6
Hardness, Total as CaCO3	mg/L		108	120	89	11	6
Color	Pt-Co		111	150	75	23	6
Solids, Total	mg/L		270	290	240	19	6
Solids, Total Dissolved	mg/L		230	260	200	20	6
Solids, Total Suspended	mg/L		33	50	13	14	6
Turbidity	NTU	≤ 29	22	27	15	4.6	6
Chloride	mg/L		14	16	12	1	6
Fluoride, Soluble	mg/L	≤ 10	1.58	4.00	0.88	1.12	6
Sulfate	mg/L		58.0	68.0	42.0	7.9	6
Sodium	mg/L		25	27	23	1	6
Calcium	mg/L		22	26	17	4	6
Magnesium	mg/L		13.5	15.0	12.0	1.0	6
Total Anions	meq/L		2.02	2.40	1.70	0.22	6
Total Cations	meq/L		3.14	3.60	1.80	0.63	6
Ammonia (un-ionized)	mg/L	≤ 0.02	0.09	0.32	0	0.12	6
Nitrogen, Nitrate	mg/L		0.55	1.70	0	0.78	6
Nitrogen, Nitrite	mg/L		0.24	1.40	0	0.52	6
Nitrogen, Total Organic	mg/L		2.73	3.40	2.18	0.46	6
Nitrogen, Kjeldahl	mg/L		2.97	4.10	2.20	0.73	6
Phosphorus, Total	mg/L		4.52	6.10	1.80	1.58	6
Surfactants	mg/L	≤ 0.5	0.01	0.03	0	0.01	6
5-day BOD	mg/L		14	20	9	4	6
Chemical Oxygen Demand	mg/L		72	83	59	8	5
Hydrogen Sulfide	mg/L		0.1	0.2	0	0.1	2
Other Metals							
Iron	mg/L	≤ 1.0	0	–	–	–	6
Lead	ug/L	≤ 2.7-4.0*	2	13	0	5	6
Manganese	mg/L		0	–	–	–	6
Silver	ug/L	≤ 0.07	0.01	0.06	0	0.02	6
Zinc	mg/L	≤ 0.10-0.12*	0	–	–	–	6
Radioactive Substances							
Radium 226	pCi/L	≤ 5	0.4	2.4	0	1.0	6
Radium 228	pCi/L	≤ 5	0.6	3.5	0	1.4	6
Gross Alpha	pCi/L	≤ 15	1.3	3.4	0	1.5	6

Note: Zero is used to compute mean value for <MDL.
Analytes not detected during the monitoring program are not included in the table.

*Standard range is calculated using the hardness from each sampling period at the station from data collected by Tampa Electric Company.

Source: ECT, 1992.

Table 2.3.4-13. Surface Water Quality Statistics for South Prong of the Alafia River (FDER/PSES Intensive Survey, 1984-1985)

Parameter	Units	S9 (SW-2)					S3 (Upstream of PPS)					S6 (SW-3)				
		Mean	Max.	Min.	Std.	No.	Mean	Max.	Min.	Std.	No.	Mean	Max.	Min.	Std.	No.
Time	*LMT*		*1120*	*925*		*12*		*1210*	*1014*		*9*		*1200*	*1040*		*4*
Water Temperature	C	21.0	27.2	8.7	5.4	12	20.1	26.3	7.1	6.1	9	22.3	27.5	14.2	5.0	4
Hydrogen Ion Activity (pH)	su	6.8	7.8	6.2		12	6.8	7.6	6.5		9	6.7	7.6	6.4		4
Specific Conductivity	umhos/cm	392	492	280	73	12	511	639	372	75	9	498	562	391	65	4
Dissolved Oxygen	mg/L	7.6	10.5	4.0	1.8	12	5.1	11.6	0.7	3.0	9	5.1	8.8	1.3	2.7	4
Total-Phosphorus	mg/L	3.05	8.20	1.34	2.10	12	6.88	16.40	3.98	3.85	8	3.59	3.92	3.26	0.33	2
Ortho-Phosphorus	mg/L	2.70	7.39	1.29	1.82	12	6.06	14.10	3.82	3.31	8	3.75	4.10	3.40	0.35	2
Total Kjeldahl Nitrogen	mg/L	0.65	1.26	0.38	0.25	12	1.01	1.33	0.75	0.21	8	1.08	1.42	0.73	0.35	2
Ammonia (as N)	mg/L	0.06	0.10	0.02	0.02	12	0.03	0.05	0.01	0.01	8	0.04	0.05	0.03	0.01	2
Organic Nitrogen	mg/L	0.59	1.17	0.36	0.23	12	0.98	1.32	0.73	0.22	8	1.04	1.37	0.70	0.34	2
Nitrite+Nitrate	mg/L	0.72	1.52	0.00	0.37	12	0.05	0.35	0.00	0.11	8	0.01	0.01	0.00	0.01	2
Carbonaceous BOD 5-day	mg/L	2.20	9.70	0.40	2.63	10	1.82	4.00	0.80	1.07	6	0.90	1.20	0.60	0.30	2
Corrected Chlorophyll-a	ug/L	1.42	2.20	0.60	0.57	5	8.09	32.90	0.60	11.17	6	3.55	4.30	2.80	0.75	2
Phaeophytin	ug/L	5.34	10.50	0.40	4.11	7	6.08	10.20	0.50	3.52	4	4.70	9.20	0.20	4.50	2
Alkalinity	mg/L	90	109	77	9	12	101	123	79	16	8	87	96	78	9	2
Fluoride	mg/L	2.49	3.91	1.28	0.99	12	5.79	6.72	4.28	0.81	8	5.04	6.07	4.01	1.03	2
Chloride	mg/L	17	20	15	2	12	24	33	19	5	8	28	34	21	7	2
Sulfate	mg/L	95	139	64	22	12	140	176	106	27	8	146	189	103	43	2
Cadmium	ug/L	ND	ND	ND	ND	4	ND	ND	ND	ND	3	ND	ND	ND	ND	1
Copper	ug/L	ND	ND	ND	ND	4	ND	ND	ND	ND	3	ND	ND	ND	ND	1
Chromium	ug/L	ND	ND	ND	ND	4	ND	ND	ND	ND	3	ND	ND	ND	ND	1
Iron	ug/L	245	367	71	122	4	122	202	51	62	3	537	537	537	0	1
Zinc	ug/L	ND	ND	ND	ND	4	ND	ND	ND	ND	3	ND	ND	ND	ND	1
Silver	ug/L	ND	ND	ND	ND	4	ND	ND	ND	ND	3	ND	ND	ND	ND	1
Arsenic	ug/L	ND	ND	ND	ND	4	ND	ND	ND	ND	3	ND	ND	ND	ND	1
Aluminum	ug/L	ND	ND	ND	ND	4	ND	ND	ND	ND	3	ND	ND	ND	ND	1
Nickel	ug/L	ND	ND	ND	ND	4	ND	ND	ND	ND	3	ND	ND	ND	ND	1
Selenium	ug/L	ND	ND	ND	ND	4	ND	ND	ND	ND	3	ND	ND	ND	ND	1
Lead	ug/L	ND	ND	ND	ND	4	ND	ND	ND	ND	3	ND	ND	ND	ND	1
Mercury	ug/L	0.06	0.23	0.00	0.10	4	ND	ND	ND	ND	3	ND	ND	ND	ND	1

Note: ND = none detected.

Sources: FDER/PSES, 1989.
ECT, 1992.

Table 2.3.4-14. Surface Water Quality Statistics for South Prong of the Alafia River at Bethlehem Road (EPA STORET Data Collected from 1981 to 1985)

Parameter	Unit	Mean	Max	Min	No.
Time	LMT		1443	910	56
Water Temperature	°C	24.1	30.0	11.8	55
Field Turbidity	FTU	5	14	1	55
Color	Pt-Co	50	140	15	56
Field Conductivity	umhos/cm	390	950	120	25
Specific Conductivity	umhos/cm	680	1178	200	30
Dissolved Oxygen (DO)	mg/L	6.8	11.3	2.1	56
DO Saturation	%	79	116	26	55
5-day Biochemical Oxygen Demand	mg/L	1.4	7.1	0.1	56
Field Hydrogen Ion Activity (pH)	su	7.2	8.0	6.6	24
Total Solids	mg/L	255	585	167	49
Total Dissolved Solids	mg/L	251	584	163	49
Total Suspended Solids	mg/L	4	20	1	53
Total Nitrogen	mg/L	1.50	3.25	0.74	54
Total Organic Nitrogen	mg/L	0.81	2.87	0.10	53
Total Ammonia+Ammonium	mg/L	0.19	1.25	0.03	52
Un-ionized Ammonia	mg/L	0.0038	0.025	0.0001	52
Total Kjeldahl Nitrogen	mg/L	0.91	2.95	0.26	55
Total Nitrite+Nitrate	mg/L	0.01	0.02	0.01	22
Dissolved Nitrite+Nitrate	mg/L	0.6	1.6	0.1	34
Total Phosphorus	mg/L	2.81	6.44	0.31	56
Dissolved (ortho) Phosphorus	mg/L	2.11	4.40	0.80	9
Total Organic Carbon	mg/L	13.0	28.8	1.1	50
Total Chloride	mg/L	16	32	6	54
Total Sulfate	mg/L	87	153	49	51
Dissolved Fluoride	mg/L	2.48	5.81	0.20	51
Total Coliform	#/100 mL	752	5500	100	56
Fecal Coliform	#/100 mL	191	2000	100	56
Chlorophyll a	ug/L	4.3	25.9	1.4	56
Chlorophyll b	ug/L	1.7	15.1	0.1	56
Chlorophyll c	ug/L	5.5	40.4	0.5	56
Total Chlorophyll	ug/L	10.4	30.6	2.6	55

Note: LMT = local military time.
FTU = field turbidity unit.

Sources: EPA, 1991.
ECT, 1992.

Table 2.3.4-15. Surface Water Quality Statistics for Payne Creek near Bowling Green (EPA STORET Data Collected from 1979 to 1983)

Parameter	Units	Mean	Max.	Min.	No.
Time	LMT		1639	900	25
Water Temperature	°C	21.7	27.5	11.0	25
Field Turbidity	FTU	2.7	4.8	1.0	3
Color	Pt-Co	80	140	20	3
Specific Conductivity	umhos/cm	286	400	188	25
Dissolved Oxygen (DO)	mg/L	7.8	9.8	5.7	25
DO Saturation	%	87	100	70	25
5-day Biochemical Oxygen Demand	mg/L	0.9	1.4	0.4	5
Hydrogen Ion Activity (pH)	su	6.8	7.9	6.1	24
Carbon Dioxide	mg/L	4.8	4.8	4.8	1
Total Alkalinity as CaCO3	mg/L	62	62	62	1
Bicarbonate	mg/L	75	75	75	1
Total Dissolved Solids	mg/L	195	195	195	1
Total Suspended Solids	mg/L	3.4	9.0	0.2	3
Total Volatile Suspended Solids	mg/L	3	5	1	3
Total Nitrogen	mg/L	2.15	2.42	1.88	2
Total Organic Nitrogen	mg/L	1.2	1.4	1.0	2
Total Ammonia+Ammonium	mg/L	0.09	0.21	0.02	3
Un-ionized Ammonia	mg/L	0.0008	0.0010	0.0006	3
Total Nitrite	mg/L	0.01	0.02	0.01	3
Total Nitrate	mg/L	0.81	0.96	0.65	2
Total Kjeldahl Nitrogen	mg/L	1.07	1.45	0.55	3
Total Nitrite+Nitrate	mg/L	1.12	1.71	0.67	3
Total Phosphorus	mg/L	0.70	0.75	0.60	3
Ortho Phosphorus	mg/L	0.65	0.75	0.48	3
Total Organic Carbon	mg/L	11.5	16.0	7.8	7
Total Chloride	mg/L	13	17	8	3
Total Sulfate	mg/L	42	59	30	3
Dissolved Fluoride	mg/L	1.1	1.3	0.9	3
Beta-D as Cs 137	pCi/L	2.3	2.3	2.3	2
Alpha-D as U	ug/L	4.7	5.6	3.7	2
Beta-D as Sr 90	pCi/L	2.2	2.2	2.2	2
Alpha-S as U	pCi/L	0.6	0.6	0.6	1
Beta-S as Cs 137	pCi/L	0.4	0.4	0.4	1
Alpha-S as U	ug/L	0.9	0.9	0.9	1
Beta-S as Sr 90	pCi/L	0.4	0.4	0.4	1

Sources: EPA, 1991.
ECT, 1992.

Hardness

Water *hardness*, although somewhat inexact in definition, is an important parameter for a number of reasons. Power plant design, especially water pre-treatment systems, often rely on the degree of hardness of the proposed plant supply water. Because Tampa Electric Company intends to obtain most plant process water from groundwater, the hardness of surface waters is less important from an engineering standpoint. Nevertheless, certain water quality standards are based on the degree of hardness--usually the natural log of hardness expressed as mg/L of calcium carbonate ($CaCO_3$).

According to Tampa Electric Company monitoring data, the mean water hardness for SW-2 and SW-3 was 138 and 153 mg/L, respectively. Sporadic hardness data collected by USGS between 1985 and 1991 downstream of SW-2 support these observations. Water within the South Prong Alafia River is considered *hard* using the classification scheme developed by Durfor and Becker (1964). Water from the unnamed tributary to the South Prong Alafia River (SW-1) has a mean value of 44 mg/L and is classified as *soft*. This is not surprising given that the stream is short and is most likely supplied by runoff with little groundwater input.

The waters of Payne Creek (SW-4) and Little Payne Creek (SW-5), with mean hardness values of 81 and 117 mg/L, respectively, are classified as *moderately hard* according to Durfor and Becker (1964). The maximum hardness measured at these two stations was 140 mg/L at station SW-5 on Little Payne Creek.

SW-6 and SW-7 had similar hardness values with means of 104 and 108 mg/L, respectively. This water would be considered *moderately hard* by Durfor and Becker (1964).

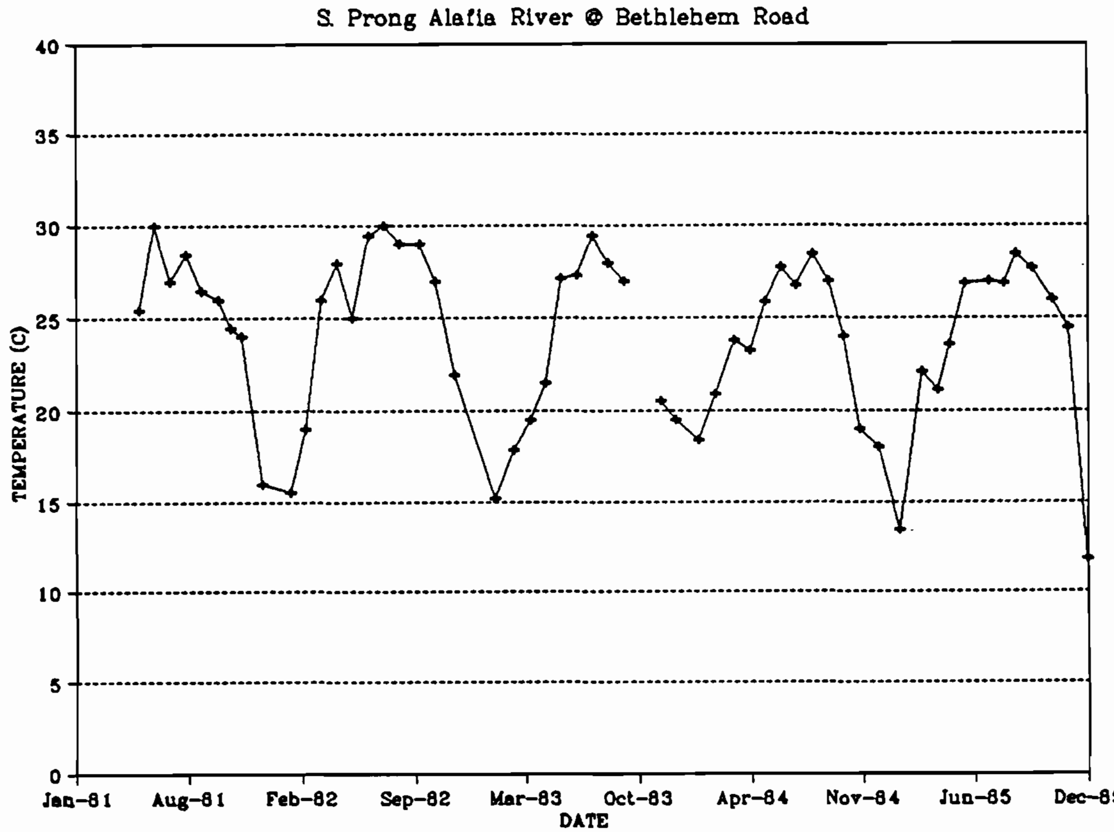
Temperature

Tampa Electric Company intends to discharge water from the proposed cooling reservoir to the reclaimed lake (SW-6) located to the east of the reservoir which flows to the Little Payne Creek system. Although the reservoir is designed to prevent significant thermal impacts, water temperature and its fluctuation still remain important for evaluating biological data and stresses on aquatic systems. The 5 years of data from EPA STORET (EPA, 1991) show that temperature on the South Prong Alafia River at Bethlehem Road (Tampa Electric Company monitoring station SW-2) ranges from 11.8 to 30.0 degrees Celsius (°C) with a mean value of 24.1°C (Figure 2.3.4-8). The mean temperature data for Tampa Electric Company monitoring stations SW-1 through SW-3 at the South Prong Alafia River, are generally about 1.0°C higher than the historical data at Bethlehem Road. This higher mean temperature is most likely the result of temperature anomaly during the monitoring period. The lowest temperature observed by Tampa Electric Company's monitoring program was 19.4°C at Station SW-4 (Payne Creek), and the maximum temperature was 30.4°C at SW-3. The temperature statistics for SW-2, based on long-term data, are probably representative of SW-3 because of their close proximity.

According to the EPA STORET data (EPA, 1991), temperature has ranged from 11.0 to 27.5°C in Payne Creek near Bowling Green, Florida. The mean temperature was 21.7°C. Mean temperatures measured at Tampa Electric Company monitoring stations SW-4 (Payne Creek) and SW-5 (Little Payne Creek) were 25.6 and 27.0°C, respectively. Maximum temperatures of about 30°C were recorded at both stations.

Temperature data collected from Payne Creek and South Prong Alafia during 1981 through 1983 are presented in Figure 2.3.4-8. A comparison of the two streams during this period show similar seasonal variations; however, water temperature at the Payne Creek station during this period was generally cooler than at the Little Payne Creek station.

The temperatures at SW-6 and SW-7 were quite similar, having mean values of 27.5°C and 27.6°C, respectively, according to the monitoring data. The temperature fluctuations in these two impoundments are relatively small, with a recorded range of less than 1.4°C during the monitoring period.



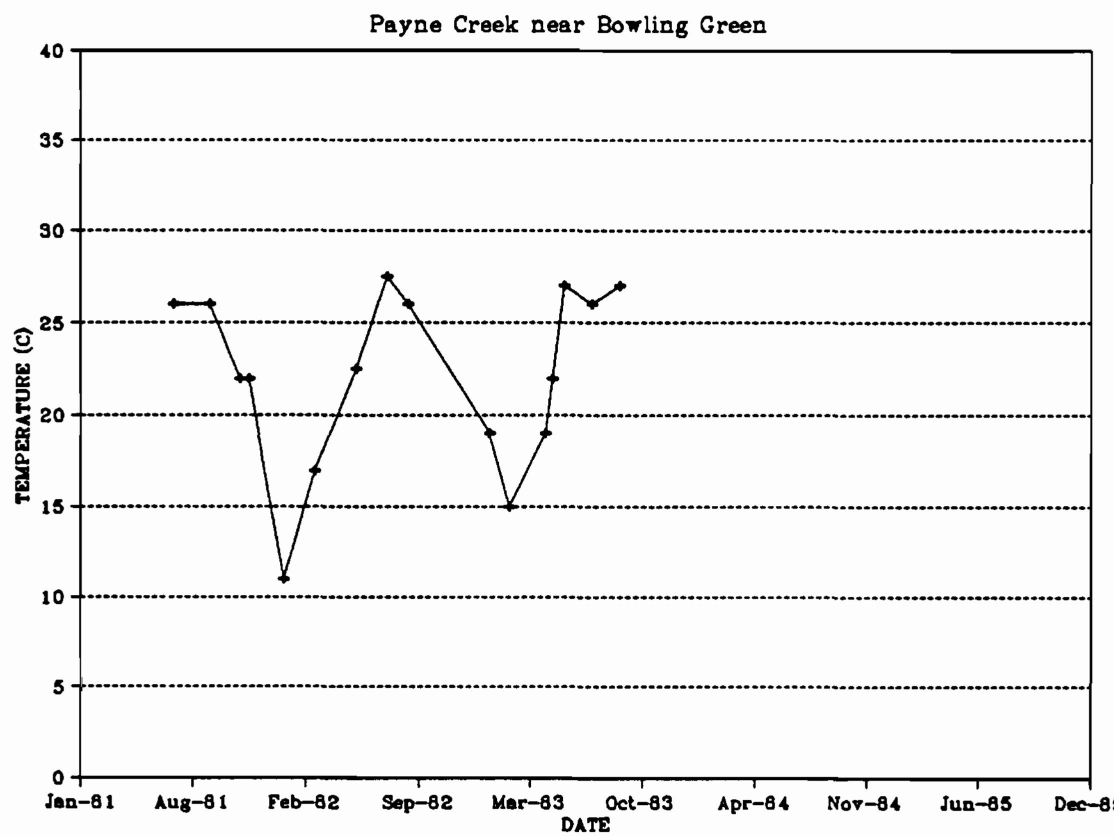


FIGURE 2.3.4-8.

HISTORICAL WATER TEMPERATURE DATA FOR SOUTH PRONG ALAFIA RIVER AND PAYNE CREEK

Source: EPA, 1991. ECT, 1992.

TAMPA ELECTRIC
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POLK POWER STATION

Dissolved Oxygen

DO concentration is often used as an indicator of the overall *health* of a water body. According to Class III water quality standards, DO concentrations shall not be less than 5 mg/L. DO was measured once at each station during each field trip. Because DO concentration is a function not only of temperature but photosynthetic and respiratory activity, the time of measurement is as important as the time of year. To quantify this variation, Tampa Electric Company conducted diurnal sampling during July and August 1991. This diurnal sampling commenced before sunrise and concluded after sunset to obtain the envelopes of the daily maximum and minimum concentrations.

The results of the diurnal surveys for all Tampa Electric Company monitoring stations for July and August are presented in Figures 2.3.4-9 and 2.3.4-10. Because flowing streams and ponded waters exhibit different characteristics of the fluctuations in DO concentration, the results have been segregated into *streams* (Figure 2.3.4-9) and *ponded water* or with minimal observed flow (Figure 2.3.4-10) to aid in comparing similar types of water bodies. Although SW-4 is technically a stream, being in the headwaters of Payne Creek, the water was ponded at the time of the sampling. Therefore, the data for SW-4 are presented with the data from other ponded water stations (SW-6 and SW-7) located in impoundment.

The diurnal DO concentration at SW-2 on July 2, 1991, ranged from 4.0 to 7.8 mg/L in the South Prong Alafia River, while DO concentrations at SW-3 ranged from 1.5 to 4.5 mg/L. The DO values at SW-1 were the highest among the stream stations with average values of 6.92 mg/L on July 2, 1991, and 6.38 mg/L on August 7, 1991. The high DO concentrations at SW-1 were probably due to the shallow depths (less than 6 inches). The DO fluctuation in stream stations on August 7, 1991, was significantly less than that of July data. The DO concentrations remained at 4.8 mg/L most of the day at SW-2, and DO concentrations ranged from 3.2 to 4.8 mg/L at SW-3 on August 7, 1991. Super saturation of DO was recorded at stations SW-6 and SW-7 because of significant photosynthesis activities due to

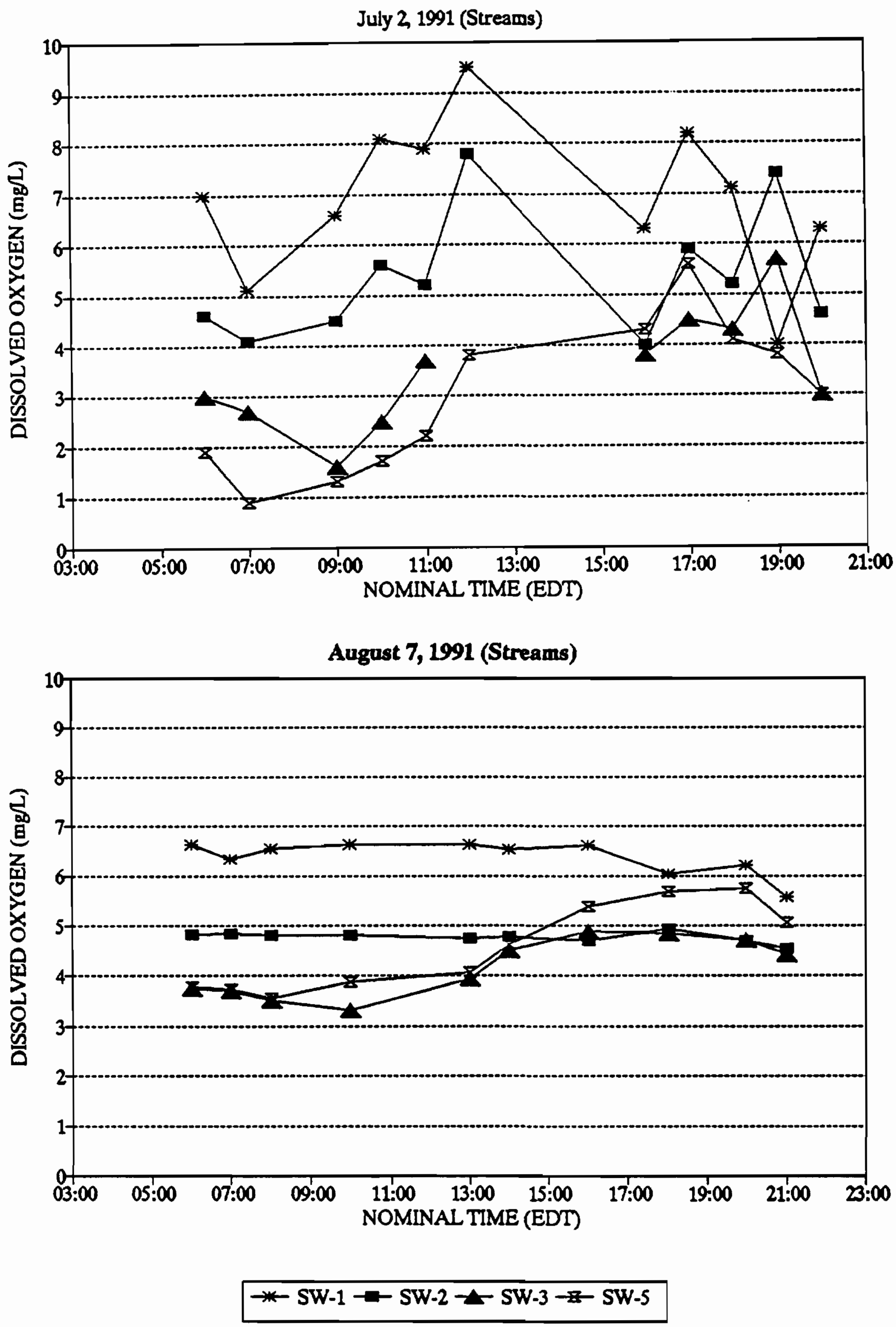

FIGURE 2.3.4-9.

DIURNAL DO CONCENTRATIONS AT SW-1, SW-2, SW-3, AND SW-5 (JULY, AUGUST 1991)

Source: ECT, 1992.

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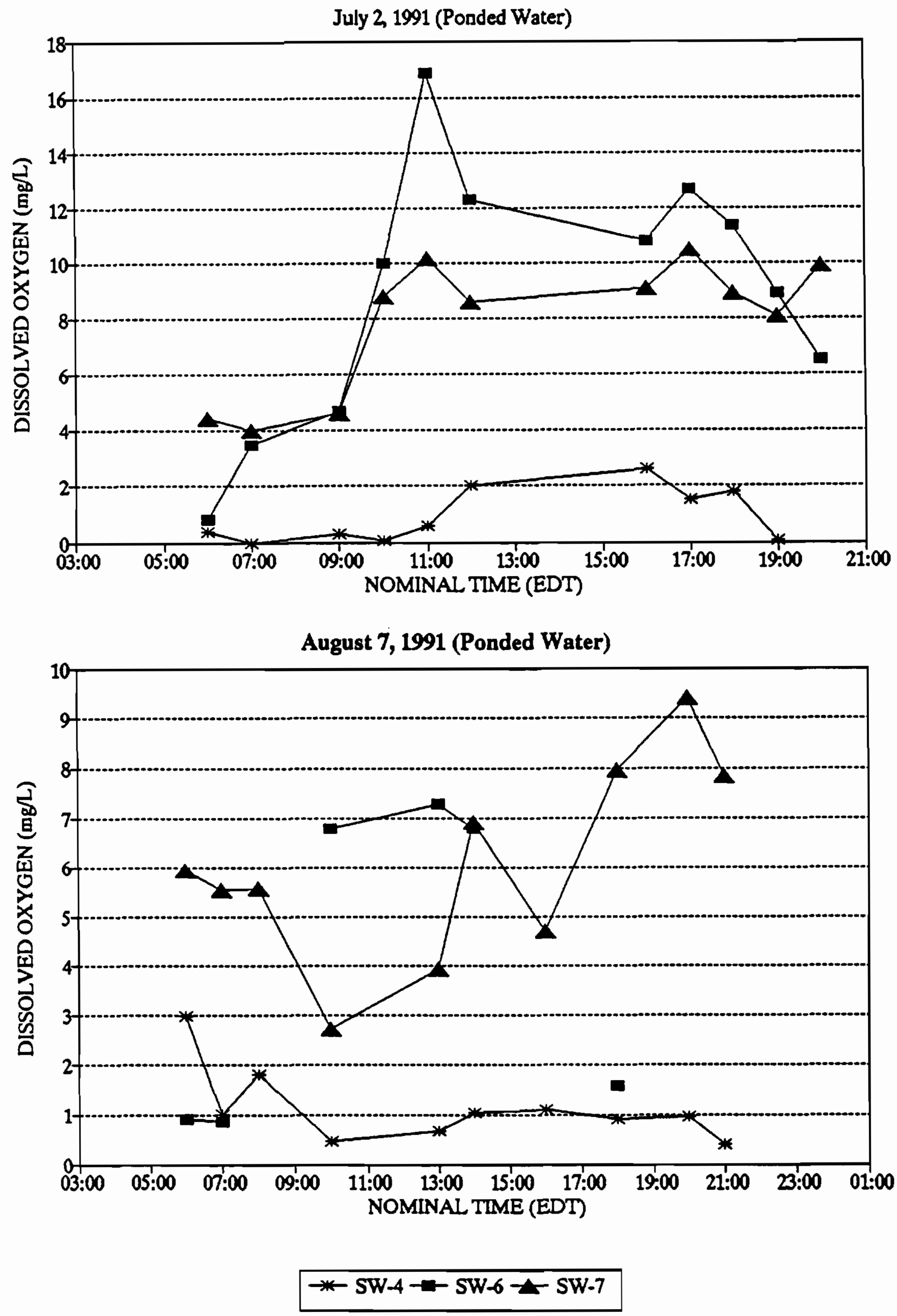

FIGURE 2.3.4-10.

DIURNAL DO CONCENTRATIONS AT SW-4, SW-6, AND SW-7 (JULY, AUGUST 1991)

Source: ECT, 1992.

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abundant aquatic communities in the mine cut and reclaimed lake. The summary of the DO diurnal data is shown in Table 2.3.4-16.

The ponding of Payne Creek at SW-4 near its headwaters and the high organic content, evident from water color, probably account for the lowest DO concentrations recorded during Tampa Electric Company water quality monitoring. There are periods during which Payne Creek is essentially anoxic. The mean DO concentration at SW-4 was 0.9 mg/L corresponding to a mean saturation of only 12 percent. DO concentrations in the flowing Little Payne Creek (SW-5) are considerably higher with a mean value of 4.9 mg/L. The diurnal variation in DO at SW-4 is about 2 mg/L; at SW-5, the variation was as much as 4.7 mg/L (0.9 to 5.6 mg/L) on July 2, 1991.

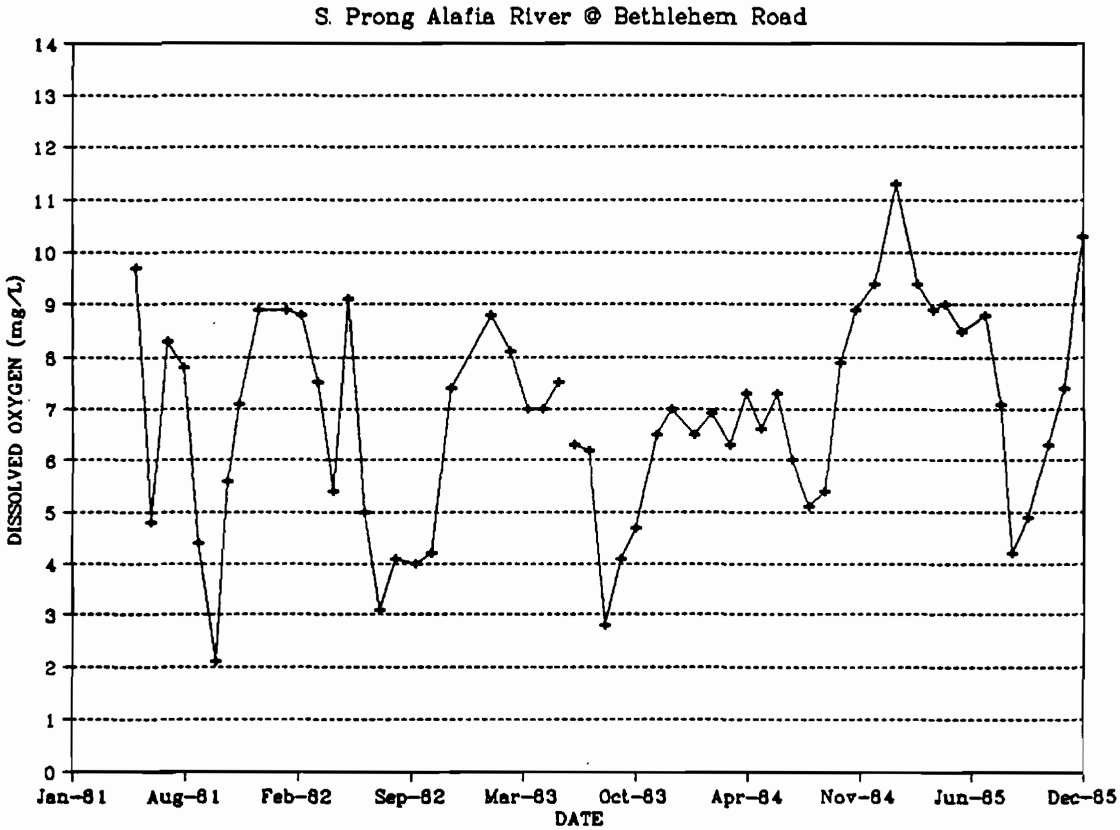
Monthly data at SW-6 and SW-7 showed high concentration with mean values of 9.3 mg/L and 11.2 mg/L, respectively. The plots of diurnal DO variation reveal many similarities between the water bodies.

Historical DO data from STORET (EPA, 1991) for the South Prong Alafia River at Bethlehem Road and Payne Creek near Bowling Green are presented in Figure 2.3.4-11. Similar to water temperature, DO concentration exhibits a seasonal trend with lower concentrations occurring during the summer when higher water temperatures decrease oxygen solubility in water. The historical data for the South Prong Alafia River exhibit much greater variability with DO concentrations ranging from about 2 to over 11 mg/L. Figure 2.3.4-11 showed that the DO concentration in Payne Creek near Bowling Green was relatively higher than South Prong Alafia River. The DO range at South Prong Alafia River was about 2 to 10 mg/L from June 1981 through August 1983, while the DO range at Payne Creek was about 5.7 to 9.4 mg/L. Moreover, although DO concentrations below 5 mg/L were observed ten times on the South Prong Alafia River, no DO values below 5 mg/L were observed in Payne Creek.

Table 2.3.4-16. Summary of DO Diurnal Data (mg/L)

Station	July 2, 1991			August 7, 1991		
	Average	Minimum	Maximum	Average	Minimum	Maximum
SW-1	6.92	4.0	9.5	6.38	5.58	6.64
SW-2	5.35	4.0	7.8	4.77	4.54	4.94
SW-3	3.48	1.6	5.7	4.16	3.33	4.88
SW-4	0.96	0.0	2.6	1.13	0.46	2.98
SW-5	3.04	0.9	5.6	4.55	3.55	5.75
SW-6	9.07	0.8	16.9	3.67	0.92	7.30
SW-7	8.09	4.0	10.5	6.06	2.73	9.42

Source: ECT, 1992.



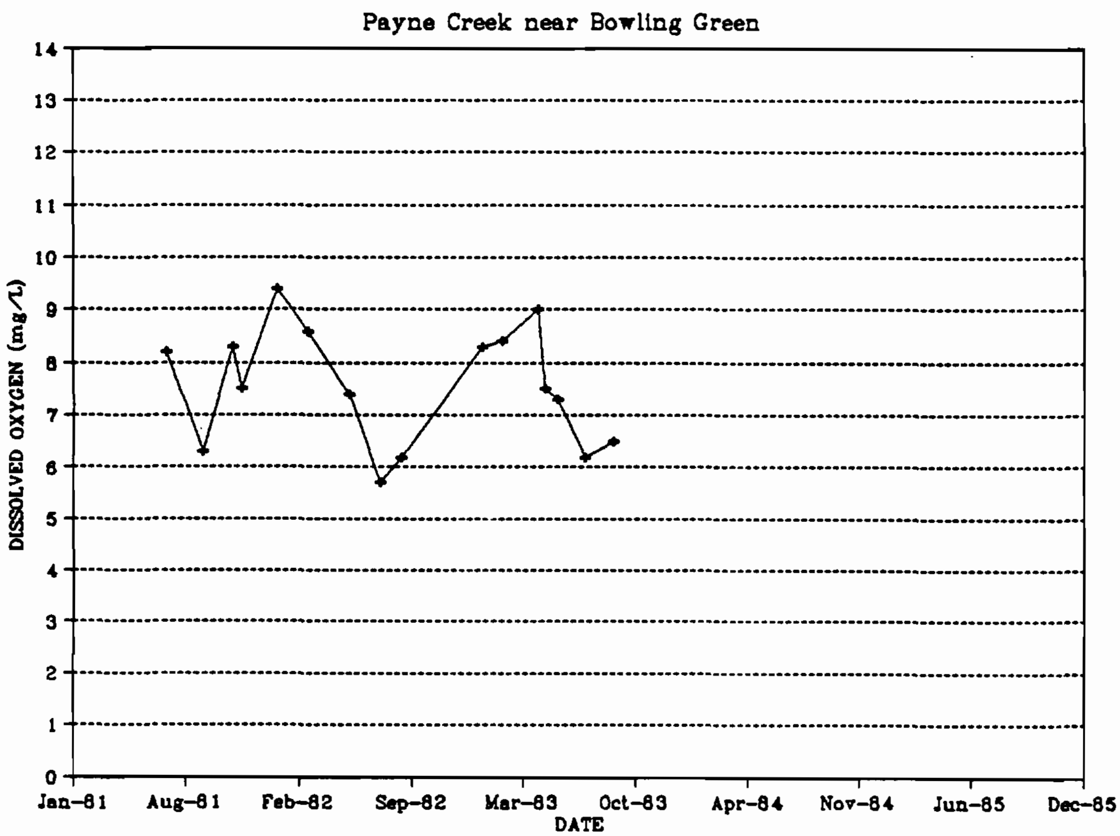


FIGURE 2.3.4-11.

HISTORICAL DO CONCENTRATIONS FOR THE SOUTH PRONG ALAFIA RIVER AND PAYNE CREEK

Source: EPA, 1991. ECT, 1992.

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Biochemical and Chemical Oxygen Demand

In addition to respiration, biochemical oxygen demand (BOD) can decrease DO concentrations. BOD is a measure of the quantity of DO required by microbes to decompose natural or anthropogenic organic matter. The higher the BOD, the poorer the water quality. According to FDER (1989), the median BOD for Florida streams is 1.5 mg/L. The 5-day BOD data for Tampa Electric Company monitoring stations SW-1 through SW-7 are summarized in Tables 2.3.4-6 through 2.3.4-12.

At SW-1 and SW-2, the mean 5-day BOD levels of 2 mg/L are near FDER's reported median value for streams. The mean 5-day BOD at SW-3, 4 mg/L, falls into the 90th percentile for Florida streams. Maximum 5-day BODs for the South Prong Alafia River ranged from 7 mg/L (SW-2) to 10 mg/L (SW-3). FDER/PSES reported maximum values for SW-2 and SW-3 of 9.7 and 1.2 mg/L, respectively. The lower value of 1.2 mg/L, however, is based on only two samples. EPA (1991) reported a maximum BOD of 7.1 mg/L on the South Prong Alafia River at Bethlehem Road (Tampa Electric Company station SW-2). These historical data suggest that Tampa Electric Company's monitoring data are representative.

BOD alone probably does not account for the low DO concentrations measured in Payne Creek at SW-4. The mean 5-day BOD at SW-4 of 4 mg/L (Table 2.3.4-9), while in the 90th percentile for Florida streams (FDER, 1989), is only in the middle of the range of BODs observed by Tampa Electric Company. The highest color and acidity levels were observed at SW-4, which would inhibit photosynthesis. The observed high chemical oxygen demand (COD) also would contribute to the low DO concentrations. Although the mean 5-day BOD in Little Payne Creek at SW-5 of 7 mg/L was higher than the mean BOD at SW-4, the mean DO concentration of 4.9 mg/L was considerably higher. Little Payne Creek at SW-5, however, is a flowing stream with the lowest mean color and lower acidity and COD values and, therefore, higher DO concentrations.

Mean 5-day BOD levels were considerably higher at SW-7 (14 mg/L) than at SW-6 (9 mg/L). The maximum BOD at SW-7 (20 mg/L), and in fact the highest 5-day BOD observed at any station, was twice as high as the maximum observed at SW-6. CODs were also higher at SW-7 with a mean of 72 mg/L compared with SW-6 (58 mg/L).

Hydrogen Ion Activity (pH)

Dissolved gases such as CO_2 can affect hydrogen ion activity or pH. During daylight hours when photosynthesis is greatest, CO_2, dissolved in the water as carbonic acid, is low because of uptake by plants. The pH, consequently, is relatively high. Conversely, during the evening, as plants in addition to the animals begin to respire, more CO_2 is added to the water which caused the pH to be lowered. The pH of water in the South Prong Alafia River ranged between 6.0 and 7.6 standard units. The unnamed tributary to the South Prong typically had lower pH values, ranging between 4.5 and 6.7.

Because pH represents the common log of the concentration of the hydrogen ion, the mean must be calculated from the anti-log of the individual pHs. Using this approach, the mean pH for SW-2 and SW-3 was 6.7 and 6.5, respectively; the mean pH for SW-1 was 5.2. Although the pH values measured at SW-1 are lower than 6.0 (the minimum numerical FDER Class III standard for pH) 40 percent of the time, it could be demonstrated that the natural background pH is best represented by the mean value of 5.2. Therefore, a violation of the standard would occur only when pH was <5.2 based on Tampa Electric Company's monitoring data. According to FDER (1989), pH values between 4 and 5 are not unusual in Florida's blackwater streams, as exhibited by SW-1. These low pH values result from the decomposition of organic matter to form the so-called humic acids or complex organic acids.

On the Payne Creek (SW-4) and Little Payne Creek (SW-5), the mean pH was 6.5 and 6.3, respectively. The observed pH values consistently fell within the range of 6.0 to 8.5. This was not the case at stations SW-6 and SW-7 where maximum pH values of 9.4 were observed at both stations. The mean pH values, however, were 8.5 and 8.4 for stations SW-6 and SW-7, respectively.

Alkalinity

Alkalinity can be defined as the capacity for solutes in water to react with and neutralize acid. Normally alkalinity is reported in terms of the equivalent amount of calcium carbonate (mg/L as $CaCO_3$). Except for waters with high pH values, i.e., greater than 9.5, or unusual waters, the alkalinity of water can be considered the result of dissolved bicarbonate and carbonate.

The lowest alkalinity values were measured on the unnamed tributary to the South Prong Alafia River (SW-1). Alkalinity at this station ranged between 3 and 17 mg/L as $CaCO_3$ with a mean value of 10 mg/L. All five measurements at SW-1 were lower than the Class III standard of $\geq$20 mg/L as $CaCO_3$. Alkalinity values at all of the remaining stations were above the Class III standard. The mean alkalinity values at the two South Prong Alafia River stations SW-2 and SW-3 were 72 and 84 mg/L, respectively.

Payne Creek (SW-4) alkalinity values ranged between 26 and 93 mg/L with a mean value of 66 mg/L. Little Payne Creek (SW-5) had higher alkalinity values with a mean of 92 mg/L.

The mean alkalinity values in the reclaimed lake (SW-6) and the old mine cut (SW-7) were 82 and 67 mg/L, respectively.

Color

The decomposition of organic matter contributes to the color of many of Florida's surface waters. Color, and associated high organic content, and its impact on DO concentration was briefly discussed previously. The median color in Florida's streams is 70 Pt-Co color units; color in excess of about 140 Pt-Co units occurs 20 percent of the time (FDER, 1989). Mean color at SW-2 and SW-3 was 77 and 89 Pt-Co units, respectively. The mean color of 144 Pt-Co units at SW-1 falls within the 80th percentile. This color is probably the result of organic decomposition and some limited agricultural activity.

The highest mean color (263 Pt-Co units) and maximum color (400 Pt-Co units) values were observed in the headwaters of Payne Creek at SW-4 indicating a high organic content at SW-4. These values are well above the median color (140 Pt-Co units) reported for Florida's streams by FDER (1989). Conversely, SW-5, along with SW-6 discussed below, had the lowest color values observed. The mean and maximum color values for SW-5 were 43 and 75 Pt-Co units, respectively. These low color values indicate relatively low organic content which, given the fact that these waters drain from mined out areas, is expected.

Color was significantly different between stations SW-6 and SW-7. SW-7 was more colored with a mean color of 111 Pt-Co units compared with SW-6 with a mean color of 48 Pt-Co units. This suggests that there was more organic material in the waters of the old mine cut (SW-7).

Total Suspended Solids

According to FDER (1990), total suspended solids have been identified as a problem in the South Prong Alafia River. Moreover, during construction, total suspended solids concentration, without mitigative measures, could be affected. Based on the data collected by Tampa Electric Company, it is apparent that, although total suspended solids were usually below about 40 mg/L, concentrations as high as 120 mg/L were observed. The highest total suspended solids concentration was observed at station SW-3 located on the South Prong Alafia River.

FDER (1990) data indicate that suspended solids are not a problem for Payne Creek and Little Payne Creek. The mean values observed by Tampa Electric Company, 17 and 5 mg/L for SW-4 and SW-5, respectively, support this assessment. Nevertheless, the value for SW-4 is in the 80th percentile for Florida's streams (FDER, 1989) and the mean value for SW-5 is in the 40th percentile.

The mean total suspended solids concentrations of 23 and 33 mg/L for SW-6 and SW-7 were higher than some of the other Tampa Electric Company stations. The maximum of 50 mg/L at these stations, however, was well below the maximum value of 120 mg/L observed by Tampa Electric Company at SW-3.

Nutrients and Chlorophyll

Nutrients are mentioned consistently by FDER (1990) as contributing to water quality problems in surface waters near the Polk Power Station site, including the South Prong Alafia River and Payne Creek systems. According to 5 years of STORET data (EPA, 1991) for the South Prong Alafia River at Bethlehem Road (Tampa Electric Company station SW-2), the mean total nitrogen concentration, which includes organic nitrogen, nitrates, nitrites, and ammonia, was 1.50 mg/L which falls within the 65th percentile for Florida streams (FDER, 1989). According to the EPA STORET data and Tampa Electric Company's data, nitrates or nitrates plus nitrites and total organic nitrogen were the primary nitrogen species present. Mean nitrate concentrations at SW-2 and SW-3 were 0.6 and 0.2 mg/L, respectively. Although there was very little nitrogen measured as nitrite at SW-2, nitrite was a major component at SW-3 with a mean concentration of 0.28 mg/L. Time series plots of total organic nitrogen and ammonia for the South Prong Alafia River are presented in Figure 2.3.4-12.

Given the phosphate mining in the vicinity of the South Prong Alafia River, total phosphorus concentrations are expectedly high. Mean concentrations measured by Tampa Electric Company range from 0.82 (SW-1) to 1.28 mg/L (SW-3). These values fall within the 90th percentile of FDER's data (FDER, 1989). The median values reported by FDER for Florida streams was 0.11 mg/L. Total phosphorus concentrations considerably higher than the maximum recorded by Tampa Electric Company, 1.70 mg/L (SW-2), have been reported by EPA (1991) as shown in

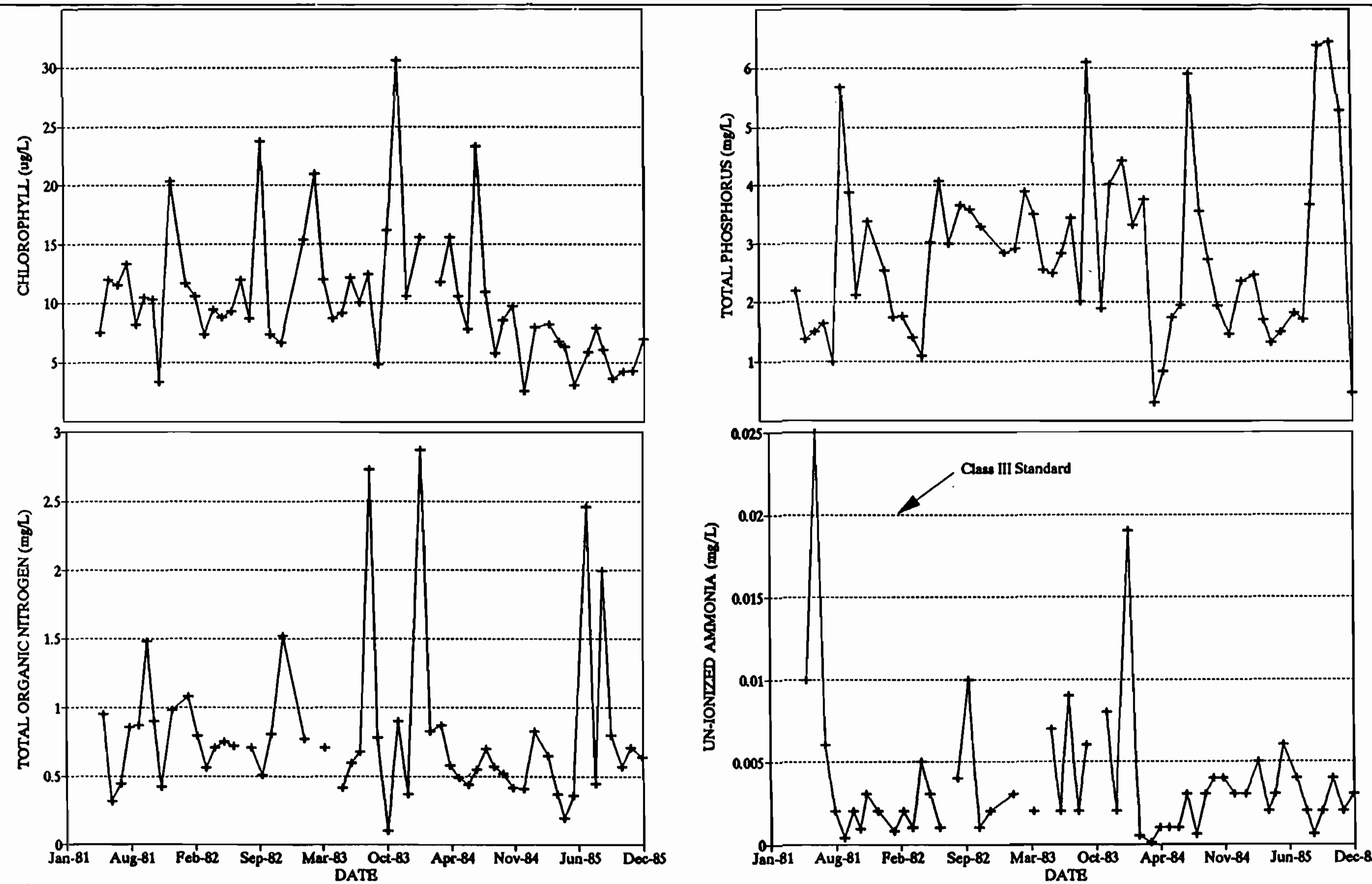

FIGURE 2.3.4-12.

HISTORICAL CHLOROPHYLL AND NUTRIENT (TOTAL ORGANIC NITROGEN, UN-IONIZED AMMONIA, AND TOTAL PHOSPHORUS) CONCENTRATIONS ON THE SOUTH PRONG ALAFIA RIVER AT BETHLEHEM ROAD

Source: EPA, 1991. ECT, 1992.

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Figure 2.3.4-12 and Table 2.3.4-13, and FDER/PSES as shown in Table 2.3.4-14. In fact the highest concentration reported by FDER/PSES--16.4 mg/L, is nearly an order of magnitude higher than total phosphorus reported by Tampa Electric Company for the South Prong Alafia River (SW-2).

Chlorophyll was not measured by Tampa Electric Company. Given the very spotty nature of chlorophyll data, longer-term historical data provide a better characterization of chlorophyll concentrations. According to STORET data (EPA, 1991), based on 56 water samples, the mean chlorophyll a concentration in the South Prong Alafia River at Bethlehem Road was 4.3 micrograms per liter (μg/L); the mean total chlorophyll concentration was 10.4 μg/L. FDER/PSES reports a lower mean chlorophyll a value of 1.42 μg/L at this same location; however, this mean is based on only five samples. Just upstream at FDER/PSES Station S3, which is upstream of the Polk Power Station site, chlorophyll a values as high as 32.90 μg/L were reported. A time-series plot of total chlorophyll, along with selected nutrients, is presented in Figure 2.3.4-12.

The mean total phosphorus concentration on Payne Creek at SW-4 (0.71 mg/L) was about twice as high as the mean for the Little Payne Creek station SW-5 (0.49 mg/L). Mean total organic nitrogen values for SW-4 and SW-5 were 1.34 and 1.01 mg/L, respectively. These values are consistent with the STORET data (EPA, 1991) with mean total phosphorus and organic nitrogen concentrations for Payne Creek near Bowling Green of 0.70 and 1.2 mg/L, respectively. These means, however, are based on only three and two samples, respectively.

The most significant difference between SW-7 and SW-6 and, for that matter, any of the other Tampa Electric Company monitoring stations, is seen in the nutrient concentrations as demonstrated by total organic nitrogen and total phosphorus. The mean total organic nitrogen concentration for SW-7 of 2.73 mg/L is 1.5 times greater than the next highest mean concentration of 1.64 mg/L (SW-6). The difference in total phosphorus concentration is even more pronounced with the mean concentration at SW-7 of 4.52 mg/L over 3.5 times higher than the next highest mean total phosphorus concentration (SW-3). No historical data have been identified for comparison.

The only violations of the nutrient concentration standards were for ammonia at SW-7 where there were three exceedances of the Class III water quality standards.

<u>Metals</u>

For the most part, metals were below the method detection limits; however, there were occasional exceptions. For example, iron, which was generally below the method detection limit at most of the stations, was occasionally above the method detection limit at SW-1 and SW-3 (Tables 2.3.4-6 and 2.3.4-8), but well below the Class III water quality standard of 1.0 mg/L.

Of the trace metals, only lead and silver were observed above the method detection limits at stations SW-1, SW-2, and SW-3 (Table 2.3.4-6 through 2.3.4-8). The Class III standard for lead was exceeded at all stations at least one time. The maximum silver concentrations at stations SW-1 through SW-3 were either at or just below the Class III standard for silver (0.07 μg/L).

Unlike the other Tampa Electric Company stations, iron was always above the method detection limit at the Payne Creek station, SW-4 (Table 2.3.4-9). Normally, iron precipitates readily in the presence of oxygen; however, given the low DO concentrations and high acidity and color, iron is more soluble. The high organic content of the water at SW-4, as indicated by high color, would tend to stabilize this soluble iron. At SW-5 (Little Payne Creek), iron was consistently below the method detection limits. Manganese was observed only at SW-4 and only once in March 1991 (0.07 mg/L).

Like the South Prong Alafia River stations (SW-1 through SW-3), lead and silver were the only trace metals observed in Payne Creek and Little Payne Creek (SW-4 and SW-5). Lead was observed at these stations, and all other stations, only during March; silver only during February. Primarily their appearance is an artifact of analysis rather than an indication of their actual distribution. During the months in question, the method detection limits were significantly lower than the standard. There were violations of the lead standard at both stations. At SW-4 in February, silver was above the Class III standard of 0.07 μg/L. This was the only time at any station that silver exceeded the Class III standard.

Iron was below the method detection limits at stations SW-6 and SW-7. Like the other Tampa Electric Company stations, silver and lead were above the method detection limit only during February and March, respectively. Lead exceeded the Class III standard at SW-6 and SW-7.

Other Priority Pollutants, Organic Compounds, and Pesticides

Other than the aforementioned trace metals, all other priority pollutants at all Tampa Electric Company stations were below the method detection limits. A special sampling was conducted in March 1992 to sample surface waters for cyanide. The analytical technique used incorporated the latest sampling and analysis methods outlined by FDER. According to the results from this sampling, cyanide was below the method detection limit of 0.02 mg/L. Organics such as phenols, phthalates, polychlorinated biphenyls (PCBs), and pesticides also were below the method detection limits.

Bacteria

Like chlorophyll, bacteria data are notoriously limited. Therefore, Tampa Electric Company relied on longer-term historical data to characterize bacteria. The geometric mean concentration for total and fecal coliform bacteria on the South Prong Alafia River at Bethlehem Road is 752 and 191 counts per 100 milliliters (mL) (Table 2.3.4-14). Compared with coliform data for streams provided by FDER (1989), the total and fecal coliform values lie between the 50th and 60th percentiles and the 60th and 70th percentiles, respectively.

Radioactive Substances

The mean values for Radium 226 ranged from 0.5 to 1.4 pCi/L, for Radium 228 1.0 to 1.3 pCi/L, and for gross alpha 1.7 to 3 pCi/L. The Radium 226 standard was exceeded one time at SW-6. The standard for Radium 228 was exceeded once at SW-2, SW-3, and SW-4. There were no violations of the gross alpha standard.

2.3.4.2 Measurement Programs

The surface water field program was described in the environmental licensing plan of study which was reviewed by the statutory agencies including FDER and EPA (ECT, 1991). The number, locations, and conditions of surface water stations, as well as detailed information on data collection methods, data analyses, and results are provided in the following paragraphs.

Seven surface water stations were established for field monitoring. These stations, shown in Figure 2.3.4-3, were located to ensure that the maximum amount of representative data were collected from the streams and other water bodies that may be affected by plant construction and operation. Station SW-1, was located on an unnamed tributary to the South Prong Alafia River. This tributary will receive some runoff from the reclaimed lands on the site to the west of SR 37. This stream is also representative of other small first order tributaries in the area. Hydrologic and water quality data from this station are used to characterize baseline conditions in this stream and to assess the potential impacts associated with intermittent flows from the reclaimed areas. Stations SW-2 and SW-3 were located to characterize the South Prong Alafia River. SW-3 was located so that it was downstream of the IMC Fertilizer Brewster Mine discharge, but upstream of runoff associated with Agrico's mining activities. Data from station SW-2, located downstream of the site, were used to characterize the river downstream of the Polk Power Station site.

Other surface water bodies that may potentially be affected either by construction or operation of the proposed plant include Little Payne Creek and Payne Creek. Both of these streams have been substantially modified as a result of mining activities. In order to characterize regional baseline surface water conditions and provide the necessary information to assess potential impacts associated with the proposed plant location, surface water stations were located along these water bodies. Station SW-4 was located near the headwaters of Payne Creek at the point where SR 37 crosses Payne Creek. Station SW-5 was located where Fort Green Road crosses the drainage canal that now represents the headwaters of Little Payne Creek.

In addition to the streams that surround the Polk Power Station site, mine cuts and a reclaimed lake are located on the site. Surface water stations were located in both the recently reclaimed lake and the old unreclaimed mine cut lake. These stations, designated SW-6 and SW-7, respectively, were used to characterize water quality in these two distinct types of water bodies.

Continuous stage recorders were installed at stations SW-2, SW-5, and SW-6 for 6 months beginning in late February and continuing through August 1991. This period encompasses central Florida's normal dry and wet seasons. The locations of these stations and the rationale for selecting these stations were presented previously.

Continuous stage was recorded using Leupold & Stevens Type A water level recorders. A typical installation is shown in Figure 2.3.4-13. These water level recorders were serviced monthly. A staff gauge was attached to the platform of each recorder. This staff gauge provided an independent check of water level that was compared to the actual chart record. This check is essential for detecting problems such as plugged outlet holes and slipped float cables.

To convert stage to discharge, instantaneous flows at stations SW-2, SW-5, and SW-6 were measured using a Teledyne-Gurley pygmy current meter and standard USGS techniques. Instantaneous flow measurements were made across the stream, if flowing water was present, at the location of the continuous stage recorder on a monthly basis over the 6-month monitoring period. The stage, as indicated by the recorder and the staff gauge, was measured prior to, and immediately following, the instan-

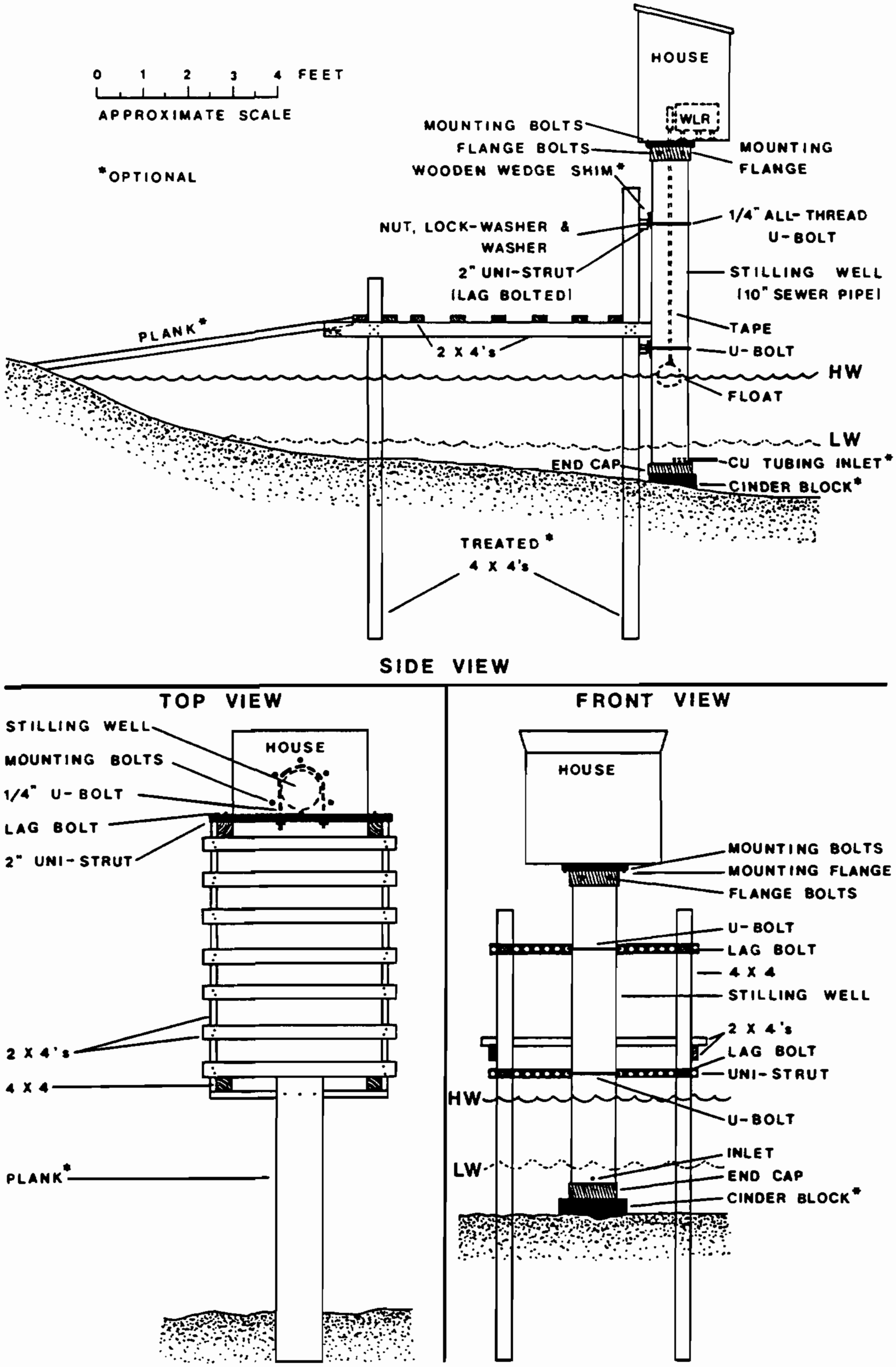

FIGURE 2.3.4-13.

TYPICAL STAGE (WATER LEVEL) RECORDER INSTALLATION

Source: ECT, 1992.

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taneous flow measurement. The reduced flow data were then plotted against the stage data from the water level recorder to produce a stage-discharge curve. Using this curve, continuous discharges from the continuous stage data were determined.

In addition, monthly instantaneous flows were measured at stations SW-1, SW-3, and SW-4. Flow measurements were not applicable at station SW-7 since the unreclaimed mine cut is not normally a flowing system. These measurements were made during the monthly sampling efforts whenever there was water flowing at these stations. From the instantaneous flow data, streamflow at these locations for a variety of conditions was characterized.

Concurrent with discharge data collection, water quality samples were collected monthly at the seven surface water monitoring stations. These samples were analyzed for the parameters listed in Table 2.3.4-17. This list is based on the Class III standards presented in Chapters 17-302.510 and 17-302.560, F.A.C. Additional analytes were included because they are either essential for describing an aquatic system or for adequately interpreting water quality conditions in these surface water bodies. The parameters in this table have been grouped into *in situ* measurements, classical analytes, other metals, radioactive substances, pesticides, and organics. The latter two categories were sampled less frequently but encompassed the dry and wet periods. All other parameters were measured during each of the six water quality sampling trips. At stations SW-2 and SW-4, two priority pollutant scans were conducted; once during the dry season and a second time during the wet season. These scans identified any such pollutants that may exist in the South Prong Alafia River and Payne Creek. Single priority pollutant scans also were conducted at SW-3 (South Prong Alafia River) and SW-5 (Little Payne Creek) during May and August 1991, respectively.

In addition to the *in situ* measurements associated with the monthly water quality sampling, diurnal (i.e., daytime) DO measurements were made twice during the 6-month sampling period. During these sampling events, DO concentration was

Table 2.3.4-17. Tampa Electric Company Surface Water Quality Analytes and Number of Analyses per Location

Analyte	Units	No. of Analyses						
		SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7
General Observations								
Date	1991							
Time	LMT							
Discharge	cfs	6	6	6	6	6	0	0
In Situ Measurements								
Temperature	C	5	6	6	6	6	5	5
Specific Conductance	umhos/cm	5	6	6	6	6	5	5
Hydrogen Ion Activity (pH)		5	6	6	6	6	5	5
Dissolved Oxygen (DO)	mg/L	5	6	6	6	6	5	5
DO Saturation	%	5	6	6	6	6	5	5
Oxidation-Reduction Potential	V	4	4	4	4	4	4	4
Classical								
Alkalinity, Total as CaCO3	mg/L	5	5	5	5	5	5	5
Alkalinity, Bicarbonate	mg/L	5	5	5	5	5	5	5
Alkalinity, Carbonate	mg/L	6	6	6	6	6	6	6
Acidity, Total	mg/L	6	6	6	6	6	6	6
Hardness, Total as CaCO3	mg/L	6	6	6	6	6	6	6
Color	Pt-Co	6	6	6	6	6	6	6
Solids, Total	mg/L	6	6	6	6	6	6	6
Solids, Total Dissolved	mg/L	6	6	6	6	6	6	6
Solids, Total Suspended	mg/L	6	6	6	6	6	6	6
Turbidity	NTU	6	6	6	6	6	6	6
Chloride	mg/L	6	6	6	6	6	6	6
Fluoride, Soluble	mg/L	6	6	6	6	6	6	6
Sulfate	mg/L	6	6	6	6	6	6	6
Cyanide	mg/L	1	1	1	1	1	1	1
Sodium	mg/L	6	6	6	6	6	6	6
Calcium	mg/L	6	6	6	6	6	6	6
Magnesium	mg/L	6	6	6	6	6	6	6
Arsenic	ug/L	6	6	6	6	6	6	6
Selenium	ug/L	6	6	6	6	6	6	6
Total Anions	meq/L	6	6	6	6	6	6	6
Total Cations	meq/L	6	6	6	6	6	6	6
Ammonia (un-ionized)	mg/L	6	6	6	6	6	6	6
Nitrogen, Nitrate	mg/L	6	6	6	6	6	6	6
Nitrogen, Nitrite	mg/L	6	6	6	6	6	6	6
Nitrogen, Total Organic	mg/L	6	6	6	6	6	6	6
Nitrogen, Kjeldahl	mg/L	6	6	6	6	6	6	6
Phosphorus, Total	mg/L	6	6	6	6	6	6	6
Total Rec. Oil & Grease	mg/L	6	6	6	6	6	6	6
Surfactants	mg/L	6	6	6	6	6	6	6
5-day BOD	mg/L	6	6	6	6	6	6	6
Chemical Oxygen Demand	mg/L	5	5	5	5	5	5	5
Hydrogen Sulfide	mg/L	2	2	2	2	2	2	2
Other Metals								
Antimony	mg/L	1	3	2	2	1	1	1
Barium	mg/L	6	6	6	6	6	6	6

Table 2.3.4-17. Tampa Electric Company Surface Water Quality Analytes and Number of Analyses per Location (Continued, Page 2 of 5)

Analyte	Units	No. of Analyses SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7
Beryllium	ug/L	6	6	6	6	6	6	6
Cadmium	ug/L	6	6	6	6	6	6	6
Chromium	mg/L	6	6	6	6	6	6	6
Chromium, Hexavalent	mg/L	4	4	4	4	4	4	4
Copper	mg/L	6	6	6	6	6	6	6
Iron	mg/L	6	6	6	6	6	6	6
Lead	ug/L	6	6	6	6	6	6	6
Manganese	mg/L	6	6	6	6	6	6	6
Mercury	ug/L	6	6	6	6	6	6	6
Nickel	mg/L	6	6	6	6	6	6	6
Silver	ug/L	6	6	6	6	6	6	6
Thallium	mg/L	1	3	2	2	1	1	1
Vanadium	mg/L	2	2	2	2	2	2	2
Zinc	mg/L	6	6	6	6	6	6	6
Radioactive Substances								
Radium 226	pCi/L	6	6	6	6	6	6	6
Radium 228	pCi/L	6	6	6	6	6	6	6
Gross Alpha	pCi/L	6	6	6	6	6	6	6
Organics (Phenols, Phthalates, PCBs)								
Phenol	ug/L	6	6	6	6	6	6	6
2-Chlorophenol	ug/L	6	6	6	6	6	6	6
2-Nitrophenol	ug/L	6	6	6	6	6	6	6
4-Nitrophenol	ug/L	6	6	6	6	6	6	6
2-Methylphenol	ug/L	0	2	1	2	1	0	0
4-Methylphenol	ug/L	0	2	1	2	1	0	0
2,4-Dimethylphenol	ug/L	6	6	6	6	6	6	6
2,4-Dichlorophenol	ug/L	6	6	6	6	6	6	6
4-Chloro-3-methylphenol	ug/L	6	6	6	6	6	6	6
2,4,5-Trichlorophenol	ug/L	0	2	1	2	1	0	0
2,4,6-Trichlorophenol	ug/L	6	6	6	6	6	6	6
2,4-Dinitrophenol	ug/L	6	6	6	6	6	6	6
2-Methyl-4,6-dinitrophenol	ug/L	6	6	6	6	6	6	6
Pentachlorophenol	ug/L	6	6	6	6	6	6	6
Di-n-butyl Phthalate	ug/L	3	4	4	4	3	3	3
bis(2-Ethyl hexyl) Phthalate	ug/L	3	4	4	4	3	3	3
Di-n-octyl Phthalate	ug/L	3	4	4	4	3	3	3
Butyl Benzyl Phthalate	ug/L	3	4	4	4	3	3	3
Diethyl Phthalate	ug/L	3	4	4	4	3	3	3
Dimethyl Phthalate	ug/L	3	4	4	4	3	3	3
PCB-1016	ug/L	3	4	4	4	3	3	3
PCB-1221	ug/L	3	4	4	4	3	3	3
PCB-1232	ug/L	3	4	4	4	3	3	3
PCB-1242	ug/L	3	4	4	4	3	3	3
PCB-1248	ug/L	3	4	4	4	3	3	3
PCB-1254	ug/L	3	4	4	4	3	3	3
PCB-1260	ug/L	3	4	4	4	3	3	3

Table 2.3.4-17. Tampa Electric Company Surface Water Quality Analytes and Number of Analyses per Location (Continued, Page 3 of 5)

Analyte	Units	No. of Analyses SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7
Pesticides								
Aldrin	ug/L	3	4	4	4	3	3	3
Dieldrin	ug/L	3	4	4	4	3	3	3
Chlordane	ug/L	3	4	4	4	3	3	3
4,4-DDT	ug/L	3	4	4	4	3	3	3
4,4-DDD	ug/L	0	2	1	2	1	0	0
4,4-DDE	ug/L	0	2	1	2	1	0	0
Demeton	ug/L	3	3	3	3	3	3	3
Endosulfan	ug/L	3	3	3	3	3	3	3
Endosulfan I	ug/L	0	2	1	2	1	2	0
Endosulfan II	ug/L	0	2	1	2	1	2	0
Endosulfan Sulfate	ug/L	0	2	1	2	1	2	0
Endrin	ug/L	3	4	4	4	3	3	3
Endrin Aldehyde	ug/L	0	2	1	2	1	2	0
Guthion	ug/L	3	3	3	3	3	3	3
Heptachlor	ug/L	3	4	4	4	3	3	3
Heptachlor Epoxide	ug/L	0	2	1	2	1	2	0
a-BHC	ug/L	0	2	1	2	1	2	0
b-BHC	ug/L	0	2	1	2	1	2	0
g-BHC	ug/L	0	1	1	1	0	0	0
d-BHC	ug/L	0	2	1	2	1	0	0
Lindane	ug/L	3	3	3	3	3	3	3
Malathion	ug/L	3	3	3	3	3	3	3
Methoxychlor	ug/L	3	3	3	3	3	3	3
Mirex	ug/L	3	3	3	3	3	3	3
Parathion	ug/L	3	3	3	3	3	3	3
Toxaphene	ug/L	3	4	4	4	3	3	3
Other Priority Pollutants								
Acrolein	ug/L	0	2	1	2	1	0	0
Acrylonitrile	ug/L	0	2	1	2	1	0	0
Benzene	ug/L	0	2	1	2	1	0	0
Bromodichloromethane	ug/L	0	2	1	2	1	0	0
Bromoform	ug/L	0	2	1	2	1	0	0
Bromomethane	ug/L	0	2	1	2	1	0	0
Carbon Tetrachloride	ug/L	0	2	1	2	1	0	0
Chlorobenzene	ug/L	0	2	1	2	1	0	0
Chloroethane	ug/L	0	2	1	2	1	0	0
2-Chloroethylvinyl Ether	ug/L	0	2	1	2	1	0	0
Chloroform	ug/L	0	2	1	2	1	0	0
Chloromethane	ug/L	0	2	1	2	1	0	0
Dibromochloromethane	ug/L	0	2	1	2	1	0	0
1,1-Dichloroethane	ug/L	0	2	1	2	1	0	0
1,2-Dichloroethane	ug/L	0	2	1	2	1	0	0
1,1-Dichloroethylene	ug/L	0	2	1	2	1	0	0
trans-1,2-Dichloroethylene	ug/L	0	2	1	2	1	0	0
1,2-Dichloropropane	ug/L	0	2	1	2	1	0	0
cis-1,3-Dichloropropene	ug/L	0	2	1	2	1	0	0
trans-1,3-Dichloropropene	ug/L	0	2	1	2	1	0	0
Ethyl Benzene	ug/L	0	2	1	2	1	0	0

Table 2.3.4-17. Tampa Electric Company Surface Water Quality Analytes and Number of Analyses per Location (Continued, Page 4 of 5)

Analyte	Units	No. of Analyses						
		SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7
Methylene Chloride	ug/L	0	2	1	2	1	0	0
1,1,2,2-Tetrachloroethane	ug/L	0	2	1	2	1	0	0
Tetrachloroethylene	ug/L	0	2	1	2	1	0	0
Toluene	ug/L	0	2	1	2	1	0	0
1,1,1-Trichloroethane	ug/L	0	2	1	2	1	0	0
1,1,2-Trichloroethane	ug/L	0	2	1	2	1	0	0
Trichloroethylene	ug/L	0	2	1	2	1	0	0
Trichlorofluoromethane	ug/L	0	2	1	2	1	0	0
Vinyl Chloride	ug/L	0	2	1	2	1	0	0
Acenaphthene	ug/L	0	3	1	2	1	0	0
Acenaphthylene	ug/L	0	3	1	2	1	0	0
Anthracene	ug/L	0	3	1	2	1	0	0
Benzoic Acid	ug/L	0	2	1	2	1	0	0
Benzo(a)anthracene	ug/L	0	3	1	2	1	0	0
Benzo(a)pyrene	ug/L	0	3	1	2	1	0	0
Benzo(b)fluoranthene	ug/L	0	3	1	2	1	0	0
Benzo(k)fluoranthene	ug/L	0	3	1	2	1	0	0
Benzo(g,h,i)perylene	ug/L	0	3	1	2	1	0	0
Benzyl Alcohol	ug/L	0	2	1	2	1	0	0
bis(2-Chloroethoxy) Methane	ug/L	0	3	1	2	1	0	0
bis(2-Chloroethyl) Ether	ug/L	0	3	1	2	1	0	0
bis(2-Chloroisopropyl) Ether	ug/L	0	3	1	2	1	0	0
4-Bromophenyl Phenyl Ether	ug/L	0	3	1	2	1	0	0
2-Chloronaphthalene	ug/L	0	3	1	2	1	0	0
4-Chlorophenyl Phenyl Ether	ug/L	0	3	1	2	1	0	0
4-Chloroaniline	ug/L	0	2	1	2	1	0	0
Chrysene	ug/L	0	3	1	2	1	0	0
Dibenzo(a,h)anthracene	ug/L	0	3	1	2	1	0	0
1,2-Dichlorobenzene	ug/L	0	2	1	2	1	0	0
1,3-Dichlorobenzene	ug/L	0	2	1	2	1	0	0
1,4-Dichlorobenzene	ug/L	0	2	1	2	1	0	0
3,3-Dichlorobenzidine	ug/L	0	3	1	2	1	0	0
Dibenzofuran	ug/L	0	2	1	2	1	0	0
2,4-Dinitrotoluene	ug/L	0	3	1	2	1	0	0
2,6-Dinitrotoluene	ug/L	0	3	1	2	1	0	0
Fluoranthene	ug/L	0	3	1	2	1	0	0
Fluorene	ug/L	0	3	1	2	1	0	0
Hexachlorobenzene	ug/L	0	3	1	2	1	0	0
Hexachlorobutadiene	ug/L	0	3	1	2	1	0	0
Hexachloroethane	ug/L	0	3	1	2	1	0	0
Indeno(1,2,3-c,d)pyrene	ug/L	0	3	1	2	1	0	0
Isophorone	ug/L	0	3	1	2	1	0	0
2-Methylnaphthalene	ug/L	0	2	1	2	1	0	0
Naphthalene	ug/L	0	3	1	2	1	0	0
2-Nitroaniline	ug/L	0	2	1	2	1	0	0
3-Nitroaniline	ug/L	0	2	1	2	1	0	0
4-Nitroaniline	ug/L	0	2	1	2	1	0	0
Nitrobenzene	ug/L	0	3	1	2	1	0	0
N-Nitrosodimethylamine	ug/L	0	2	0	1	1	0	0
N-Nitrosodi-n-propylamine	ug/L	0	3	1	2	1	0	0

Table 2.3.4-17. Tampa Electric Company Surface Water Quality Analytes and Number of Analyses per Location (Continued, Page 5 of 5)

Analyte	Units	No. of Analyses						
		SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7
N-Nitrosodiphenylamine	ug/L	0	3	1	2	1	0	0
Phenanthrene	ug/L	0	3	1	2	1	0	0
Pyrene	ug/L	0	3	1	2	1	0	0
1,2,4-Trichlorobenzene	ug/L	0	3	1	2	1	0	0
Hexachlorocyclopentadiene	ug/L	0	3	1	2	1	0	0
cis-1,2-Dichloroethene	ug/L	0	1	0	1	1	0	0
2-Hexanone	ug/L	0	1	0	1	1	0	0
Methyl tert-butyl Ether	ug/L	0	1	0	1	1	0	0
4-Methyl-2-pentanone (MIBK)	ug/L	0	1	0	1	1	0	0
Vinyl Acetate	ug/L	0	1	0	1	1	0	0
Xylenes	ug/L	0	1	0	1	1	0	0
2-Butanone (MEK)	ug/L	0	1	0	1	1	0	0
Carbon Disulfide	ug/L	0	1	0	1	1	0	0
Benzidine	ug/L	0	1	0	1	1	0	0
1,2-Diphenylhydrazine	ug/L	0	1	0	1	1	0	0
Dibromomethane	ug/L	0	1	0	1	1	0	0

Source: ECT, 1992.

measured *in situ* from about 1 hour before sunrise to 2 hours after sunrise. It is during this period that the highest and lowest DO concentrations are expected. Temperature was measured concurrently with DO in order to determine DO saturation.

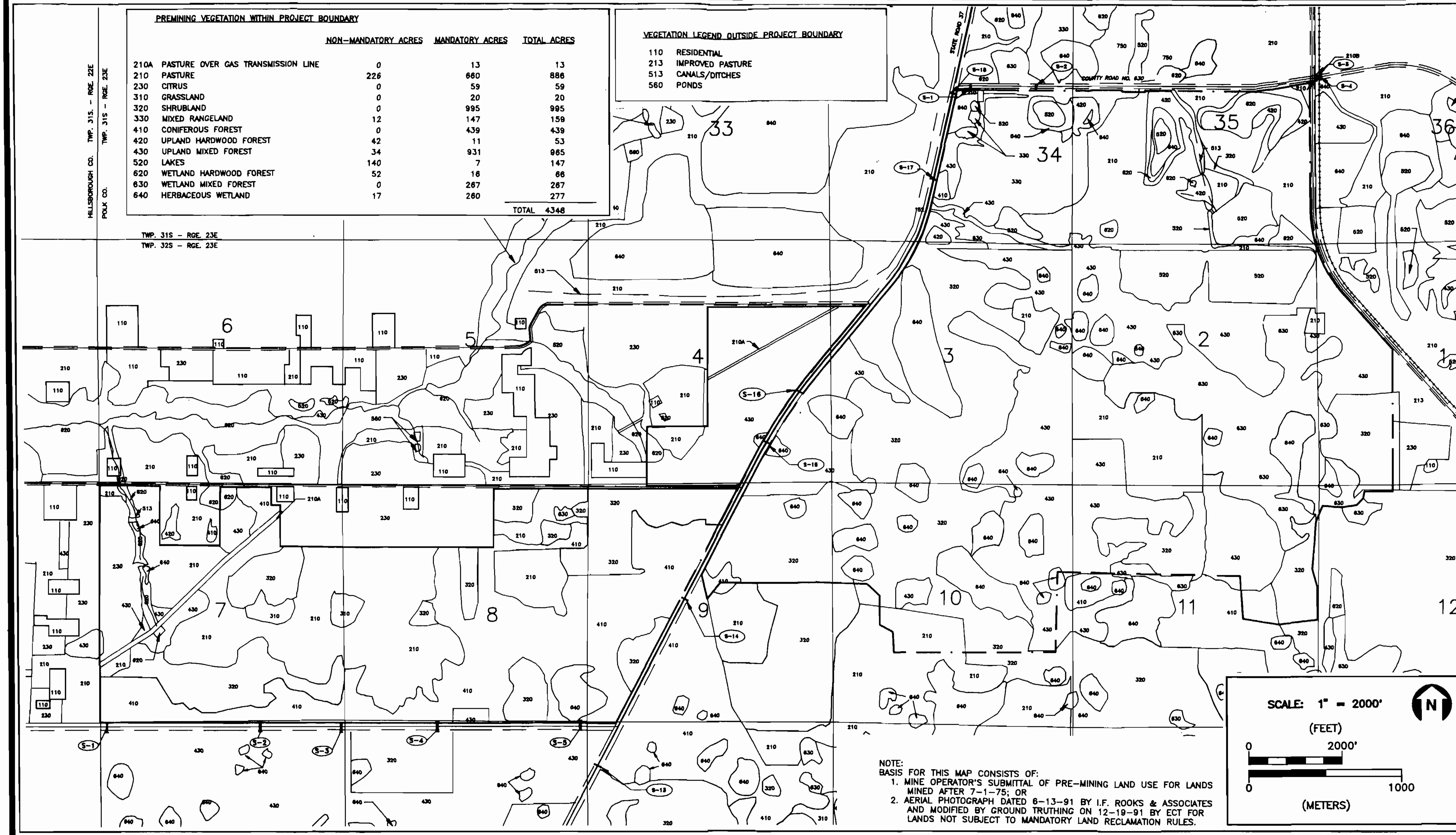
The detailed results of the surface water quality monitoring program for the Polk Power Station are provided in Appendix 11.8.8.

2.3.5 VEGETATION/LAND USE

The majority of the Polk Power Station site has been or is in the process of being mined or disturbed by phosphate mining activities. Consequently, most of the original flora on the site has been drastically altered. As a result of past and ongoing mining activities, only small, portions of relatively undisturbed terrestrial, wetland and aquatic habitats still remain on the site. Major land uses and vegetation represented on the site consist of mined land; developed land (e.g., transmission lines, a pipeline, and a small industrial site); uplands (e.g., pasture, shrub and brushland, overgrown spoil, old fields, orange grove, mixed oak/pine woods, palmetto rangeland, pine flatwoods, and oak hammock); remaining wetlands (e.g., hardwood swamp and marsh); and open water systems (e.g., ditches, canals, mine cut and reclaimed lakes, and an intermittent stream). Threatened and endangered species and other important species, as well as the site status of unique and sensitive habitats, are discussed in Section 2.3.6. Potential impacts to these species from site development are discussed in Section 4.4.

Vegetation cover/land use existing on the Polk Power Station site prior to mining operations since mid-1975 is shown in Figure 2.3.5-1. These site conditions are generally referred to as pre-mining conditions in this SCA. As indicated on the figure, the majority (65 percent) of the site was covered with primarily three upland vegetation types: pasture, shrub and brushland, and mixed forest. Coniferous forest (pine flatwoods) also covered 10 percent of the site. Wetlands primarily associated with the headwater area of Little Payne Creek comprised 759 acres (17 percent) of the site.

Phosphate mining activities have significantly affected the acreages of vegetation communities on the property as described in the remainder of this section and in Section 2.3.6. Some old-mined areas (i.e., prior to 1950) have revegetated. However, the majority of the site (i.e., more than 2,500 acres) reflect more recent mining disturbance and are essentially non-vegetated. The three upland vegetation types on the site in pre-mining conditions now only comprise 23 percent of the site. Wetland



PREMINING VEGETATION WITHIN PROJECT BOUNDARY

		NON-MANDATORY ACRES	MANDATORY ACRES	TOTAL ACRES
210A	PASTURE OVER GAS TRANSMISSION LINE	0	13	13
210	PASTURE	226	660	886
230	CITRUS	0	59	59
310	GRASSLAND	0	20	20
320	SHRUBLAND	0	995	995
330	MIXED RANGELAND	12	147	159
410	CONIFEROUS FOREST	0	439	439
420	UPLAND HARDWOOD FOREST	42	11	53
430	UPLAND MIXED FOREST	34	931	965
520	LAKES	140	7	147
620	WETLAND HARDWOOD FOREST	52	16	66
630	WETLAND MIXED FOREST	0	267	267
640	HERBACEOUS WETLAND	17	260	277
			TOTAL	4348

VEGETATION LEGEND OUTSIDE PROJECT BOUNDARY

110	RESIDENTIAL
213	IMPROVED PASTURE
513	CANALS/DITCHES
560	PONDS

NOTE:
BASIS FOR THIS MAP CONSISTS OF:
1. MINE OPERATOR'S SUBMITTAL OF PRE-MINING LAND USE FOR LANDS MINED AFTER 7-1-75; OR
2. AERIAL PHOTOGRAPH DATED 6-13-91 BY I.F. ROOKS & ASSOCIATES AND MODIFIED BY GROUND TRUTHING ON 12-19-91 BY ECT FOR LANDS NOT SUBJECT TO MANDATORY LAND RECLAMATION RULES.

FIGURE 2.3.5-1.

PREMINING VEGETATION AND LAND USE MAP

Source: ECT, 1992.

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areas have been reduced from 17 to 8 percent in areal extent on the site. Although all other communities have generally been significantly reduced in acreage, no community types have been eliminated.

Figure 2.3.5-2 shows the existing land use and cover types associated with and adjacent to the site. The following provides a description of the vegetation on the Tampa Electric Company Polk Power Station site based on ecological surveys conducted in the field during wet and dry season events in 1991. Scientific names for plant species identified in the text are found in Appendix 11.10.1. A more detailed description of current vegetation communities is provided in Section 2.3.6.2.

The Polk Power Station site consists of two main tracts. The eastern tract is bounded by SR 37 on the west; the Tampa Electric Company 230-kV Hardee-Pebbledale transmission line/Fort Green Road on the east; CR 630 on the north; mined land and clay settling areas on the south; and citrus grove, pasture, and a private residence on the southeast. This tract consists primarily of recently mined areas with water-filled mine cuts between overburden spoil piles surrounding a central, unmined parcel of land. The primary power plant facilities (i.e., power block and fuel storage) will be located on this unmined parcel. This parcel mostly contains remnant oak/pine woods, with smaller areas of shrub and brushland, old fields, pasture, scraped-over areas, disturbed marsh, and hardwood swamp. The oak/pine forests were historically pine flatwoods. Due to the lack of periodic fires, the former sub-climax, pine-dominated woods have succeeded to a mixed forest association with a significant component of oaks in the canopy. The shrub, brushland, and old field associations are a result of opportunistic, pioneer species invading newly scraped-over areas. Old fields are herb-dominated uplands that result after clearings in pine flatwoods and other upland associations on the site. Typical species associated with old fields include common ragweed, little bluestem, hairy indigo, beardgrass, foxtail grass, rabbit's tobacco, dog fennel, bushy goldenrod, and goldenrod. Shrub and brushland is an overgrown shrubby association that also results after the former vegetation is removed. This shrubby association is dominated by a mixture of weedy

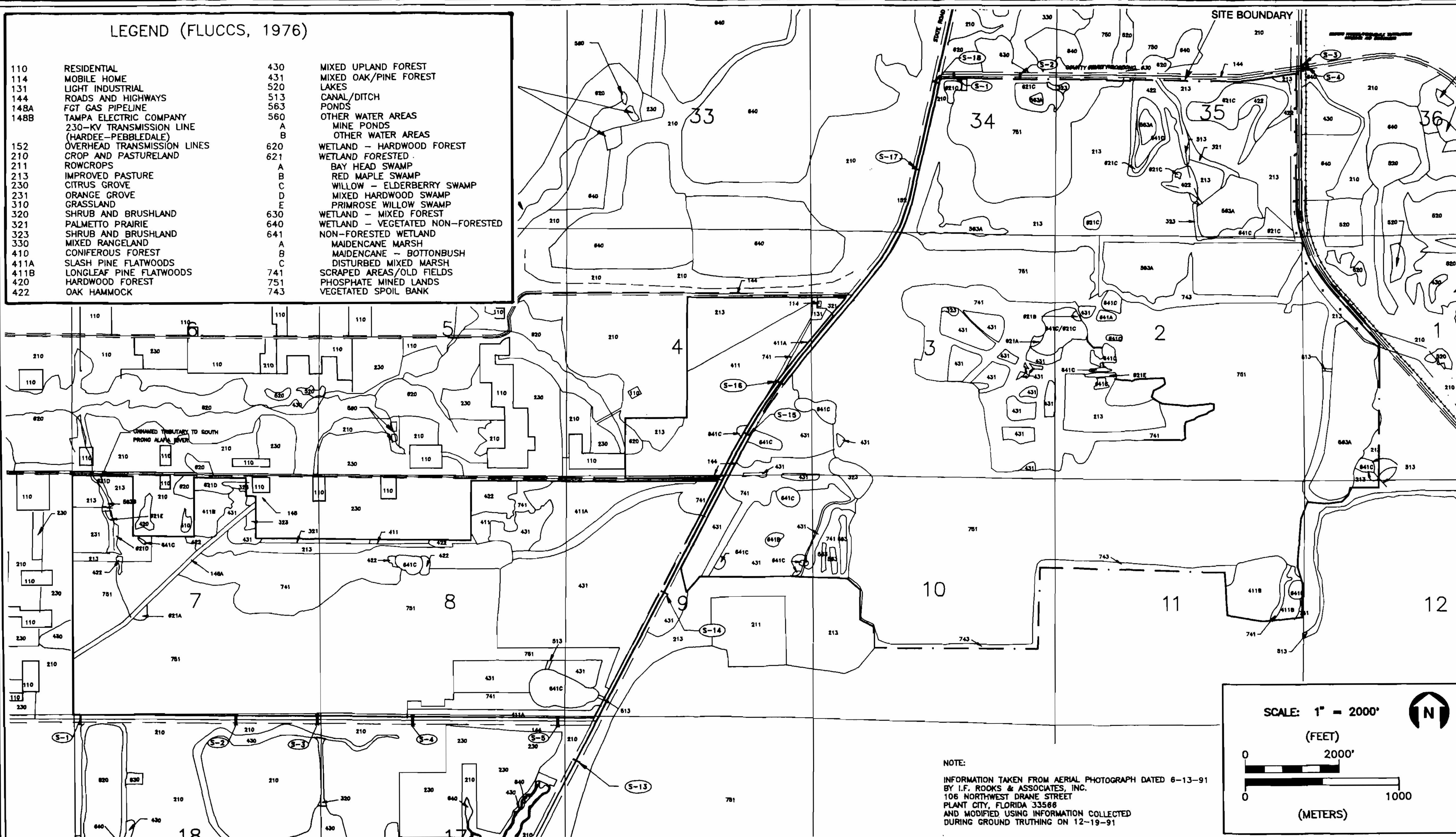

FIGURE 2.3.5-2.

EXISTING LAND USE/LAND COVER MAP

Source: ECT, 1992.

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shrubs such as wax myrtle and groundsel bush. Remnant pasture is also situated on the tract. This open, grassy upland community is usually dominated by one or two species such as bahia grass and beardgrass. Marshland on the tract consists of herbaceous wetlands dominated by maidencane, rushes, sedges, and other aquatic macrophytes; most show evidence of disturbance. Forested wetlands on the tract are dominated by one or more wetland trees and/or shrubs such as red maple, swamp redbay, sweet bay, loblolly bay, dahoon holly, willow, elderberry, and primrose willow. These freshwater swamps on the site have also been altered to various degrees by prior activities or exist as a result of mining activities.

Two smaller, unmined areas are also located on the southeastern and southwestern corners of the eastern tract. The southwestern corner contains mostly oak/pine woods with small areas of marsh, shrub and brushland, and old fields. The marshes on the southwestern area consist mostly of disturbed assemblages of herbaceous hydrophytes and a small, relatively undisturbed maidencane-buttonbush wetland located in the center of the parcel. The majority of the approximate 33-acre southeastern corner area contains pine flatwoods together with smaller areas of old field and marsh. The pine flatwoods on this parcel is characterized by a shrub layer dominated by saw palmetto and an overstory of longleaf pines. With the absence of fire, this community will eventually succeed to a mixed oak/pine woods. In addition, the eastern tract includes a previously mined and unreclaimed parcel which contains some naturally reclaimed, stabilized terrestrial habitat. This northern portion of the tract contains lakes/ponds, a drainage ditch system, marsh, shrub swamp, pasture, oak hammock, and shrub and brushland. The oak hammock in this area is dominated by live oak and laurel oak.

The western tract is bounded by SR 37 on the east, Albritton and Bethlehem Roads on the north, citrus groves, oak/pine woods and pasture on the west and SR 674 (Wimauma Road) on the south. Most of this tract has recently been or will be mined. The mined area will ultimately be reclaimed into a series of lakes, wetlands, and uplands and used for water management and retention purposes. Currently, portions of unmined areas are dominated by oak/pine woods and pine flatwoods. Other plant associations in the areas to be mined include pasture, palmetto prairie, old field, oak hammock, and marsh. An approximately 98-acre northwestern portion of the western tract which lies west of an existing FGT pipeline (i.e., Sarasota lateral) is not scheduled for mining. This parcel contains pine flatwoods, hardwood swamp, shrub and brushland, mixed oak/pine woods, oak hammock, old field, marsh, and an orange grove. A floodplain forest situated along an unnamed tributary to the South Prong Alafia River is also present. The forested wetlands in this northwestern corner of the western tract consist of: (1) mixed hardwood swamp along the floodplain reaches of the intermittent tributary and at another location east of the creek along Albritton Road, (2) a shrubby swamp area in the center of the unnamed tributary at a disturbed crossing, and (3) an isolated bayhead situated on the southern edge of the pipeline corridor.

The mined portions of the site consist of spoil piles, ditches, canals, berms, and lakes in varying degrees of vegetative recovery. The mined lands exhibit various stages of early to mid-successional species depending on time lapsed since mining and also include some areas planted as part of reclamation. Berms and spoil piles exhibit such species as wax myrtle, southern fox grape, laurel oak, water oak, Virginia creeper, and poison ivy. Along the shallow edges of mine pits, red maple, willow, primrose willow, wax myrtle, groundsel bush, and cattail occur.

As stated previously, most of the historical wetlands which existed within the site boundary have been disturbed by past mining activities. Less than twenty-five acres of wetlands have been permitted for disturbance since the promulgation of wetland protection rules by FDER and USACE in the late 1970s.

Wetland systems remaining onsite fall within three categories:

1. Small isolated ponds and the upper tip of one forested stream system to be left undisturbed;

2. Reclaimed wetlands and other lakes and wetland remnants left from mining activities prior to 1930; and
3. Open phosphate mine cuts which have re-established some degree of wetland form and function even though they are still subject to the FDNR mandatory reclamation requirements of Chapter 16C-16, F.A.C.

Based on the disturbed nature of the site under FDNR jurisdiction and existing FDER permits with mitigation requirements, FDER has determined that a formal FDER Jurisdictional Declaratory Statement determination will not be required (see Appendix 11.1.2, correspondence with FDER, April 20, 1992). FDER jurisdiction will be confirmed on a case by case basis if development or reclamation activities encroach on Waters of the State as defined by current rules and methodology.

The existing policy of USACE defines Waters of the United States as any wetland system, man-made or otherwise, which contains water and vegetation to the extent that it exhibits, in form and function, the characteristics of wetlands. In the case of phosphate mining excavations, wetland jurisdiction is a subjective interpretation of the degree of vegetation re-establishment and wildlife utilization.

USACE visited the site on March 17, 1992, and confirmed that all wetlands and water bodies with established vegetation would be considered jurisdictional. Exempted from USACE jurisdiction would be the active mining areas nominally less than 2 years old. This would include all areas west of SR 37 and approximately 100 acres of the last area to be mined east of SR 37. A map showing the exact limits of USACE jurisdiction is provided in Appendix 11.1.2 with the Joint Permit Application for Works in Waters of Florida and the United States.

SWFWMD has also confirmed in a site visit on June 29, 1992, that wetlands located on old phosphate-mined land proposed to be developed for this project are under SWFWMD's jurisdiction. A letter and map confirming their jurisdiction is also provided in Appendix 11.1.2.

2.3.6 ECOLOGY

2.3.6.1 Species-Environmental Relationships

Aquatic Systems

Little Payne Creek, Payne Creek and the unnamed tributary to the South Prong Alafia River are the aquatic systems located on or in the vicinity of the Tampa Electric Company Polk Power Station site. Wetlands associated with the onsite drainage basins of Little Payne Creek and Payne Creek have been drastically altered due to past and current mining activity on the property. An old, unreclaimed mine-cut lake and a reclaimed lake are situated in the east-central area of the eastern tract within the former headwater area of Little Payne Creek.

In the site vicinity, the Little Payne Creek system consists primarily of a man-made ditch which connects to the reclaimed lake on the site and runs along the western side of Fort Green Road. This ditch crosses Fort Green Road in an easterly direction at a point approximately 1.5 miles south of the Polk Power Station site and eventually discharges into a remnant portion of Little Payne Creek. The headwaters and only remaining relatively undisturbed portion of Payne Creek are located 1 mile south of the property boundary on the western side of SR 37. Culverts direct the water under SR 37 into a canal which proceeds south and then east. The unnamed tributary to the South Prong Alafia River is located in the northwestern corner of the western tract. This tributary is relatively undisturbed and consists of a small, incised creekbed within a narrow, floodplain forest. Figure 2.3.6-1 presents the locations of the aquatic sampling stations on and off the property where fisheries and macroinvertebrate sampling was conducted for this study. The following sections describe the results of these sampling efforts.

Fisheries

Table 2.3.6-1 provides the results of the wet and dry season sampling for fisheries within the seven aquatic ecology sampling stations. Overall, fisheries sampling during the dry season event (April 1991) yielded greater numbers of individuals and greater species diversity. The stagnant station (AE-1) sampled during the dry season was the

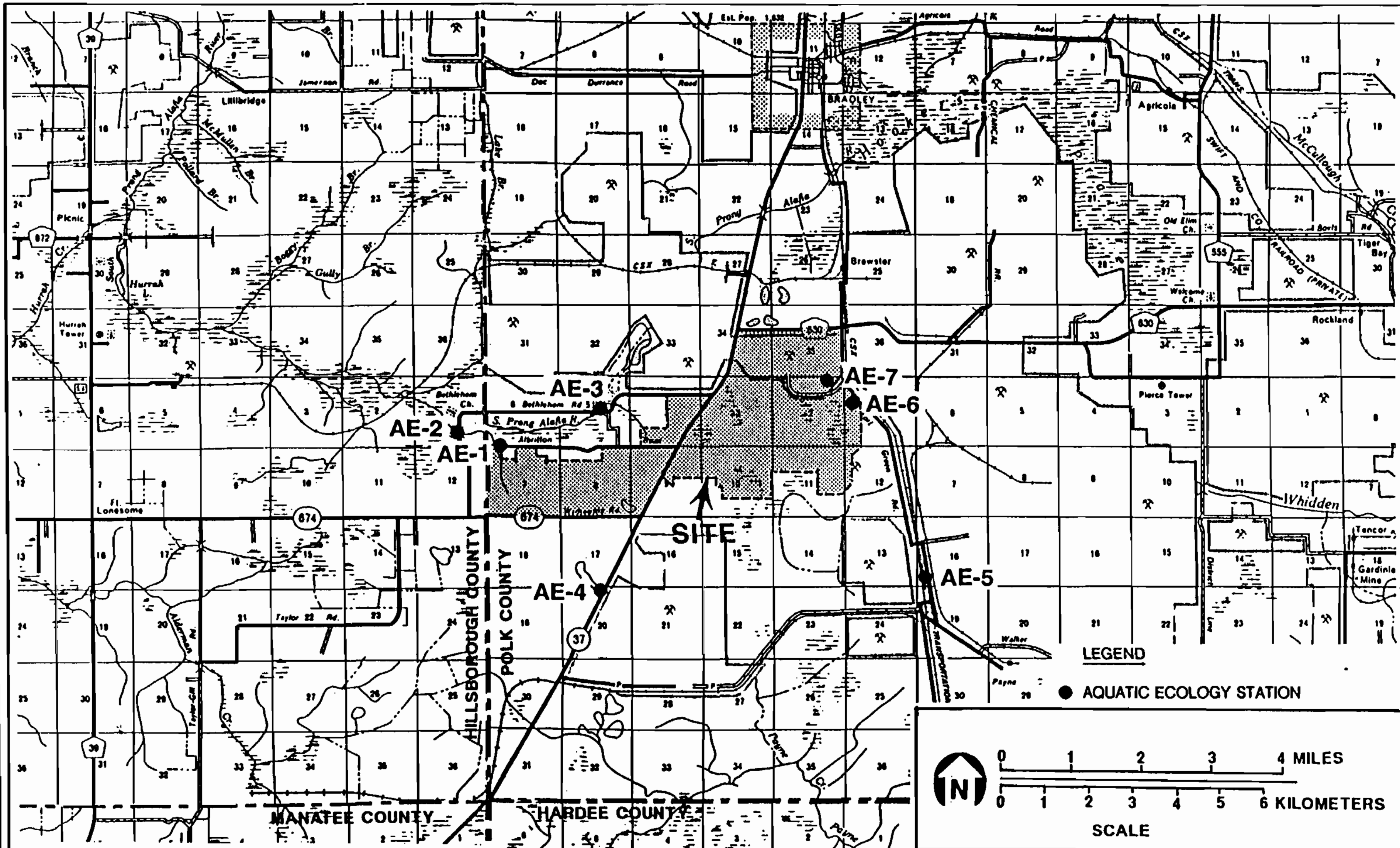

FIGURE 2.3.6-1.

AQUATIC ECOLOGY MONITORING STATIONS

Source: FDOT Map, FL; ECT, 1992.

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Table 2.3.6-1. Number of Taxa of Fish Collected from the Tampa Electric Company Polk Power Station Site, April and August 1991

Family	Common Name	Scientific Name	Sampling Stations						
			AE-1	AE-2	AE-3	AE-4	AE-5	AE-6	AE-7
April 1991									
Cyprinidae	Golden Shiner	Notemigonus crysoleucas	1						
Cyprinodontidae	Seminole killifish	Fundulus seminolis		3	6	18			17
	Bluefin killifish	Lucania goodei			4			1	
	Least killifish	Heterandria formosa						2	
Poeciliidae	Mosquitofish	Gambusia affinis		6		58	5	107	49
	Sailfin molly	Poecilia latipinna							12
Atherinidae	Brook silverside	Labidesthes sicculus		6	5			17	
Centrarchidae	Bluegill	Lepomis macrochirus		3		3	5	37	1
	Banded pygmy sunfish	Elassoma zonatum				18			
	Largemouth bass	Micropterus salmoides						40	
	Redear sunfish	Lepomis microlophus						1	
August 1991									
Lepisosteidae	Florida spotted gar	Lepisosteus platyrhincus		1		*			
Clupeidae	Threadfin shad	Dorsoma petenense							7
Cyprinidae	Taillight shiner	Notropis maculatus			8				
Cyprinodontidae	Seminole killifish	Fundulus seminolis		1					
Poeciliidae	Mosquitofish	Gambusia affinis	4			5		11	12
Centrarchidae	Bluegill	Lepomis macrochirus			2		3	1	1
	Largemouth bass	Micropterus salmoides					1	4	

*Numerous individuals observed, none actually caught.

Source: ECT, 1992.

exception. Since the sampling methodology remained consistent for both dry and wet season events, the difference in numbers of taxa and species diversity can be mostly attributed to seasonal migration except perhaps at Stations AE-6 and AE-7 which correspond to a reclaimed and an old mine-cut lake, respectively. In the deeper stream stations (AE-2 and AE-3), fish more than likely moved further upstream in the wet season.

In the reclaimed lake station (AE-6), the numerous largemouth bass caught in the spring were quite young. It is likely that many of these fish were occupying deeper habitats offshore as they matured (i.e., they were less common in the lake-edge habitat sampled in August 1991).

There were occasions when some fish species were observed, but none were actually caught during the sampling events. During the dry season event, numerous fish in the family Cichlidae were observed in the stream channel at Station AE-5. These fish were believed to be Mozambique Tilapia, also known as Nile perch (Tilapia mossambica), but could not be positively identified without closer examination. Similarly, numerous Florida spotted gar were identified near the sampling station at Station AE-4. Due to restrictive site conditions (steep banks, deep pools, snags, and abundant vegetation), no Florida spotted gars were captured during sampling. Although not collected, no specimens were needed of this distinctive fish for a positive species identification.

The results of the fisheries sampling showed Station AE-1 to have the lowest number of individuals and species diversity. This is not surprising since Station AE-1 is an intermittent stream with very reduced accessibility to fish. Mosquitofish comprised the sole species captured at AE-1 during April 1991. Mosquitofish are a highly invasive and adaptive species which give birth to their young live thereby reducing mortality associated with limited oxygen and water availability to eggs.

The results from Stations AE-2 and AE-3 were similar to one another; both stations yielded five different species and the number of individuals were similar. Although more opportunistic species (i.e., mosquitofish) were more evident of Station AE-2, differences between the two stations were insignificant.

Station AE-4 yielded five different species. Although species diversity did not appear very high, the representation by different families was high relative to other stations sampled. Station AE-4 is a popular fishing spot, by both humans and small alligators. The presence of both sometimes interfered with sampling.

Station AE-5 is essentially a ditch, with rock forming the substrate under a railroad crossing. Water flow at Station AE-5 was normally brisk. High flow and the abundance of floating/submerged vegetation tended to allow the easy escape of Nile perch during sampling.

Stations AE-6 and AE-7 were rather dissimilar in appearance and fisheries. The reclaimed lake (Station AE-6) has a gradually sloping shoreline and native aquatic vegetation. Station AE-6 had the largest population density of all the stations sampled and the highest species diversity. The old mine-cut (Station AE-7) has sheer limerock walls which rapidly drop to an unknown depth. Vegetation at Station AE-7 was dominated by both nuisance and exotic species. Fish obtained in sampling probably represented only those species occupying the narrowly, vegetated edge of the lake. These fish were dominated by opportunistic species and baitfish (i.e., threadfin shad). The larger fish and the predatory species were difficult to capture, as they could quickly dive and seek refuge in the numerous limestone crevices.

Benthic Macroinvertebrates

Benthic macroinvertebrate samples were collected with artificial substrates (Hester-Dendy samples) and a ponar grab. Hester-Dendy samples specifically collected epifauna, i.e., the organisms that live *on* the substrate. Ponar grabs collected not only the epifauna living on the surface of the sediment, but also those organisms that live *in* the sediment, i.e., infauna. Both methods were used at all seven stations. During the Polk Power Station study, 198 taxa were identified. A total of 132 taxa was identified from artificial substrate samples and 137 taxa were identified from the Ponar grab samples (Appendix 11.9, Table 1). Individual species collected in each sample and their counts are shown in Appendix 11.9, Tables 2 through 29.

Different species groups dominated the two sample types. The artificial substrate samples collected mostly insects (81 percent composition), while the Ponar grab collected mostly (53 percent) annelids (segmented worms). However, insects were still abundant (39 percent) within the sediment samples (Table 2.3.6-2). Insects were overwhelmingly dominated by the family Chironomidae, the nonbiting midge flies. The annelids were primarily tubificid worms, although leeches were abundant at one station (AE-5). The species on the artificial substrate samplers were those that are typically found on vegetation, sticks, and other woody substrates. The species in Ponar grab samples were those that live on or burrow into the substrate (infauna). Less mobile organisms are generally collected by the Ponar grab. At stations where a layer of sticks and detritus cover the substrate, many species that are typically found on artificial substrates (epifauna) will also be collected by the Ponar grab.

The taxonomic composition, density, and diversity of macroinvertebrate populations in the present study were similar to those from Payne Creek reported in the SCA for the Hardee Power Station (TECO Power Services, Tampa Electric Company, Seminole Electric Cooperative, Inc., 1990). Densities and diversities of macroinvertebrates in the reclaimed streams of the South Prong Alafia River from the Brewster Phosphate monitoring study were much lower than those collected in the present study at stations in the South Prong Alafia River and tributary stream (Aurora, Inc., 1988 and 1989). The same invertebrates collected from Horse Creek and several associated sloughs in DeSoto County in a continuing monitoring study of the Consolidated Minerals, Inc., property were also collected in the present study (ECT unpublished, 1991).

Table 2.3.6-2. Percent Composition of the Macroinvertebrate Populations Collected from the Tampa Electric Company Polk Power Station Site, March and August 1991

Stations	Annelida		Crustacea		Chironomid		Other Insects		Mollusca	
	M	A	M	A	M	A	M	A	M	A
Artificial Substrates										
AE-1	0	1	22	15	51	65	8	10	19	8
AE-2	2	0	1	<1	90	81	7	17	<1	2
AE-3	<1	2	<1	2	91	77	8	19	<1	<1
AE-4*	0	19	13	9	66	63	31	9	0	0
AE-5	17	<1	48	<1	26	96	9	3	0	0
AE-6	5	82	9	<1	87	13	5	2	2	17
AE-7	1	<1	4	0	95	100	<1	0	0	0
Mean†	9		9		72		9		3	
Ponar Samples										
AE-1	14	27	4	1	72	94	7	3	2	28
AE-2	3	84	1	16	94	9	1	0	1	9
AE-3	40	32	1	2	48	19	3	7	8	38
AE-4	57	89	10	0	33	11	0	0	0	0
AE-5	44	47	14	1	32	50	<1	<1	2	7
AE-6	86	81	5	1	5	11	3	2	0	4
AE-7	31	90	15	<1	54	10	0	<1	0	0
Mean†	53		5		39		2		7	

Note: M = March 1991.
A = August 1991.

* Data from the artificial substrates at Station AE-4 were obtained from Hester-Dendy samplers collected in October 1991 rather than in August 1991 due to vandalism.

† Mean of all stations from both sampling episodes.

Source: ECT, 1992.

Densities--Densities of macroinvertebrates collected by station, sample type, and sampling episode are shown in Figure 2.3.6-2. Average density collected over the course of the study is shown in Table 2.3.6-3 by station and sample type. Densities of epifaunal invertebrates ranged from a low of 59 organisms per square meter (organisms/m^2) at Station AE-4 in March 1991 to a high of 85,482 organisms/m^2 at Station AE-5 in August 1991 (Figure 2.3.6-2 and Appendix 11.9, Tables 2 through 29). These highest and lowest densities were both collected on artificial substrate samplers.

Epifaunal Densities On Artificial Substrate Samples--Greatest invertebrate densities during the study were found on artificial substrate samplers at Station AE-5 and averaged 56,506 organisms/m^2 (Figure 2.3.6-2 and Table 2.3.6-3). The invertebrate densities at this station are indicative of an enriched water body although flow at this station was high, in-stream vegetation abundant, and DO not depleted. DO is often low in areas experiencing such enrichment. DO is often a limiting factor, depending on the species present. Many invertebrate species cannot tolerate conditions when DO falls below a critical concentration. Since the samplers at Station AE-5 were suspended in the water column where DO was great, the populations were able to proliferate because of the high quantities of food available.

Epifaunal densities were high at Stations AE-6 and AE-7, averaging 20,412 and 30,064 organisms/m^2, respectively. These stations are located in old mine cuts, and the high densities reflect the enriched conditions in these lakes.

Lowest densities of epifauna occurred at Station AE-4, where an average of 70 organisms/m^2 was collected during the year of study. This station, located on SR 37, is in the remnant headwaters of Payne Creek. This station is an extremely popular fishing spot, and the samplers were frequently disturbed during their incubation period with samplers vandalized in August, redeployed, and vandalized again in September. Another group of samplers redeployed in September were finally collected in an undisturbed condition in late October. Repeated disturbance

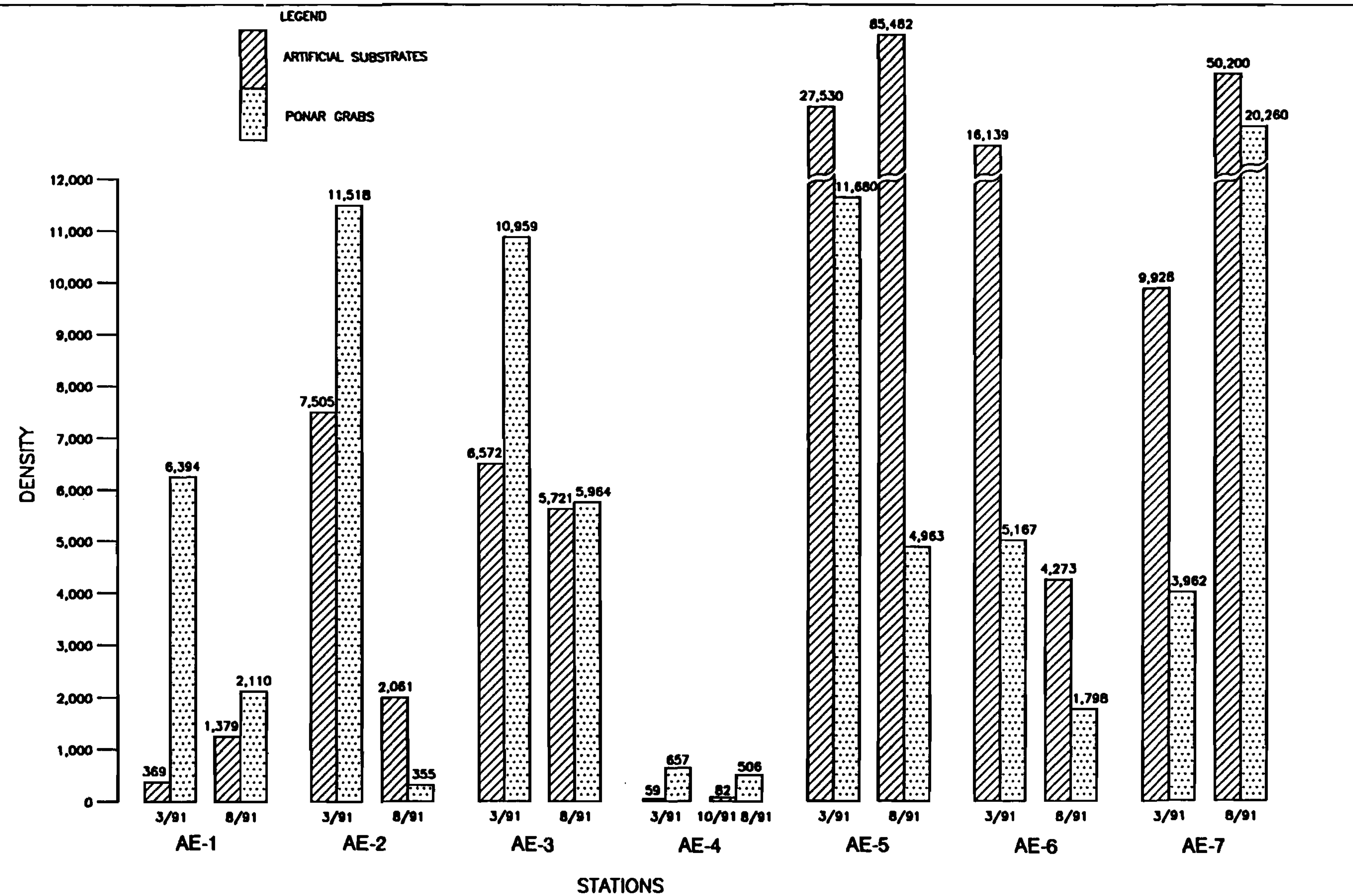

FIGURE 2.3.6-2.

MACROINVERTEBRATE DENSITY (NO./m^2) FROM ARTIFICIAL SUBSTRATE AND PONAR GRAB SAMPLES, COLLECTED FROM THE SEVEN AQUATIC SAMPLING STATIONS (MARCH, AUGUST 1991)

Source: ECT, 1992.

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Table 2.3.6-3. Mean Density, Diversity, and Number of Macroinvertebrate Taxa Collected from the Tampa Electric Company Polk Power Station Site, March and August 1991

	Artificial Substrates			Ponar Grab		
Station	Mean Density*	Number of Taxa	Diversity (d)	Mean Density*	Number of Taxa	Diversity (d)
AE-1	874	34	3.74	4,252	40	4.12
AE-2	4,783	40	3.48	5,936	22	2.47
AE-3	3,189	44	3.65	8,462	34	3.29
AE-4	70	10	2.63	582	10	2.69
AE-5	56,506	19	1.94	8,322	24	3.14
AE-6	20,412	24	1.77	3,482	18	2.09
AE-7	30,064	12	0.92	12,111	18	2.48

Note: (d) = Shannon-Weaver diversity index.

*Mean number of organisms per square meter.

Source: ECT, 1992.

of this location by fishermen, etc., may partially account for the low densities. Other reasons for the low densities at this site are related to stream order, low DO, and low flow. Headwater streams often have a depauperate macroinvertebrate fauna partially due to limited recruitment potential from upstream areas. Station AE-4 was enriched, as evidenced by the deep layers of anaerobic muck in the substrate. Because of negligible flow, enrichment, and lentic (ponded) conditions, DO levels may have been too low to support stable macroinvertebrate populations.

Epifaunal densities at Station AE-1 also were relatively low, although not nearly as low as at Station AE-4. An average of 874 organisms/m^2 were collected at Station AE-1 during the year of study (Table 2.3.6-3). This station was located in the upper reaches of a tributary stream to the South Prong Alafia River. This stream was intermittent and during the March collecting period, a large part of it was pooled. The low densities at Station AE-1 are a reflection of the pooled conditions, small size, and limited recruitment potential of this portion of the stream.

Stations AE-2 and AE-3 had moderate densities of epifauna that averaged 8,765 and 3,189 organisms/m^2, respectively. The moderate densities are a reflection of the fair water quality in the streams. The environmental conditions and habitat at Stations AE-2 and AE-3 were suitable for supporting stable macroinvertebrate populations.

Densities On Ponar Grab Samples--Macroinvertebrate densities were lower in Ponar samples than in artificial substrate samples. Similar to artificial substrate samples, lowest infaunal and epifaunal densities were collected at Station AE-4 and averaged 582 organisms/m^2. Highest densities were collected at Station AE-7 and averaged 12,111 organisms/m^2. In Ponar samples, densities at enriched Stations AE-5 and AE-6 were similar to those stations not suffering from high enrichment (Stations AE-1, AE-2, and AE-3).

Seasonal Fluctuations--Invertebrate densities in Ponar samples decreased in August, except at Station AE-7 where densities increased to five times the March concentrations (Figure 2.3.6-2). In general, no seasonal trend was apparent for densities on artificial substrate samples. A considerable decrease in densities occurred at Station AE-2 in August in both ponar and Hester-Dendy samples. This decrease could be attributable to water quality degradation associated with surface water runoff between sampling events just upstream of the station or elevated water temperatures and subsequent decreases in DO concentration. However, the exact cause of this decrease in macroinvertebrate population parameters is unknown at the time of this report preparation.

At most stations, fewer taxa were collected in August compared to March (Figure 2.3.6-3). This decrease was generally slight except for Station AE-2, where a large drop in the number of taxa and the species diversity index occurred. This was especially evident in Ponar samples. At other stations the diversity index did not show any clear seasonal trends.

Taxonomic Compositions--Percent composition of major macroinvertebrate groups is listed in Table 2.3.6-2 by station, sample type and sampling episode.

Taxonomic Composition on Hester-Dendy Samples--The Hester-Dendy artificial substrate suspended in the water column provides excellent habitat for chironomids. Most chironomids feed on algae, periphyton, or detritus that is scraped from the substrate or filtered from the water (Oliver, 1971). Periphyton grows well on the samplers and provides a ready food source for scrapers. Other species that construct tubes to catch detritus and microorganisms find that these samplers provide a stable substrate for attachment. At clean water stations, these samplers usually collect many different species; whereas, at stations having high organic enrichment, these samplers may contain very high densities of a few tolerant or opportunistic species.

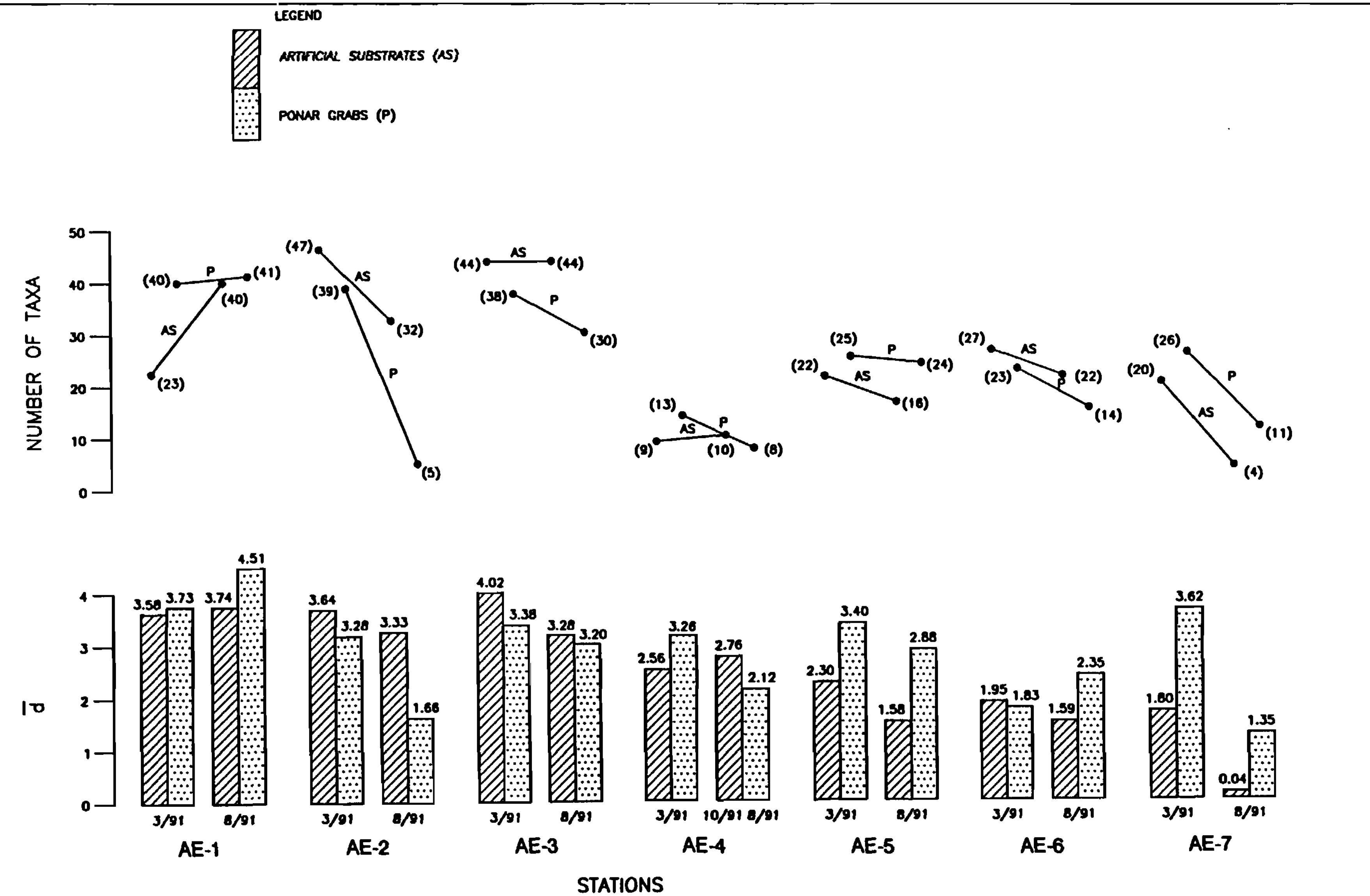

FIGURE 2.3.6-3.

MACROINVERTEBRATE DIVERSITY ($\bar{d}$) AND TOTAL NUMBER OF TAXA FROM ARTIFICIAL SUBSTRATE AND PONAR GRAB SAMPLES, COLLECTED FROM THE SEVEN AQUATIC SAMPLING STATIONS (MARCH, AUGUST 1991)
Source: ECT, 1992.

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Diptera (true flies) comprised 72 percent of the epifauna. These Diptera were primarily one family, the Chironomidae. Sixty-eight chironomid taxa were collected on artificial substrates. Dominant species fluctuated by station and sampling period and included the following taxa: Tanytarsus spp., Polypedilum spp., Glyptotendipes lobiferous, Cladotanytarsus spp., Goeldichironomus spp., Corynoneura sp., Thienemanniella spp., Rheotanytarsus exiguus, Paratanytarsus sp., and Rheocricotopus robacki (Appendix 11.9, Tables 2-8 and Tables 16-22). The dominant taxa listed above have different environmental requirements. Some taxa are tolerant of high organics and associated low DO regimes, other taxa can tolerate only moderate organic enrichment when oxygen levels do not fall below 5.0 mg/L, while still other taxa are characteristic of clean-water streams (Beck, 1977; Simpson and Bode, 1980; Roback, 1974; and Rudolph and Strom, 1990).

The environmental requirements of the dominant species reflected the prevailing environmental conditions of the stations at which they were found to dominate. Dominant chironomids at Stations AE-1, AE-2, and AE-3 included Tanytarsus spp., Paratanytarsus sp., Rheotanytarsus exiguus, Cladotanytarsus spp., Thienemanniella spp., Rheocricotopus robacki, and Cricotopus bicinctus. Most of these midges are considered to be characteristic of clean water habitats; however, they are capable of tolerating moderate amounts of organic enrichment if oxygen concentrations remain above 5.0 mg/L, and pH and water temperature are not adversely altered. Corynoneura spp., also occurring in high densities at these stations, is considered sensitive to organic pollution. These chironomid species are generally restricted to areas of moderate to high flow.

One chironomid species, Glyptotendipes lobiferous, dominated the epifauna at the enriched stations (AE-4 through AE-7). This species is well-known to tolerate high organic enrichment. It was abundant at Station AE-7 comprising 95 percent of the epifauna (Appendix 11.9, Tables 8 and 15). Beck (1977) reported that this species prefers standing water and is common in both polluted and clean water. Simpson and Bode (1980) found that this species became dominant in areas polluted by sewage. Other common species at these stations were Goeldichironomus spp., Dicrotendipes spp., and Endochironomus group. These midges often occur in high densities in areas of low flow and high organic enrichment. Stations AE-4, AE-6, and AE-7 had virtually no flow; whereas, Station AE-5 had considerable flow.

Annelids, crustaceans, and insects other than chironomids each comprised 9 percent of the fauna on artificial substrates (Table 2.3.6-2). The majority of annelids on the artificial substrate samplers were either naidid worms or the leech, Helobdela stagnalis. Most naidid worms were species of Dero and Pristina. Annelids were collected from the more enriched stations (Stations AE-4 through AE-6). Although Station AE-7 was also highly enriched, comparatively few annelids were collected here. Leeches occurred in extremely high densities at Station AE-5 in March.

A species of crustacean, Hyalella azteca, was common throughout the study area. This species was collected in extremely high densities (more than 13,000 organisms/m^2) in epifauna at Station AE-5 in March 1991. Such high densities of this organism reflect enriched conditions where dissolved oxygen was not severely reduced. Crustaceans were also an important component of the fauna on artificial substrates at Station AE-1. The important crustacean at Station AE-1 was Lirceus sp., but this taxa did not occur in extremely high densities.

Other insects commonly collected on artificial substrates included Stenelmis sp., Cheumatopsyche sp., Caenis diminuta, Baetis spp., and Corydalus corneutus. In general, other insects were more common at less enriched sites (Stations AE-1, AE-2, and AE-3) and their presence indicated the station had better environmental conditions than sites where few or no other insect taxa were present. The high percent composition of other insects at Station AE-4 in March 1991 resulted when several beetles and a true bug (order Hemiptera) was collected in conjunction with low total densities. Adult beetles and true bugs are highly mobile and can breath atmospheric oxygen; therefore, the presence of these species is not indicative of good environmental conditions at this site.

Taxonomic Composition on Ponar Grab Samples--Annelidas were the dominant benthic organisms (53 percent) collected by the Ponar grab (Table 2.3.6-2). Most of these annelids were tubificid worms; only five taxa were collected. The dominant taxon was immature tubificids without capiliform setae. These were most likely all Limnodrilus hoffmeisteri. These tubificids are well-known for their ability to tolerate low DO conditions typically found associated with organic pollution (Brinkhurst and Cook, 1974).

Dipteran families, Chironomidae, Ceratopogonidae, Chaoboridae, Empididae, Psychodidae, and Simuliidae comprised 39 percent of the infauna and were represented by 63 taxa. Fifty-six of these taxa were chironomids. Species collected by the Ponar grab were generally more tolerant of high organics and the associated low DO levels than those collected on artificial substrate samplers.

Mollusks and insects other than Dipterans were rarely collected in Ponar samples comprising only 7 and 2 percent of the infauna, respectively. These groups were generally present only in samples from Stations AE-1, AE-2, and AE-3 where environmental conditions were better. The dominant mollusk species was the Asiatic clam, Corbicula fluminea. This clam is an introduced species which often becomes a biotic and economic problem. This species frequently occurs in extremely high densities out-competing the native fauna; it is also a well-known biofouling organism. Corbicula was very abundant only at Station AE-3, occurring in all samples collected at that station. Elliptio buckleyi, a freshwater mussel, was also collected in Ponar grab samples from Station AE-3. These mussels do not live in severely stressed systems and their presence indicate conditions may be enriched but not grossly polluted (Fuller, 1974). High densities of the fingernail clam, Sphaerium spp., were also collected in August 1991 from Station AE-1.

Crustaceans were collected throughout the stations but in low numbers. Except for Stations AE-1, AE-2, and AE-3, crustaceans were only represented by the tolerant Hyalella azteca.

Diversity--The Shannon Weaver diversity index (d) and number of taxa are shown by station, sample type, and sample episode in Figure 2.3.6-3. Diversity ranged from a low of 0.04 in samples collected by artificial substrates at Station AE-7 in August to a high of 4.51 in samples collected by the Ponar grab at Station AE-1 in August.

Diversity is influenced both by the number of taxa collected and the distribution of organisms among the taxa. The fewest number of taxa (4) were collected on artificial substrates at Station AE-7 in August. The greatest number of taxa (47) were found on artificial substrates from Station AE-2 in March. Diversity and number of taxa were generally lower at Stations AE-4, AE-5, AE-6, and AE-7 than at Stations AE-1, AE-2, and AE-3 in both infaunal and epifaunal samples. An exception occurred in Ponar samples at Station AE-2 in August, where only 5 taxa were collected and diversity was 1.66. Another exception occurred at Station AE-5 where ponar samples had high diversities averaging 3.14 during the study. Conditions were enriched at Station AE-5 as indicated by many population parameters already discussed; however, optimum habitat was created by the high flow conditions and abundant vegetation. This resulted in high diversities within the infauna.

Table 2.3.6-3 lists the average of all diversity values and number of taxa by station and sample type. During the study, the lowest mean diversities were found on artificial substrate samples at Stations AE-5, AE-6, and AE-7 and averaged 1.94, 1.77, and 0.92, respectively. Fewest taxa were collected at Station AE-4, where an average of 10 taxa per sample was found.

Wilhm and Dorris (1968) proposed a relationship between diversity and the pollutional status of the sampling stations. They rate stations with diversity values above 3 as having clean water, values from 1 to 3 as moderately polluted, and values less than 1 as heavily polluted. These guidelines were based on data from a variety of clean-water and polluted streams. Based on these guidelines, Stations AE-1, AE-2, and AE-3 would be considered to generally have better water quality than Stations

AE-4 through AE-7. This is further supported by Tampa Electric Company's water quality data in Section 2.3.4.1.

Stations segregate into three distinct groups based on the total number of taxa collected at each station by all sampling methods and during all sampling episodes (Appendix 11.9, Table 1). Only 27 taxa were collected at Station AE-4 during the study. Fifty to 55 taxa were taken from Stations AE-5, AE-6, and AE-7; whereas, 85 to 90 taxa were collected at Stations AE-1, AE-2, and AE-3. Upon evaluating total taxa alone, the following assessment can be made: (1) Station AE-4 is undergoing most stress and is least stable; (2) Stations AE-5, AE-6, and AE-7 are moderately stressed through enrichment; and (3) Stations AE-1, AE-2, and AE-3 are generally less polluted with respect to nutrients.

Terrestrial Systems--Flora

The majority of the 4,348-acre Tampa Electric Company Polk Power Station has been or will be disturbed by phosphate mining activities and only relatively small, remnant areas of undisturbed, native vegetation exist on the site. Vegetation within the site has been separated into 14 major groupings based upon the FLUCCS. Table 2.3.6-4 provides the FLUCCS Level III legend, acreages and percentages for the land use and cover map of the site (Figure 2.3.5-2). A plant species inventory of the site by plant community type is presented in Appendix 11.10.2. Taxonomic identification of plant species follows that of Wunderlin (1982).

The following descriptions of plant community types are based upon qualitative and quantitative vegetation field surveys conducted from March to December 1991 and January to March in 1992. A discussion of potential impacts to these habitat types resulting from power plant development is provided in Section 4.4.

The developed uses on the property are not included in the following vegetative descriptions (i.e., FLUCCS Codes 131, 148, and 152). However, improved pasture

Table 2.3.6-4. Current Acreages and Percentages of Land Use/Cover on the Tampa Electric Company Polk Power Station Site*

Land Use/ Cover Code	Type	Acres	Percentage
131	Light Industrial	3	0.1
148	Gas Transmission Pipeline	13	0.3
152	Electrical Transmission Line	27	0.6
213	Improved Pasture	453	10.4
231	Orange Grove	17	0.4
321	Palmetto Rangeland	5	0.1
323	Shrub and Brushland	18	0.4
411	Pine Flatwoods	118	2.7
422	Oak Hammock	78	1.8
431	Mixed Oak/Pine Woods	530	12.2
513	Canals and Ditches	1	0.1
563	Ponds and Lakes	200	4.6
621	Freshwater Swamp	66	1.5
641	Freshwater Marsh	101	2.3
741	Scraped Over Areas	472	10.9
743	Spoil Banks	60	1.4
751	Phosphate Mined Land	2,186	50.2
	Total	**4,348**	**100**

*Current acreages as of December 19, 1991. It should also be noted that 94.6 percent of the entire site has been previously or will be mined or disturbed through mining operations. Current acreages reflect unmined areas and mined areas that are still disturbed and unreclaimed, but have revegetated since mining. Therefore, for this table, Category 751 includes only those areas currently disturbed and not revegetated.

Source: ECT, 1992.

is the dominant vegetative cover represented underneath the electrical transmission line (152) and over the gas transmission line (148) on the site.

Improved Pasture--213

Approximately 453 acres (or 10.4 percent) of the site is pasture. Improved pasture/old fields are located in scattered localities on the site, but these grasslands mostly occur along the edges of property boundaries. Improved pasture located on the site consists of mostly native pine flatwoods that was cleared in the past of all the vegetative strata and seeded with forage grasses (bahia grass) and legumes (tick trefoil, hairy indigo) for cattle production. The pastureland still remaining on the site can be characterized as remnant, old field, or reclaimed. Remnant pasture consists of pastureland that has remained in continuous use for cattle. Old field consists of abandoned pastureland that has: (1) increased in species diversity by the invasion of weedy vegetation, and (2) become overgrown with the lack of maintenance by cattle grazing. Reclaimed pasture consists of recently reclaimed land that has been seeded with forage grasses and legumes for cattle. Reclaimed pasture only occurs at the northeastern corner of the property on the eastern tract. Pasture occupies a variety of poorly drained to somewhat poorly drained soils on the property. Generally, these soils have a seasonal high water table within 1 ft of the ground surface for 1 to 4 months out of the year. Organic content is typically 1 to 5 percent.

Orange Grove--231

One citrus grove on approximately 17 acres (0.4 percent) is present on the northwestern corner of the western tract of the site. This citrus grove is planted with Valencia orange trees. Common weedy opportunistic plant species associated with the grove on the property include soda apple, Caesar's weed, smutgrass, sida, pokeweed, and painted leaf. The orange grove on the site is on Tavares fine sand. Typically, this soil type occurs in uplands and knolls within flatwoods. The seasonal high water table is at a depth of 40 to 80 inches beneath the ground surface for several months in most normal rainfall years. Organic content is low, from 0.5 to 2 percent.

Palmetto Rangeland--321

Approximately 5 acres (0.1 percent) of palmetto rangeland or prairie occurs at two separate locations as narrow strips of land along property boundaries in the western tract of the site. Palmetto rangeland was pine flatwoods before the land was logged and cattle were presumably introduced. Palmetto rangeland is remnant on the site and is not currently being utilized for cattle production. Palmetto rangeland can be characterized as an open prairie dominated by a dense shrub layer of saw palmetto. Although rangeland has no true tree stratum, a few remnant pines and oaks are scattered throughout the association. Scattered woody shrub associates of the rangeland on the site include gallberry, wax myrtle, fetterbush, and dwarf huckleberry. Due to the dense growth of the shrubby layer, few herb species are present within rangeland on the property. Palmetto rangeland occupies the same poorly drained soils as described for pine flatwoods.

Shrub and Brushland--323

Almost 18 acres (0.4 percent) of the property contains shrub and brushland. This plant association can be characterized as highly disturbed areas dominated by weedy shrub and herb species. Typically, shrub and brushland results after opportunistic plants invade and proliferate on areas disturbed through earth moving activities. Common species associated with shrub and brushland on the property include groundsel bush, low senna, shrub verbena, wax myrtle, and shiny sumac. Shrub and brushland typically occurs on soils resulting from mining or other man-induced activities.

Pine Flatwoods--411

Approximately 118 acres (2.7 percent) of the property contains pine flatwoods. Pine flatwoods are distributed along the northern property boundary, as a large area between Bethlehem Road and Albritton Road on the western tract, and as a small isolated area at the southeastern corner of the eastern tract. Pine flatwoods are open to dense woods dominated by an overstory of pines. Longleaf pine occurs on the drier sites; slash pine is frequently found along wetter areas. Portions of the flatwoods located on the western tract also contain planted slash pines. Shrub layers are dominated by saw palmetto and other associated woody vegetation (e.g., gallberry, wax myrtle, dwarf huckleberry, and fetterbush). Pine flatwoods is a sub-climax community that is maintained in an open woodland state through the periodic occurrence of ground fires. In the absence of fire, woody taxa form a sub-canopy layer. The two stands of longleaf pine-dominated woods located on the northwestern corner of the western tract and the southeastern corner of the eastern tract are good examples of flatwoods with established hardwoods in the understory due to fire suppression. Pine flatwoods occupy poorly drained soils such as Smyrna and Myakka fine sands and Ona fine sand on the property. The soils exhibit a seasonal high water table within 12 inches of the surface for 1 to 4 months in most normal rainfall years.

Oak Hammock--422

Less than 2 percent (78 acres) of the site supports stands of upland hardwoods or oak hammock. From an ecological perspective, the term *hammock* refers to any broad-leaved evergreen forest characterized by a closed canopy of hardwoods and/or palms. The hammocks on the property are dominated by a canopy of live oaks. Other arboreal associates of the oak hammock include laurel oak, water oak, cabbage palm, persimmon, and black cherry. Oak hammocks occur on somewhat poorly drained, sandy soils with thin (less than 3 percent) organic layers. Due to the closed canopy, the oak hammocks on the property have a cool, moist interior that supports mesic species. In climax or near climax hammocks, the canopy cover of mature oaks intercepts light and limits development of vegetation in the shrub and herbaceous layers. Hammocks on the site contained occasional saw palmetto, beautyberry, wax myrtle, and oak seedlings in the open shrub stratum; the sparsely-vegetated ground layer support such shade tolerant herb taxa as dichanthelium grass, chickweed, elephant's foot, Florida parietaria, and broomweed.

Mixed Oak/Pine Woods--431

Mixed oak/pine woods is the dominant, plant community on the Polk Power Station site, occupying 530 acres (12.2 percent). Mixed oak/pine forest results when oaks become co-dominant with pines either through the absence of fire or logging operations followed by fire suppression. Except for the mixture of pines and oaks in the canopy, the species composition and structure of understory layers are similar to pine flatwoods and palmetto rangeland. The majority of the relatively disturbed but unmined habitat located within the area of power plant facility development consists of mixed oak/pine forest. The mixed oak/pine woods on the site occupy the same soils as described for pine flatwoods.

For comparative purposes, oak/pine forest was sampled at two separate locations (southwestern and northeastern) within the unmined portions of the site's eastern tract. The shrub layers of the two stands were floristically similar (Appendix 11.10.2, Tables 2 and 3). Both areas exhibited open understory layers. In the southwestern area, the understory was dominated by water oak seedlings, saw palmetto, gallberry, wax myrtle, live oak seedlings, slash pine seedlings, dahoon holly seedlings, swamp redbay seedlings, staggerbush, and paw paw. The northeastern area had a similar shrub stratum of saw palmetto, laurel oak seedlings, wax myrtle, live oak seedlings gallberry, Southern fox grape, shiny sumac, dahoon holly, and highbush blueberry.

The canopy strata were also similar in species composition. Water oak and live oak dominated the northeastern area; while live oak and laurel oak were more prominent in the southeastern site. Slash pine and wax myrtle followed in order of importance within both stands (see Section 2.3.6.3 for a description of species importance within a community).

The herbaceous complement of both stands was the most diverse and the most variable between sample sites and seasons (Appendix 11.10.2, Tables 4 and 5). Over the years, both areas (southwestern and northeastern) exhibited a prominent open, unvegetated ground layer of leaf litter and bare ground. The most important species of the ground stratum within the southwestern and northeastern sites in spring were Virginia chain fern and Southern fox grape, respectively. Both stands also shared 13 species within the herb stratum in the spring. In the southwestern site from spring to fall, species composition decreased from 21 to 17 species; only nine species were common to both survey episodes. In the northeastern stand, changes in ground layer species composition also occurred between sampling events. Out of the 22 species present in the spring, 14 species still remained in the fall. The referenced changes in seasonal species composition within the ground stratum of the two oak/pine stands are probably due to the following factors: (1) dieback of spring annuals followed by the emergence of fall flowering species, (2) disturbances between the two sampling periods within the sample sites due to vehicles/machinery, and (3) variance in species' occurrences based upon potential quadrant relocations (i.e., many of the flagged plots were disturbed beyond recognition presumably either by man or animals).

Canals and Ditches/Ponds and Lakes--513/563

About 1 acre (0.02 percent) of ditches/canals were of a sufficient size on the property to map. The ditches and canals on the site can be characterized as sparsely vegetated, deeply incised permanent to semi-permanent water channels.

Approximately 200 acres (or 4.6 percent) of old ponds/lakes resulting from either drainage or mine-related activities occur at scattered locations on the site. The smaller man-made ponds are seasonally inundated and typically support a proliferation of aquatic emergent macrophytes. Two prominent, large lakes located at the east side of the eastern tract are permanent surface water features that were created as a result of phosphate mining. The northern lake in this area is a 30-year-old mine cut with unstable, eroding steep banks and was never reclaimed. The southern lake has been recently reclaimed and supports shallow slopes partially planted with native hydrophytes such as pickerelweed, arrowhead, and bulrush.

An intermittent stream, which is an unnamed tributary to the South Prong Alafia River occurs on the site at the northwestern corner of the western tract. This surface water feature was not mapped as a stream because it is obscured by floodplain forest. It is, however, included within the FLUCCS designation of freshwater swamp (621).

Freshwater Swamp--621

The swamp community is situated on 66 acres (1.5 percent) of the Tampa Electric Company Polk Power Station site. Freshwater swamps are remnant forested wetland associations that occur as small connected or hydrologically-isolated lowlands throughout the property. Arboreal overstory and understory water-tolerant hardwood components of the swamps on the site include either single species dominant or mixed assemblages of red maple, black gum, swamp redbay, loblolly bay, willow and sweet bay. Hardwood swamps typically are found on deep organic layers and may have standing water for long periods. Included in the swamp category are shrub swamps. Shrub swamps are seral stages leading in transition to mature tree swamps. Willow, elderberry and primrose willow form monotypic or codominant stands of shrub swamp on the property. In general, swamps on the site occur on poorly drained Placid and Myakka fine sand, depressional soils. These soil types are ponded for at least 6 months out of the year. Placid soils have an organic matter content of 2 to 10 percent, while the Myakka portion has a content of 2 to 7 percent.

Three remnant, disturbed hardwood swamps were sampled within the northeastern, unmined parcel of the eastern tract where the power block is proposed. The three hardwood swamp types include maple swamp, mixed hardwood swamp, and mixed shrub swamp (see Tables 6, 7, and 8, respectively, Appendix 11.10.2). The maple swamp is a small association located on the edge of a larger, open marshy area. The canopy of the swamp is composed of red maple, willow and dahoon holly. The shrub layer is open and contains red maple saplings. Dog fennel was also recorded as a shrub associate, due to its woody nature and stature at this sampling site. Frog's-bit was the most important taxon within the herb stratum. Other herbaceous components included goldenrod, smartweed, clubrush, soft rush, torpedograss, dog fennel, marsh pennywort, panic grass, water hoarhound, beardgrass, galingale, and big carpetgrass, in decreasing order of importance.

The mixed hardwood swamp located west of the maple swamp exhibited a greater species diversity within the canopy, although red maple was still the most important tree species overall. Other canopy associates included laurel oak, water oak, dahoon holly, black gum, slash pine, swamp redbay, and wax myrtle. The shrub layer was open with red maple saplings, saw palmetto, groundsel bush and wax myrtle, in descending order of importance. The herb stratum was mostly unvegetated, but contained species generally indicative of a fluctuating hydrological regime such as Virginia chain fern, redroot, goldenrod, soft rush, dog fennel, chalky bluestem, clubrush, smartweed, bushy goldenrod, and torpedograss. The mixed shrub swamp is located within the center of the remnant, disturbed area which was historically the headwaters of Little Payne Creek. The area has been altered due to mining operations. However, the depressions located between berms and spoil piles collect water and support the growth of hydrophytes. The area is mostly open with the occasional occurrence of shrubs throughout. Groundsel bush, primrose willow, willow, and red maple saplings comprise the shrub layer. Large specimens of Caesar's weed and pokeweed were also conspicuous components within the shrub stratum.

The open herbaceous layer contained 26 species of plants that are typically associated with transitional or disturbed wetlands. Maidencane dominated the deeper water areas of the system. The most common herbs within the ground stratum included the following species in order of importance: maidencane, beardgrass, goldenrod, pickerelweed, smartweed, soft rush, frog's-bit, wild balsam apple and bushy beardgrass.

Freshwater Marsh--641

Total acreage of freshwater marsh on the site is approximately 101 acres (2.3 percent). Freshwater marshes are circular to irregularly-shaped, herb-dominated wetlands that may be ponded for 6 months out of the year. The marshes on the property occupy hydric soils such as Samsulla muck and Basinger mucky fine sand, depressional soils that have an organic matter content that ranges from 8 to 20 percent and greater than 20 percent, respectively. These open, nonforested wetlands are represented by remnant, natural areas that have been hydrologically altered due to drawdowns of the surficial aquifer associated with mining and artificially-created wetlands established during past earth-moving operations. Maidencane, pickerelweed, arrowhead, and fire flag are some of the typical emergents associated with the deeper water areas of the marshes. The shallow fringes to the deeper water areas are dominated by such species as sand cordgrass, little bluestem, chalky bluestem, soft rush and fireweed. Most of the marshes on the property have been invaded by weedy species such as dog fennel due to alterations in hydrological regimes or other disturbances.

Since the majority of marshes have not experienced fires over a long period of time, wetland tree and shrub species have become established in some areas. One marsh located in the center of the southwestern corner of the eastern tract is relatively undisturbed (see Tables 9 and 10, Appendix 11.10.2). This marsh is dominated by maidencane in the herbaceous layer. Buttonbush also occurred sporadically throughout this marsh. Other emergents included sand cordgrass, redroot, chalky bluestem, creeping rush, big carpetgrass, beak rush, dichanthelium grass, and pedicelled milkweed, in descending order of importance. From spring to summer, the marsh exhibited a decrease in the importance value by maidencane (importance values = 151.1 to 79.7). However, this system was not invaded by weedy, opportunistic species at any time during 1991. Due to the rather isolated location of this wetland, past perturbations have not apparently had an adverse effect on overall species composition or diversity (i.e., all of the species present are indicative of a healthy, stable wetland system). However, this wetland is the exception to the rule on the property.

The majority of marshes on the site are disturbed, as stated previously. These marshes are experiencing a shift in species composition due to alterations to historic hydrologic regimes. For example, dog fennel has invaded many of the marshes on the site. This composite is a pioneer, weedy species that usually becomes established in open wetlands that are experiencing prolonged dry conditions. During a long period of drought, dog fennel may temporarily invade undisturbed marshes, but die back once normal water levels return. In a wetland system hydrologically altered either due to surface water drainage or groundwater interruptions, dog fennel may become established for longer durations. Most of the marshes on the property reflect this latter circumstance. A typical disturbed marsh was sampled within the southwestern area of the eastern tract (see Table 9, Appendix 11.10.2). Dog fennel is the most important species in this marsh with an overall importance value of 54.6. The next most important species, bushy goldenrod, is also indicative of moist to dry soils and is a common component of upland flatwoods and rangeland. Other associates in decreasing order of importance include: goldenrod, chalky bluestem, little bluestem, water primrose, smartweed, galingale, marsh fleabane, fireweed, pickerelweed, rush, dichanthelium grass, and buttonweed.

Due to higher water levels in the fall, species composition within the marsh changed dramatically (see Table 10, Appendix 11.10.2). The species dominance of dog fennel (importance value = 28.8) was replaced by an obligate wetland species, arrowhead. However, it should be noted that dog fennel quickly resprouted after water levels receded in the winter-spring of 1992.

Scraped Over Areas/Spoil Banks--741/743

Approximately 532 acres (12.3 percent) of the site contains scraped areas and spoil banks. Weedy, pioneer species of grasses, forbs, and herbs quickly invade newly exposed soil created by clearing and earthmoving operations. These open, grassy areas resemble old fields in character and are dominated by a diverse assemblage of upland and in some portions, wetland transitional plant species. Species compositions of these fields are generally dependent upon the local seed source and the corresponding hydrological/elevational gradients resulting from abrupt changes in the natural topography. Old field species such as common ragweed, bushy beardgrass, beardgrass, purple thistle, tick trefoil, and rabbit's tobacco are characteristic of scraped areas. Spoil piles and banks that were created by the dumping of overburden from mining operations either support similar species to the old fields or are dominated by woody taxa such as shrub verbena, shiny sumac, and black cherry.

Old fields occur throughout the southwestern and northeastern parcels located in the eastern tract. Little bluestem dominated both of these areas in the spring and fall seasons (see Tables 11 through 14, Appendix 11.10.2). However, overall species composition changed dramatically between sampling events due to changes associated with the season and rainfall.

Phosphate Mined Land--751

The majority of the Polk Power Station site has been or will be mined or disturbed through phosphate mining operations (4,115 acres or 94.6 percent). Prior to July 1, 1975, approximately 523 acres of land on the site was mined or disturbed through mining. From July 1, 1975, to May 1992, an additional 906 acres of land was disturbed through mining activities, and an additional 2,173 acres of the site was mined between July 1, 1975, and May 1992. From May 1992 until mining ceases in 1994, approximately 21 acres of land will be disturbed by mining activities, and 492 acres will be mined. Only 233 acres of the site has not been or will not be mined or disturbed through mining activities. Based on current (December 19, 1991) site conditions (i.e., land cover changes since mining operations began), only 2,186 acres or 50.2 percent of the site exhibits the land forms consistent with FLUCCS category 751. These lands consist of cleared land, spoil piles of material which have been scraped from the surface, and excavated areas which are filled with water. Generally, these areas are either devoid of vegetation, are dominated by the ruderal species as described for old fields, or support opportunistic wetland plants (especially cattails) along the littoral/shallow water reaches of mine ponds and cuts.

Terrestrial Systems--Fauna

Wildlife

Presence and likelihood of occurrence were assessed for terrestrial vertebrates occurring onsite during field inspections conducted throughout 1991 and early 1992. Semi-annual (dry and wet season) surveys were conducted in March and August 1991. Appendix 11.10.3 presents lists of amphibian, reptile, bird, and mammal species with their scientific names that were either observed onsite or have the potential to occur there. Descriptions and likelihood of occurrence of endangered, threatened, or species of special concern wildlife can be found in the following section. A discussion of potential impacts to these species resulting from power plant development can be found in Section 4.4.

Birds

The 4,348-acre Polk Power Station property supports a variety of upland, wetland, and aquatic bird habitats ranging from relatively small, undisturbed tracts of oak hammock, freshwater swamp, mixed oak/pine woods, and pine flatwoods to large, highly altered areas such as phosphate-mined land, spoil areas, and scraped-over areas. The former comprise only 18 percent of the available habitat, while mined, spoil, and scraped-over land (FLUCCS categories 741, 743, and 751), which offer only marginal habitat value to birds, currently comprise 62 percent of the property's acreage. The remaining onsite habitats include improved pasture, citrus grove, canals and ditches, ponds and lakes, palmetto rangeland, freshwater marsh, and shrub and brushland, which offer different degrees of habitat value to resident as well as migratory species. Many of these remaining habitats had been mined and regenerated or were reclaimed while others will be mined in the near future.

The avifauna of the Polk Power Station site generally consists of species common to central Florida. The population of summer residents (i.e., nesting species) is seasonally augmented by the influx of migrant species and winter residents. Migrant species commonly observed and expected to occur on the property include yellow-rumped warbler, palm warbler, pine warbler, black and white warbler, blue-gray gnatcatcher, ruby-crowned kinglet, brown creeper, cedar waxwing, northern parula warbler, Canada warbler, American redstart, yellow warbler, brown-headed cowbird, and a variety of sparrows (Family Fringillidae). These migrants occur primarily in mixed species flocks and forage ubiquitously in onsite hedgerow, shrub- and brushland, and forested habitats during the spring and fall migratory seasons. None of these species is expected to nest on the property or in central Florida.

The aquatic habitats of the site, particularly the old mine cuts and reclaimed lake on the eastern portion of the property, also provide feeding habitat to large numbers of migratory waterbirds including ducks, mergansers, pelicans, coots, gallinules, gulls, terns, and shorebirds. Although a number of these species (e.g., pied-billed grebe, mottled duck, American coot, common gallinule, laughing gull, Caspian tern, and killdeer) also occur as summer residents, their relative abundance on the Polk Power Station site sharply decreases each spring.

A number of resident species such as black and turkey vultures, common crow, bluejay, mourning dove, several species of swallows, eastern cardinal, common grackle, and rufous-sided towhee occur throughout all upland habitats. However, the onsite bird species diversity and distribution are primarily dependent on the presence of specific vegetation communities and suitable habitat conditions. The highest diversity of species and the greatest abundance of birds were regularly observed along the dike road separating old mine ponds and lakes on the east-central portion of the site. This area supports several interspersed vegetation communities including mixed oak/pine, shrub and brushland, freshwater swamp, and revegetated spoil areas in different seral stages. This mix of habitats, along with the adjoining densely vegetated shorelines, provides excellent forage and nesting areas for upland and wetland species. Resident upland species commonly recorded in this area of the property include northern cardinal, rufous-sided towhee, common crow, white-eyed vireo, tufted titmouse, bluejay, eastern mockingbird, mourning dove, gray catbird, common grackle, Carolina wren, and brown thrasher. Common yellowthroat, boattailed grackle, redwing, and short-billed marsh wren were the common wetland songbirds in this area.

The avifauna of the eastern portion of the property, however, is dominated by aquatic and wading birds due to the presence of old mine ponds and lakes with shallow littoral zones as well as sections of dense shrub swamp. Large numbers of double-crested cormorants, ring-billed gulls, laughing gulls, Caspian terns, black terns, American coots, common gallinules, American anhinga, and pairs of mottled ducks, wood ducks, pied-billed grebes, purple gallinules, king rails, and white pelicans were observed during each field survey. Wading birds were particularly abundant along the eastern ponds and lakes. One March 1992 early morning bird survey of these areas identified 240 great egrets, 50 great blue herons, 57 black-crowned night herons, 20 glossy ibis, 78 snowy egrets, 5 tricolored herons, 50 cattle egrets, and several green-backed herons feeding along shorelines on the eastern portion of the property. Although many of these waders, particularly black-crowned night herons, roost in the maples, willows, and cattails surrounding these lakes, no wading bird nesting colony was located within the boundaries of the Polk Power Station site. Several American woodstorks, which were also recorded roosting and feeding along the eastern lakes, are not expected to nest on or in the vicinity of the property due to the absence of suitable nesting habitat. Ospreys and an occasional individual bald eagle were also recorded in the aquatic habitats of the eastern portions of the site.

The bird species diversity and abundance on the remaining, i.e., central and western, portions of the property are lower. Improved pasture, mixed oak/pine forest, and to a lesser degree, oak hammock are the principal habitats on the central portion of the site. Eastern meadowlark, killdeer, American kestrel (including the southeastern and eastern subspecies), red-tailed hawk, great horned owl, loggerhead shrike, tree swallow, and cattle egret are the most commonly recorded species in the improved pasture habitat. The associated mixed oak/pine forest stands and interspersed shrub-brushland communities support eastern cardinal, rufous-sided towhee, ruddy ground dove, bluejay, tufted titmouse, Carolina wren, yellow-breasted sapsucker, downy woodpecker, red-bellied woodpecker, common nighthawk, ruby-throated hummingbird, white-eyed vireo, Cooper's hawk, sharp-shinned hawk, bobwhite, eastern bluebird, eastern phoebe, brown thrasher, Carolina chickadee, common grackle, yellow-breasted chat, downy woodpecker, and gray catbird. A survey of the shrub-brushland habitats for scrub jays failed to locate any scrub jay nesting colonies.

Birds characteristic of the oak hammocks include barred owl, pileated woodpecker, black-billed cuckoo, red-headed woodpecker, red-shouldered hawk, red-eyed vireo, summer tanager, wild turkey, bluejay, screech owl, chuck-wills-widow, and great-crested flycatcher. Many of the species listed under the mixed oak/pine community, however, are opportunistic feeders and frequently range into the oak hammocks of the site as well.

In comparison with the forested, shrub and brushland, and aquatic habitats, the bird diversity and abundance in the isolated marshes of the property were low. This was directly attributable to the recent drought conditions and the concomitant lowering of the surficial water table, which left most of the onsite marshes dry. As a result, wetland species such as Florida sandhill crane, American woodstork, king rail, Virginia rail, eastern snipe, American woodcock, belted kingfisher, and redwing were not recorded in these habitats during the 1991-1992 bird surveys.

The western portion of the Polk Power Station property, located west of SR 37, supports primarily phosphate-mined land and active mining operations. As a result, birds occur in scattered tracts of mixed oak/pine forest and improved pasture, as well as in the pine flatwoods community covering the northern section of this tract. Birds commonly observed or expected in this pine flatwoods habitat include great horned owl, Bachman's sparrow, great-crested flycatcher, eastern bluebird, common flicker, bluejay, bobwhite, mourning dove, pileated woodpecker, brown-headed nuthatch, blue-gray gnatcatcher, summer tanager, and pine warbler. No red-cockaded woodpeckers were recorded in onsite pine flatwoods during seasonal surveys of this habitat. The citrus grove, located on the northwestern corner of the western tract, supports primarily eastern mockingbirds, loggerhead shrikes, southeastern American kestrels, ruddy ground doves, and common grackles.

In summary, the bird composition of the Polk Power Station site consists primarily of common species characteristic of grassland, shrub, and forested habitats of central Florida. The mine cuts and lakes on the eastern portion of the site provide feeding habitat for large numbers of cormorants, wading birds, shorebirds, gulls, and terns. In contrast, bird habitats on the western portions of the property are confined to remnant unmined areas.

Mammals

The relatively undisturbed habitats onsite (mixed oak/pine woods, pine flatwoods, and various wetlands), coupled with the mined and reclaimed areas provide sufficient requirements for most mammals found in this region of Florida. Species using edge communities were commonly observed and included white-tailed deer, eastern cottontail, armadillo, and southeastern pocket gopher. Forest dwelling animals included bobcat, raccoon, opossum, and the eastern gray squirrel. The aquatic systems provide habitat for marsh rabbits and river otters. Although not observed onsite, it would be expected that the gray fox, feral hog, and both the striped and spotted skunk would also occur there. Appendix 11.10.3 lists all mammal species either occurring or expected to occur on the site.

Small mammal live-trapping, conducted in the dry and wet seasons, was performed in wetlands, old field, and mixed oak/pine habitats. The results of these efforts are presented in Table 2.3.6-5. More individuals but fewer species were trapped in March 1991. The two most common species captured were the eastern harvest mouse and hispid cotton rat. Species trapped in old field habitats included these two species plus the cotton mouse. Oak/pine forests produced hispid cotton rat, eastern harvest mouse, cotton mouse, golden mouse, and eastern wood rat. Trapping in wetland communities produced hispid cotton rat, eastern harvest mouse, short-tailed

Table 2.3.6-5. Results of Small Mammal Trapping at the Tampa Electric Company Polk Power Station Site

Species	Dry Season (March 1991)			Wet Season (September 1991)			Total
	Old Field	Oak/Pine	Wetland	Old Field	Oak/Pine	Wetland	
Short-tailed shrew			1				1
Eastern harvest mouse	56	123	11	5	63	1	259
Cotton mouse					1		1
Golden mouse					8		8
Eastern wood rat		4					4
Hispid cotton rat	98	20	28	30	8	16	200
Rice rat						2	2
Subtotal	154	147	40	35	80	19	
TOTAL							**475**

Source: ECT, 1992.

shrew, and rice rat. No unusual species were captured which would be expected in such a disturbed site.

Reptiles and Amphibians

Reptiles and amphibians were noted by direct sightings or calls heard while performing other field investigations. Common reptile species encountered in the oak/pine woods or brushy fields included the corn snake, eastern coachwhip snake, black racer, pygmy rattlesnake, eastern box turtle, and green anole. The Florida cooter and alligator were common inhabitants of the open water habitats.

Commonly encountered amphibians included the oak toad in the oak/pine communities and the green treefrog and southern leopard frog in the hardwood swamp habitats. Given the abundance of aquatic habitats onsite, several other species of frogs and toads would be expected to occur commonly and are listed in Appendix 11.10.3.

Threatened and Endangered Species--Flora and Fauna

Important species identified as occurring or potentially occurring on or near the Tampa Electric Company Polk Power Plant site and the probability of their occurrence are provided in Table 2.3.6-6. This list was derived from a review of the Florida Natural Areas Inventory (FNAI) matrix, the current records of FGFWFC, and USFWS, and a thorough investigation of the site and the immediate vicinity. Monitoring for endangered and threatened species and species of special concern was conducted at quarterly intervals on and adjacent to the site during 1991. Each species' current status is discussed in the following paragraphs. An assessment of potential impacts to these species due to construction of the project can be found in Section 4.4.

Table 2.3.6-6. Threatened and Endangered Species that Occur or Could Potentially Occur on or Near the Tampa Electric Company Polk Power Station Site

Common Name	Scientific Name	Designated Status*					Potential for Occurrence†
		USFWS[1]	FGFWFC[2]	FDACS[3]	FCREPA[4]	CITES[5]	
Plants							
Rein orchid	Habenaria odontopetala	--	--	T	--	II	H
Long-horned orchid	Habenaria quinqueseta	--	--	T	--	II	H
Water spider orchid	Habenaria repens	--	--	T	--	II	H
Hartwrightia	Hartwrightia floridana	C2	--	T	R	--	L
Dahoon holly	Ilex cassine	--	--	CE	--	--	P
Prickly pear	Opuntia compressa**	--	--	T	--	II	P
Cinnamon fern	Osmunda cinnamomea	--	--	CE	--	--	P
Royal fern	Osmunda regalis	--	--	CE	--	--	P
Spoon-flower	Peltandra sagittifolia	--	--	--	R	--	H
Golden polypody	Phlebodium aureum	--	--	T	--	--	P
Wild coco	Pteroglossapsis ecristata	C2	--	T	--	II	P
Wild azalea	Rhododendrum viscosum	--	--	T	--	--	P
Bluestem	Sabal minor	--	--	T	--	--	P
Aspidium fern	Thelypteris kunthii	--	--	T	--	--	P
Red-needle leaf	Tillandsia setacea	--	--	T	--	--	H
Shoestring fern	Vittaria lineata	--	--	T	--	--	H
Netted chain fern	Woodwardia areolata	--	--	T	--	--	P
Coontie	Zamia pumila††	--	--	CE	T	II	M
Amphibians and Reptiles							
American alligator	Alligator mississippiensis	T(S/A)	SSC	--	SSC	II	P
Eastern indigo snake	Drymarchon corais couperi	T	T	--	SSC	--	P
Florida pine snake	Pituophis melanoleucus mugitus	C2	SSC	--	--	--	H
Short-tailed snake	Stilosoma extenuatum	C2	T	--	E	--	M
Gopher tortoise	Gopherus polyphemus	C2	SSC	--	T	--	P
Gopher frog	Rana areolata aesopus	C2	SSC	--	T	--	H

Table 2.3.6-6. Threatened and Endangered Species that Occur or Could Potentially Occur on or Near the Tampa Electric Company Polk Power Station Site (Continued, Page 2 of 3)

Common Name	Scientific Name	Designated Status*					Potential for Occurrence†
		USFWS[1]	FGFWFC[2]	FDACS[3]	FCREPA[4]	CITES[5]	
Birds							
Southern bald eagle	Haliaeetus leucocephalus leucocephalus	E	T	--	T	I	P
Southeastern American kestrel	Falco sparverius paulus	C2	T	--	T	II	P
Arctic peregrine falcon	Falco peregrinus tundrius	T	E	--	E	I	U
Short-tailed hawk	Buteo brachyurus	--	--	--	R	--	L
Cooper's hawk	Accipiter cooperii	--	--	--	SSC	--	P
Osprey	Pandion haliaetus	--	SSC***	--	T	II	P
Little blue heron	Egretta caerula	--	SSC	--	SSC	--	P
Great egret	Casmerodius albus	--	--	--	SSC	--	P
Snowy egret	Egretta thula	--	SSC	--	SSC	--	P
Tricolored heron	Egretta tricolor	--	SSC	--	SSC	--	P
Black-crowned night heron	Nycticorax nycticorax	--	--	--	SSC	--	P
Yellow-crowned night heron	Nycticorax violacea	--	--	--	SSC	--	L
Eastern least bittern	Ixobrychus exilis	--	--	--	SSC	--	H
Glossy ibis	Plegadis falcinellus	--	--	--	SSC	--	P
White ibis	Eudocimus albus	--	--	--	SSC	--	P
Wood stork	Mycteria americana	E	E	--	E	--	P
Limpkin	Aramus guarauna	--	SSC	--	SSC	--	H
Florida sandhill crane	Grus canadensis pratensis	--	T	--	T	II	P
Red-cockaded woodpecker	Picoides borealis	E	T	--	--	--	L
Southern hairy woodpecker	Picoides villosus auduboni	--	--	--	SSC	--	L
Florida scrub jay	Aphelocoma coerulescens coerulescens	T	T	--	T	--	P
Mammals							
Sherman's fox squirrel	Sciurus niger shermani	C2	SSC	--	T	--	P
Florida mouse	Podomys floridanus	C2	SSC	--	T	--	L

Table 2.3.6-6. Threatened and Endangered Species that Occur or Could Potentially Occur on or Near the Tampa Electric Company Polk Power Station Site (Continued, Page 3 of 3)

Common Name	Scientific Name	Designated Status*					Potential for Occurrence†
		USFWS[1]	FGFWFC[2]	FDACS[3]	FCREPA[4]	CITES[5]	
Round-tailed muskrat	Neofiber alleni	C2	--	--	SSC	--	L
Florida panther	Felis concolor coryi	E	E	--	E	I	U

* R = rare.
T = threatened.
T(S/A) = threatened due to similarity of appearance.
E = endangered.
SSC = species of special concern.
CE = commercially exploited.
C2 = a candidate for listing, with some evidence of vulnerability, but for which not enough data exists to support listing.
I = included in Appendix I (of CITES).
II = included in Appendix II (of CITES).

†U = unlikely; site is not within the species' range and contains unsuitable habitat.
L = low; occurrence of an important species within or near property boundaries is highly unlikely because of species range or unsuitable habitat or both.
M = moderate; important species may occur onsite since range and suitable habitat exists within property boundaries.
H = high; there is a very good possibility that an important species exists within property boundaries since range and suitable to optimal habitat for the species are found onsite.
P = present; the species listed has been observed on the subject property either visually or by signs thereof.

**Opuntia compressa = O. humifusa fide Wunderlin, 1982.
††Zamia floridana, Z. integrifolia, and Z. umbrosa = Zamia pumila fide Wunderlin, 1982.
***Applicable in Monroe County only.

Sources: [1]USFWS, 1991.
[2]FGFWFC, 1991.
[3]FDACS (list published in Preservation of Native Flora of Florida Act, Section 581.185-187, F.S.).
[4]FCREPA (Pritchard, 1978-1979).
[5]CITES of Wild Fauna and Flora, 1973.
ECT, 1992.

Flora

Due to the highly disturbed condition of the site, few important plant species would be expected to occur. No federally listed plant species have the potential to occur on the site. Eighteen species of plants either listed by the Florida Department of Agriculture and Consumer Services (FDACS) as either threatened or commercially exploited or by Florida Committee on Rare and Endangered Plants and Animals (FCREPA) as rare have the potential for occurrence on the property. Out of the 18 species, 10 species were found on the site. However, two epiphytic species (shoe-string fern and red-needle leaf), a terrestrial aroid (spoon-flower), and three terrestrial orchids (Habenaria orchids) also have a high potential for occurrence within appropriate habitat in unmined areas of the site. The majority of listed plant species either found onsite or that have a high probability of occurrence do occur or are likely to occur in areas not proposed for power plant development. Therefore, no significant adverse effects to regional or local populations of these species are anticipated from the proposed project. Species descriptions and the results of the field surveys for important species on the site follow.

Habenaria Orchids (Habenaria odontopetala, H. quinqueseta and H. repens)--The three species of Habenaria referenced above are listed as threatened by FDACS and are listed in Appendix II of Convention on International Trade in Endangered Species (CITES). These orchids are small, leafy, light green terrestrial herbs with greenish-white flowers. Habenaria orchids grow within cypress swamps, hardwood swamps, hammocks, marshes, bogs, and ditches. These orchids are actually quite common throughout central and south Florida, but have received a *threatened* status by FDACS presumably to restrict collection by orchid enthusiasts. Although not seen on the property, Habenaria orchids could occur within the floodplain forest of the unmined tributary to the South Prong Alafia River in the northwestern corner of the site. Since this area is not slated for mining or power plant development, no impacts to potential populations of Habenaria orchids are anticipated.

Hartwrightia (Hartwrightia floridana)--Hartwrightia is currently under review (Category 2) for federal listing by USFWS and is listed as threatened by FDACS and rare by FCREPA. Hartwrightia is a fall-flowering composite with pinkish or lavender flowers. This species occasionally inhabits open, acidic seepage areas such as the edges of marshes in central and northern Florida. None of the potential habitat areas investigated during 1991 contained Hartwrightia. Since this conspicuous composite was not observed during the fall flowering season on the property, the probability of occurrence for this species on the property is considered low.

Dahoon Holly (Ilex cassine), Prickly Pear (Opuntia compressa = O. humifusa fide Wunderlin, 1982), Cinnamon Fern (Osmunda cinnamomea), and Royal Fern (Osmunda regalis)--The referenced species are very common within the State of Florida. Dahoon holly, cinnamon fern and royal fern are listed as commercially exploited species by FDACS; while prickly pear is listed as threatened by FDACS and within Appendix II of CITES. Dahoon holly, cinnamon fern, and royal fern are mostly swamp inhabitants, while prickly pear occurs within flatwoods and scrubby areas. All of these species were observed on the site. Dahoon holly, cinnamon fern, and royal fern mostly occur within the woods contiguous to the unnamed tributary to the South Prong Alafia River on the western tract. This area will not be impacted by mining or site development. Prickly pear occurs sporadically throughout the flatwoods and mixed oak/pine woods on the site. No significant adverse impacts to regional populations of prickly pear are anticipated from the proposed plant development.

Spoon-Flower (Peltandra sagittifolia)--Spoon-flower is listed as rare by FCREPA. Spoon-flower is an aroid with showy white spathes, sagittate to hastate leaves, and red berries which occasionally inhabit swamps and marshes in central and northern Florida. Only one flowering specimen of Peltandra (P. virginica) was found on the site within the floodplain of the unnamed tributary to South Prong Alafia River. However, in its vegetative stage, spoon-flower is virtually indistinguishable from P. virginica. There is a high probability of occurrence for spoon-flower on the site.

However, since it is likely to occur in an area not scheduled for power plant development, no impacts to this species are expected.

Golden Polypody (Phlebodium aureum)--Golden polypody is listed as a threatened species by FDACS. This species is widespread and quite common throughout central and south Florida. Golden polypody is an epiphytic, pendent or spreading fern with broadly ovate, lobed, pinnatifed blades on shiny petioles attached to creeping, golden-brown-colored rhizomes. This species, which mostly inhabits the old frond bases of cabbage palms, occurs within the floodplain reaches of the unnamed tributary to the South Prong Alafia River located on the extreme northwestern area of the western tract and within the unmined, southeastern area of the eastern tract. Since these areas are not scheduled for mining or power plant development, no impacts to golden polypody are expected.

Wild Coco (Pteroglossapsis ecristata)--This orchid is under review (Category 2) by USFWS and is listed as threatened by FDACS. Wild coco is a 4-ft tall or taller, terrestrial fall-flowering orchid with a conspicuous raceme of magenta or yellowish-colored flowers. Wild coco is frequent within sand pine scrub, sandhills, and pinelands in central and south Florida. Approximately 500 or more individuals of wild coco were observed within the grassy fields of the power block area within the eastern tract. Smaller numbers of this orchid were also observed in the southwestern, unmined area within the eastern tract. Since this southwestern area is not scheduled for power plant development or mining operations, no significant adverse effects to regional populations of wild coco are anticipated from the proposed project.

Wild Azalea (Rhododendron viscosum), Bluestem (Sabal minor), and Aspidium Fern (Thelpteris kunthii)--All of the above-referenced species are common mostly within hydric hammocks and hardwood swamps in the State of Florida. These species are only listed as threatened by FDACS. All of these species were observed in the floodplain swamp along the unnamed tributary to the South Prong Alafia River on the property. No impacts to species populations are expected from plant development.

Red-Needle Leaf (Tillandsia setacea)--Red-needle leaf is listed as a threatened species by FDACS. Red-needle leaf or wild pine is a small, epiphytic bromeliad with needle-like leaves and violet flowers with reddish floral bracts. Red-needle leaf occurs on tree trunks and branches within hammocks and swamps throughout central Florida. This air plant is the third most common species of indigenous bromeliad in the State of Florida. The *threatened* species status by FDACS is probably attributable to its potential over-collection because of its showy needle-like leaves that turn a reddish color in the fall. No red-needle leaf was found on the site. However, due to suitable habitat, this epiphyte may occur within the unnamed tributary to South Prong Alafia River floodplain forest, which is not scheduled for power plant development.

Shoestring Fern (Vittaria lineata)--Shoestring fern is listed as threatened by FDACS. Typically, shoestring fern can be found growing in the axils of old cabbage palm leaf bases within hammocks or the woodland edges of hardwood swamps. Its dark green, pendent linear leaves are distinctive and resemble shoestrings. This fern is frequent throughout central and south Florida and probably occurs within the floodplain of the unnamed tributary to the South Prong Alafia River. However, no specimens of shoestring fern were observed during searches on the site.

Netted Chain Fern (Woodwardia areolata)--Netted chain fern is listed as threatened by FDACS. This terrestrial fern species is common within swamps and marshes in Florida. Netted chain fern was observed in the floodplain area adjacent to the unnamed tributary to the South Prong Alafia River. No impacts to populations of netted chain fern are anticipated from the proposed action.

Coontie (Zamia floridana, Z. integrifolia, Z. umbrosa = Zamia pumila fide Wunderlin, 1982)--Coontie is listed as a commercially exploited species by FDACS, as threatened by FCREPA, and within Appendix II of CITES. Coontie is a cycad with a large starchy tuber used by Florida Indians as an important food source. This palmlike plant occasionally occurs within scrub, hammocks, pine flatwoods, and sometimes in converted palmetto rangeland and pasture within interior counties in west-central Florida. No coontie was found within the well-drained rangeland, pasture, flatwoods, or hammock on the property during repeated searches. Therefore, there is only a moderate potential for occurrence of coontie on the site.

Fauna

A total of 31 wildlife species either endangered, threatened, rare, or species of special concern were identified as occurring or having potential to occur on the Polk Power Station site. These species are discussed in the following paragraphs.

American Alligator (Alligator mississippiensis)--The American alligator is designated as a species of special concern by FGFWFC and FCREPA, and threatened due to similarity of appearance by USFWS. This species ranges throughout the southeastern United States in the lower coastal plain and inhabits most wetland communities where sufficient open water is present. Since alligator populations have recovered sufficiently within their historic range, the species' USFWS-protected status has been downgraded to threatened due to similarity of appearance, which will maintain protective measures for other protected crocodile species. Currently, the State of Florida permits regulated harvests of alligators to control population growth, especially where alligators are incompatible with current land uses. Alligators were commonly observed in the reclaimed and unreclaimed lakes onsite as well as ditches, canals, and streams in the vicinity of the site.

Eastern Indigo Snake, Drymarchon corais couperi--Eastern indigo snakes are listed as threatened by USFWS and FGFWFC, and as a species of special concern by FCREPA. Reasons for their decline include overcollecting, mortality from rattlesnake roundups, and habitat destruction due to clearing for agriculture and residential developments. Indigo snakes occur in xeric scrub and sandhill communities (frequently in association with gopher tortoises), and moister communities such as pine flatwoods and hardwood hammocks. One individual was observed in the old field portion of the eastern tract. Gopher tortoise burrows were also found onsite so it is likely this uncommon species resides on the property. The gopher tortoise burrows, however, occur in areas not scheduled for power plant development.

Florida Pine Snake, Pituophis melanoleucus mugitus--The Florida pine snake has similar habitat requirements as the gopher tortoise and is found in xeric upland habitats including sandhill, scrub oak, and longleaf pine/turkey oak habitats where the pocket gopher is found. Designated as a species of special concern by FGFWFC and under review for listing by USFWS, this upland species is known to inhabit gopher tortoise burrows. Since its range includes the site, and its preferred habitat and prey species occur onsite, it is highly likely this snake occurs onsite.

Short-Tailed Snake (Stilosoma extenuatum)--This endemic species is currently listed as threatened by FGFWFC, endangered by FCREPA, and is under review by USFWS. It prefers extremely well-drained soils usually in longleaf pine-turkey oak habitats. Not much is known of its life history, but it does spend much of its time underground. Since its range and some habitat occur onsite, there is a moderate likelihood this species could be found onsite.

Gopher Tortoise (Gopherus polyphemus)--Florida gopher tortoises are listed as a species of special concern by FGFWFC, threatened by FCREPA, and under review for listing by USFWS. Gopher tortoises have been primarily impacted by habitat losses associated with residential, commercial, and industrial developments on well-drained soils, and conversion of lands into commercial pine plantations. Gopher tortoises prefer xeric habitats such as sand pine scrub, oak scrub, turkey oak associations, relatively well-drained pine flatwoods, and old-field associations. This species is present on the site due to discovery of nine active, four inactive, and six abandoned burrows. In the northeastern corner of the eastern tract, one active burrow was found. In the southeastern corner of the eastern tract, four active burrows were found, and in the southwestern corner of that same tract, two active burrows were discovered. Two active burrows were also discovered on the northwestern corner of the western tract. All active burrows were found in areas not scheduled for power plant development.

Gopher Frog (Rana areolata)--The gopher frog is designated as a species of special concern by FGFWFC, threatened by FCREPA, and is currently under review by USFWS. The primary cause for concern is habitat loss resulting from clearing for residential, commercial, and industrial development. Suitable habitat for gopher frogs includes xeric uplands such as sandhill and sand pine scrub communities. Although occasionally found in mouse burrows, crayfish holes, and stump holes, the gopher frog is most often associated with gopher tortoise burrows. The occurrence of this species onsite is listed as high due to its range and habitat requirements being met. However, as previously stated, gopher tortoise burrows which may be inhabited by gopher frogs were only located in areas not scheduled for power plant development.

Southern Bald Eagle (Haliaeetus l. leucocephalus)--The southern bald eagle is listed as endangered by USFWS and as threatened by FCREPA and FGFWFC. Eagles occurring in peninsular Florida include permanent residents and seasonally occurring migrants. The distribution, population, status, nest locations, and reproductive success of resident Florida eagles are closely monitored by FGFWFC and the National Audubon Society (NAS) through annual counts and aerial nest surveys. Based on aerial and ground surveys of the study area and a review of known nest locations and agency data, three bald eagle nests are known to occur in the study area. Most eagle nests are located in tall pines or cypress high above the surrounding forest, are large and conspicuous, and can be detected during aerial surveys.

Two of the nests were found onsite (one in the southeast corner of the eastern tract and one in the northwest corner of the western tract) and both are believed to be abandoned. Neither of these abandoned nest areas will be disturbed by the proposed project development (see Section 4.4). Repeated visits during potential nesting periods yielded no sighting of eagles. Both nests are in relatively poor shape structurally. No evidence underneath the nest indicated any eagle use. Great horned owls were recorded using the eastern nest in early 1991.

The third nest is active but occurs offsite to the east along Fort Green Road. This nest is identified by FGFWFC as PO-40-A and has been active since 1989. The nest is located in a slash pine tree situated on a farmstead, with a residence located near the tree. The nest was active when observed in January 1992. This nest lies approximately 1.5 miles from the power block area, while the closest construction activities (the cooling reservoir) will occur approximately 2,500 ft away. Both these distances fall outside the primary management zone (750 to 1,500 ft away from nests) recommended by USFWS in their Habitat Management Guidelines for the Bald Eagle in the Southeast Region. The entire power block actually falls beyond the secondary management zone (1,500 ft to 1 mile) recommended by USFWS.

Southeastern American Kestrel (Falco sparverius paulus)--This small falcon is an openland bird often seen perching on utility poles and wires, preying on insects and small rodents. It is found throughout Florida and typically nests in cavities drilled by woodpeckers or in nest boxes and birdhouses. Several individuals were observed on the site, although no nesting areas were found. The species is listed as threatened by both FGFWFC and FCREPA and is under review by USFWS. Its status is really unknown since locally the species may be abundant but declining elsewhere.

Arctic Peregrine Falcon (Falco peregrinus tundrius)--This bird of prey breeds throughout most of the United States, but not in Florida. It is unique in that it nests on cliffs, tall trees, or buildings, and captures its prey (birds) on the wing. It is currently listed as threatened by USFWS, but endangered by both FGFWFC and FCREPA. None were observed onsite although it does like areas where birds congregate. If it were to occur, it would be considered an uncommon migrant.

Short-Tailed Hawk (Buteo brachyurus)--This medium-sized hawk is listed as rare by FCREPA. Their preferred habitat is mature cypress, mangroves, or riverine hardwood swamps bordering open areas where they hunt. Its main prey is small birds. Due to the lack of suitable habitats, the likelihood of occurrence for this bird on the site is low.

Cooper's Hawk (Accipiter cooperi)--The Cooper's hawk inhabits edge areas between lowland hardwoods or hammocks and open areas primarily preying on small birds, mammals, or herpetofauna. This species is currently designated as a species of special concern by FCREPA. Population declines have been attributed to illegal shooting, pesticide contamination, and habitat destruction. Its breeding and wintering range includes all of the study area. Suitable habitat is also present throughout the site. One individual was observed onsite during field investigations.

Osprey (Pandion haliaetus)--The osprey is designated as a species of special concern (Monroe County only) by FGFWFC and as threatened by FCREPA. It inhabits wooded edges of water bodies such as lakes, rivers, and bays. It utilizes tall trees, utility poles, and navigation channel markers for nesting. Birds were observed feeding onsite, and one active nest was found onsite at the southern edge of the proposed power block area. Another osprey nest was located just offsite along the edge of a large clay settling area south of the southern property boundary of the eastern tract.

Little Blue Heron (Egretta caerulea)--This medium-sized wading bird, like the great egret, inhabits all wetland systems in Florida including fresh and salt water. Prey consists of small fish, crustaceans, and insects. This bird is designated a species of special concern by FGFWFC and FCREPA due to habitat destruction. Found with other waders, it was observed occasionally on the site.

Great Egret (Casmerodius albus)--This large, white bird is found throughout Florida in virtually all wetland habitats from fresh to salt water. Due to loss of wetland habitats, FCREPA lists this bird as a species of special concern. Great egrets were the most common wading bird observed onsite. It was seen in all lakes, ponds, and ditches around the site.

Snowy Egret (Egretta thula)--Snowy egrets nest throughout Florida in both salt and fresh water wetlands. They frequently nest in mixed colonies with great egrets and tricolored herons; they feed on small fish and insects. Habitat destruction is attributed to its decline over the last half-century, although, it is still considered a common bird. It is currently listed as a species of special concern by FGFWFC and FCREPA. This bird was also commonly observed using the aquatic habitats onsite.

Tricolored Heron (Egretta tricolor)--This species occurs throughout Florida but tends to nest more in coastal areas than freshwater areas. They are commonly found either nesting or feeding with other waders and eat primarily small fish. Their status as a species of special concern by FGFWFC and FCREPA is again attributed to habitat loss. They were occasionally observed onsite feeding with other waders. However, no nest sites were found during site surveys.

Black-Crowned Night Heron (Nycticorax nycticorax)--This species is common throughout most of the United States and breeds and winters throughout Florida. They utilize virtually all shallow aquatic habitats and tend to forage at night. Population levels within the state are unknown and FCREPA has listed the species as one of special concern. Several individuals were repeatedly observed roosting and feeding along the willows bordering the unreclaimed lake on the northeast corner of the site. No nests were discovered, however.

Yellow-Crowned Night Heron (Nyctanassa violacea)--Similar to the black-crowned night heron, this species utilizes a wide range of wetland habitats in Florida. However, it appears that coastal areas (mangroves and mud flats) are favored. The species is listed as a species of special concern by FCREPA. None were observed onsite and due to its habitat preference, there is a low likelihood of occurrence onsite.

Least Bittern (Ixobrychus exilis)--This secretive, small heron inhabits both fresh and saltwater marshes and prefers dense stands of grassy vegetation. Its status in Florida is somewhat unknown, but FCREPA lists the species as one of special concern due to vanishing wetlands. Although not observed onsite, there is a high likelihood of occurrence due to suitable habitat onsite.

Glossy Ibis (Plegadis f. falcinellus)--This species utilizes many wetland types in the state and feeds in marshy or wet prairie areas. Principal food items include crayfish and insects. Its dependence on wetland habitats has caused FCREPA to classify this species as a species of special concern. As with other wading birds, it was observed feeding in some of the lakes onsite.

White Ibis (Eudocimus albus)--The white ibis also inhabits both fresh and salt water wetlands. They typically nest in large colonies and feed in shallow water. Principal food items are crayfish and insects. This species is one of the most abundant wading birds in the state but is declining due to habitat loss. Their status is listed as a species of special concern by FCREPA. This bird was also observed feeding onsite, although in small numbers.

Wood Stork (Mycteria americana)--Wood storks are listed as endangered by USFWS, FCREPA, and FGFWFC due to their continued population decline caused by the progressive loss of suitable feeding and nesting areas. As a result, their population status, colony locations, and reproductive success are closely monitored by FGFWFC and NAS through annual counts and ground and aerial colony surveys. Wood storks nest in cypress swamps and feed in freshwater marshes and flooded pastures and ditches.

A review of FGFWFC colony data compiled during annual aerial surveys indicates that no known colonies are located in the vicinity of the site. Individual storks or small flocks may feed or occur as transients throughout the study area that is suitable feeding habitat. Such areas include wet prairie and freshwater marshes, and flooded portions of fields and pastures. A few individuals were observed feeding on the site.

Limpkin (Aramus guarauna)--The limpkin inhabits slow-moving freshwater habitats such as rivers, streams, marshes, and lake shores of Florida. The limpkin feeds on freshwater snails and mussels. It is listed as a species of special concern by FGFWFC and FCREPA. No individuals were observed onsite although suitable habitat is available. Its likelihood of occurrence is considered high.

Florida Sandhill Crane (Grus canadensis pratensis)--The Florida sandhill crane is a nonmigratory resident and is listed as threatened by FGFWFC and FCREPA. Florida sandhill cranes nest and feed in shallow freshwater marshes and wet prairies throughout central and south Florida. Feeding also occurs in low-lying pastures, shallow marshes, and prairies. The primary reasons for their population decline are habitat loss and human encroachment of nesting and feeding areas. The range of the Florida sandhill crane includes the proposed plant site and it can be expected to be found occasionally in suitable non-forested wetland habitats onsite. No known nesting areas for the sandhill were identified in the site vicinity, however.

Red-Cockaded Woodpecker (Picoides borealis)--This species is listed as endangered by USFWS and FCREPA and threatened by FGFWFC. The red-cockaded woodpecker is usually restricted to pine flatwoods containing overmature longleaf pine stands affected by red-heart disease. Although this habitat extends throughout the southeastern United States, early harvesting of southern pines has reduced the number of preferable trees for these birds. Due to the limited acreage and age of pine flatwoods found onsite, there is a low probability of finding red-cockaded woodpeckers.

Southern Hairy Woodpecker (Picoides villosus auduboni)--Although little is known about this bird, it is believed to prefer heavily forested areas including pines, cypress stands, or hardwood swamps. The species is classified as one of special concern by FCREPA, but that may be due more to lack of its life history knowledge than anything. Since large tracts of forested lands do not exist onsite, the likelihood of occurrence for this species is expected to be low.

Florida Scrub Jay (Aphelocoma c. coerulescens)--Florida scrub jays, listed as threatened by FGFWFC, FCREPA, and USFWS, occur in xeric scrub habitats in scattered locations along the central Florida ridge and along coastal ridges. Florida scrub jays have specific habitat requirements and require oak scrub along with saw palmetto, scattered sand pine, and rosemary. They tend to avoid wetlands and forested communities. The decline of Florida scrub jays is apparently caused by the loss of scrub habitat which has been converted to residential developments, citrus groves, and pastureland. Two individuals were observed onsite in the proposed power block area; however, repeated efforts failed to locate individuals on subsequent field inspections.

Sherman's Fox Squirrel (Sciurus niger shermani)--Sherman's fox squirrel, which is designated as threatened by FCREPA, as a species of special concern by FGFWFC, and under review for listing by USFWS, inhabits northern and central peninsular Florida where suitable habitat such as sandhill and scrub oak communities exist. Alteration of its habitat is a major reason for its decline. A few individuals were observed in the oak/pine woods in the northwestern corner of the western tract in an area not scheduled for power plant development (see Section 4.4 and Figure 4.4.1-1). Even more individuals were observed offsite along areas of Albritton Road to the west of the site.

Florida Mouse (Podomys floridanus)--The Florida mouse is listed as threatened by FCREPA, as a species of special concern by FGFWFC, and is currently under review for listing by USFWS. This burrowing species is confined to xeric scrub habitats of peninsular Florida, and the principal habitat of this Florida endemic is sand pine scrub in an early successional stage. It also occurs in xeric longleaf pine-turkey oak and scrubby flatwood associations. It is often found as a commensal with gopher tortoises. Although some suitable habitat is found onsite, the range of this species is marginal in southern Polk County, so its likelihood of occurrence is listed as low.

Round-Tailed Muskrat (Neofiber alleni)--This rodent, also called the Florida water rat, lives in and around freshwater marshes composed of dense maidencane stands and pickerelweed. Although this species is found throughout much of Florida and southeastern Georgia, the round-tailed muskrat is designated a species of special concern by FCREPA and is currently under review for listing by USFWS. Because the muskrat is nocturnal and its presence is sporadic even in suitable habitat, accurate population estimates are difficult to obtain. Since the preferred habitat of this species is extremely limited onsite, its likelihood of occurrence is considered low.

Florida Panther (Felis concolor coryi)--Currently, panthers in Florida occur primarily in large tracts of undisturbed lands south of the site. The majority of panther sightings are from Big Cypress Swamp in Collier County. In Charlotte County, Telegraph Swamp provides suitable habitat. This species is listed as endangered by USFWS, FGFWFC, and FCREPA.

Numerous cat tracks (primarily bobcat) were observed onsite. Although a larger cat was actually observed by field personnel, its tracks were too small for an adult panther. Discussions with FGFWFC's biologists seem to indicate that the cat may have been a jaguarundi (Felis yagouaroundi), which sporadically occur in Florida. In either case, it was FGFWFC's opinion that due to the range and habitat requirements of the panther, it is highly unlikely one would be found onsite.

2.3.6.2 Pre-existing Stresses

Aquatic Systems

As discussed in Section 2.1, the wetland headwater areas of Little Payne Creek and Payne Creek were originally located in the area of what is today the Polk Power Station site. However, due to phosphate mining on the property prior to 1991, these headwaters and any recognizable creek beds have long been eliminated. Prior to and during the time of ecological investigations, a headwater area just upstream to the unnamed tributary to South Prong Alafia River was also mined. However, the floodplain forest associated with the tributary was left undisturbed. The offsite aquatic sampling stations along Little Payne and Payne Creek are located within channelized portions of the original stream courses. The two lakes sampled on the site have resulted from mining. One lake was reclaimed recently; the other 30-year old lake, an old mine cut, was not reclaimed.

Terrestrial Systems

Phosphate mining is the greatest pre-existing stress to biota on and in the vicinity to the site. Over the life of the mine, 4,115 acres (94.6 percent) of the property will be or have been mined or disturbed through mining operations. Mining results in elimination or conversion of vegetation and wildlife habitats and alterations to the topography, surface water drainage, groundwater levels, and soil compositions. Areas within the western tract and at the northwestern corner of the eastern tract were still being mined during the site investigations. Currently, only portions of the northern area of the eastern tract have been reclaimed. It is proposed that the entire site, except for unmined areas and the proposed power plant facilities will be completely reclaimed.

Other secondary stresses to the remaining vegetation and wildlife habitats on the property associated with mining are fugitive dust and hydrological alterations. Fugitive dust particles from nearby mining operations are carried by wind and deposited on the leaf surfaces of vegetation. This accumulation of dust can result in lower transpiration rates and photosynthesis causing physiological stress during periods of drought. Except for the presence of fugitive dust, the majority of vegetation surveyed near mining operations appeared to be relatively healthy.

Alterations to the surface water and groundwater have resulted in drastic changes to the hydroperiods of remnant wetland associations. Most of the wetlands onsite have been invaded by weedy plants that flourish due to hydrological changes. Invasion by these competitive plants results in changes in community structure, species dominance, and species diversity.

Prior to 1981, 945 acres (21.7 percent) of land had previously been converted and maintained for agricultural uses (i.e., citrus groves and pastureland). Although not as ecologically devastating as mining, agriculture also results in major changes to native communities. With the exception of mining, agriculture is the predominant land use within Polk County. Approximately 451 acres or 10.4 percent of the land on the Polk Power Station site will be reclaimed or left under its current land use (i.e., pasture and citrus).

2.3.6.3 Measurement Programs

Aquatic Ecology

The Polk Power Station site is located within three drainage basins: South Prong Alafia River, Payne Creek, and Little Payne Creek. The portion of the site east of SR 37, to be devoted to plant facilities and the cooling reservoir, lies primarily within the Little Payne Creek drainage basin. Most of the site has been extensively impacted by previous and ongoing phosphate mining activities. The portion of the site to the west of SR 37 lies primarily within the South Prong Alafia River and Payne Creek drainage basins.

As discussed in Section 3.0, stormwater drainage after development/reclamation of the site will be discharged to the South Prong Alafia River, Payne Creek, and Little Payne Creek in compliance with applicable reclamation and stormwater management requirements. In addition, cooling reservoir discharges will be directed to the Little

Payne Creek. The aquatic ecology baseline studies were designed to provide needed data on important species, populations, and habitats for ecological impact assessments in all three site drainage basins.

The monitoring program focused on collecting and analyzing macroinvertebrate and fish samples to describe existing biological communities. The field studies conducted to define the biological communities in the receiving waters included two macroinvertebrate and fisheries field efforts: one in March-April and the other in August 1991.

In addition to the onsite collection of empirical data, the available literature pertaining to the region of the Tampa Electric Company project site involving macroinvertebrate communities and fish populations was also reviewed.

The aquatic sampling program was described in the environmental licensing plan of study which was reviewed and approved by reviewing agencies (ECT, 1991b). The number, location, and condition of aquatic sampling stations, as well as detailed information on aquatic sampling and other data collection methods, data analyses and results are provided in the following sections.

Description of Sampling Stations

The aquatic ecology monitoring program focused on providing the baseline information needed to assess potential impacts associated with the cooling reservoir, stormwater, or wastewater discharges on the receiving water bodies within the three drainage basins associated with the Polk Power Station site. Seven aquatic ecology sampling stations (AE-1 through AE-7) were located in these drainage systems to characterize the important species, seasonal variability, community structure, and pre-existing stresses associated with the biological communities that may be impacted by construction and operation of the plant (see Figure 2.3.6-1). These data were also correlated with water quality data collected at the same sampling station locations, to aid in the interpretation of baseline information (see Section 4.2.1.2).

Three aquatic ecology stations were located in the South Prong Alafia River drainage basin. Station AE-1 was located on a small, unnamed tributary to the South Prong Alafia River at the northern property boundary along Albritton Road. The tributary is a first-order, intermittent stream located within a mixed hardwood swamp surrounded by citrus grove and pasture. The stream bed is very narrow and shallow at this location. The stream almost completely disappears within a lowland, floodplain forest situated within property boundaries. During the March 1991 sampling period, a portion of the stream was pooled. Water depth was generally 6 inches or less. The stream width averaged less than a foot at the sampling station. The water was relatively cool during sampling events because of shading by trees. The substrate consists of a mixture of leaves, sand, silt, and detritus. Vegetation growing in the stream includes soft rush, false nettle, dog fennel, buttonbush, and water hemlock. Canopy trees growing at this station include red maple, laurel oak, sweet bay, and storax. Two additional aquatic sampling stations were located on the South Prong Alafia River along Bethlehem Road at bridged crossings with one as a reference or upstream station (Station AE-3) in Polk County and the other a downstream site (Station AE-2) located in Hillsborough County (see Figure 2.3.6-1). The South Prong Alafia River is a relatively shallow stream situated just north-northwest of the property. Depth within the narrow stream bed is generally less than 1 ft. The creek bottom is typically a combination of leaves, detritus, sand, and silt. There is a moderate input of allochthonous detrital material into the system, primarily from leaf fall. Abundant leaf packs, undercut banks, instream woody substrates, and aquatic vegetation provide ample habitat for stream macroinvertebrates. Shoreline vegetation at Station AE-2 includes elderberry, red maple, dog fennel, smartweed, willow, paragrass, marsh pennywort, pop ash, false nettle, and Florida parietaria. Vegetation in the vicinity of Station AE-3 includes a canopy of laurel oak, live oak, stiff cornel, pop ash, and red maple. Shoreline vegetation at this station includes Florida parietaria, string lily, peppervine, false nettle, cranesbill, lizard's tail, cat-brier, buttonbush, galingale, and butterweed.

Station AE-4 was located near the highly disturbed headwaters of Payne Creek at the point where SR 37 crosses the channelized portion of Payne Creek. The headwater area of Payne Creek situated upstream to the west of Station AE-4 has been completely altered due to current mining activities. The channel at the station exhibited no appreciable flow. The sediment consists of deep layers of anaerobic muck. During sampling, hydrogen sulfide bubbles were released as the Ponar penetrated the sediment. Channel width at this site is approximately 15 ft. Instream vegetation consisted of cattail, spatterdock, water lettuce, water fern, pickerelweed, willow, smartweed, clubrush, and soft rush.

Station AE-5 was located in the drainage canal that now replaces a portion of the headwaters of Little Payne Creek at Fort Green Road. Flow at this station was considerable during sampling episodes. Because of the strong flow, the substrate is primarily sand with some silt around vegetated areas. Instream vegetation is abundant and consists of dock, water pennywort, water primrose, water hyacinth, and Florida elodea. Bank vegetation at this station includes primrose willow, water hemlock, false nettle, shrub verbena, Spanish needles, and wax myrtle. Phosphate mining has occurred upstream of this site and a railroad crossing is approximately 100 ft upstream of the station.

Stations AE-6 and AE-7 were both located in phosphate mining-created lakes. Station AE-6 was an approximately 73-acre reclaimed lake. The sampling station was located along the northeastern shore. Depth at the sample site was 2 ft or less. The substrate is primarily clay, occasionally mixed with small quantities of sand. Conspicuous vegetation at this station consisted of primrose willow, marsh pennywort, galingale, smartweed, and hydrilla. Planted vegetation included common flag and bulrush. Station AE-7 was a >30-year-old mine cut with steep side slopes that was never reclaimed. Samples were collected from the southeastern shore in a bed of cattails at a depth of approximately 1 to 2 ft within a sandy substrate area. Vegetation at this station also includes primrose willow, paragrass, and willow.

Data Collection and Analyses

Macroinvertebrate Sampling--Macroinvertebrate sampling included benthic infaunal communities and epifaunal communities. Benthic infaunal organisms are normally considered indicators of the relative health of a system. In addition to the important role benthic communities play at the base of the aquatic food web as primary, secondary, and detrital consumers, benthic invertebrates are thought to reflect changes and/or fluctuations in environmental quality. Benthic organisms are good indicators of the relative ecological status of aquatic systems because they generally have limited mobility and cannot escape from deteriorating environmental conditions.

Adequate description of the structure and function of any benthic community considers spatial and temporal variables using both quantitative and qualitative methods. The use of techniques designed to measure spatial changes in communities is especially important for this project since large fluctuations in community composition may be expected within the various water bodies. Seasonal measurements allow the assessment of naturally occurring changes in macroinvertebrate assemblages associated with seasonal differences in environmental conditions. Therefore, the macroinvertebrate studies consisted of sediment grab sampling of the infaunal (organisms living within the substrate) benthic community and of artificial substrate sampling of the epifaunal (organisms living on vegetation, wood, and other substrates) communities in March and August 1991.

The epifaunal communities were sampled by allowing them to colonize Hester-Dendy artificial substrate samplers. At each station, four samplers were suspended in the water column at mid-depth and allowed to incubate for 4 weeks or approximately 28 days. Infaunal communities were sampled with a petite Ponar grab. Five Ponar samples were collected along a transect to identify the populations inhabiting different substrate locations. Each station was marked along the shoreline with flagging.

Artificial substrate samples were carefully placed within screw lid, plastic jars while underwater and then preserved in 95 percent ethanol/rose bengal solution. Ponar samples were washed in the field through a U.S. No. 30 sieve (595-micrometer openings), placed and double-bagged in pre-labeled Ziploc® freezer bags, and preserved with a 20 percent formalin/rose bengal solution. Both the artificial substrate and Ponar samples were then stored in coolers and immediately transported to the laboratory for analysis.

In the laboratory, samples were washed of preservative, sorted from the debris, and identified to the lowest practical taxonomic level. Three artificial substrate and four Ponar grab samples were analyzed from each station. The additional samples were retained in the event that the replicates analyzed did not provide an adequate sample size. The Shannon Weaver diversity index as described by Wilhm and Dorris (1968) was used to calculate a species diversity for each sample and each station.

Fisheries Sampling--The fisheries associated with the Polk Power Station site were sampled once in the spring dry season and again in the summer wet season. Seven fisheries sampling stations were established which corresponded with data collection stations for water quality and aquatic macroinvertebrates.

The majority of the fish species collected were obtained with a 30-ft long, 6-ft tall seine having a 0.5-centimeter (cm) mesh size. In the larger, flowing streams (Stations AE-2, AE-3, AE-4, and AE-5), one seine was stretched across the stream and tended by one sampler, while two other samplers moved upstream overland with a second seine. The second seine was stretched across the stream and vigorously worked within the vegetation along the banks downstream towards the first seine. Once the second seine reached the first, the first seine was looped around the second and dragged toward one stream bank. This method proved to be very effective and tended to achieve both more numerous individuals and greater species diversity than all other methods attempted. In streams with low flow and narrow cross section (Station AE-1), a 0.5-cm mesh D-framed dip net was used to sample the limited fishery.

Sampling in the reclaimed lake (Station AE-6) and an old mine cut (Station AE-7) was primarily performed using a large seine. The net was worked quietly out from the bank to the maximum depth (6 ft), and looped around to return to the bank. Care was taken to minimize any disturbance to the desirable aquatic emergent vegetation when the seine was dragged ashore.

Individuals captured during the collection effort were identified to species and tallied by station. If taxonomy was uncertain, specimens were preserved in 10 percent formalin for later identification. Unknowns were labelled ("Unknown A," "Unknown B," etc.) and most individuals were released alive after being counted. Preserved specimens were identified to species under magnification utilizing taxonomic keys. The preserved individuals are archived as voucher specimens as dictated by the project plan of study.

Terrestrial Ecology

The terrestrial ecology surveys conducted for this project were specifically designed to obtain the baseline information necessary to characterize the site as required by specific regulatory requirements and as needed for the impact assessment. The required information includes: (1) identification of important flora and fauna on and in the vicinity of the site, including state and federally listed species; (2) their habitats, abundance and distribution; (3) the relationship between species and their environment; and (4) the identification of the extent, distribution, type, successional status, preexisting stresses, condition, species composition and diversity, and function of vegetation communities on the site, particularly wetlands. The referenced ecological information on the site's biota under existing conditions, i.e., prior to power plant construction, will serve as the basis for projecting impacts of the proposed facility to ecosystem structure and function, as well as to species composition and diversity.

As preparation for site reconnaissance and field surveys, a literature search/agency consultation was conducted to review maps and aerial photographs, current listings and records of endangered and threatened species, and published material dealing with regional biota, pre-existing environmental stresses, and effects of power plant construction and operation on plant and animal species. After the appropriate documents, records, photographs, and maps were reviewed, two senior ecologists, a botanist and a wildlife biologist, conducted a preliminary site reconnaissance in February 1991. The purpose of this site walkover was to verify any previously collected information, locate potentially sensitive or unique areas, classify major vegetation communities on the site, identify land uses and existing stresses and impacts, identify any observed endangered or threatened species, determine the number and locations of sampling transects in each major plant community/wildlife habitat selected for evaluation, identify the locations of appropriate areas for seasonal threatened and endangered species surveys, and identify the locations of major wetlands to be evaluated. Subsequently, vegetation and wildlife surveys were scheduled for both dry and wet seasons.

Because of the highly altered condition of the property due to mining and the relative size of the power block as compared to the overall dimensions of the site (1:4 ratio), it was necessary to focus ecological investigations upon those components and processes associated with the site which are most vital to defining the character and functions of the ecosystems, and those which are most pertinent for defining or assessing impacts of the proposed action. The criteria for selection of the systems to be studied included, but were not limited to, the following:

- Major communities or ecosystems comprising 10 percent or more of the areal extent of the property, and which are characteristic of the site;
- Unique features which are rare within the vicinity or have restrictive environmental requirements;
- Areas whose functional integrity could be critical for a species listed in one of the prior categories, or whose integrity is necessary for maintenance of offsite environmental quality; and
- Components or processes identified as those most likely to be altered by the proposed action or facility.

These criteria were generally used in the selection of sampling areas and organisms to be sampled. Standard field sampling, laboratory analysis, chain-of-custody, and documentation procedures for terrestrial ecology were followed. The following describes the vegetation and wildlife sampling efforts used for this project.

Flora

All vegetation communities and associations on the proposed plant site were identified and characterized by species composition and habitat structure. Quantitative sampling of vegetative strata was performed in selected plant communities to provide information on the abundance and relative importance of the more common plant species in each community. Comparisons of species composition among tree canopy and shrub and ground covers, as well as the comparisons between communities, yield information valuable to understanding the relationships between species, successional status of communities, and species-environmental relationships. Understanding these relationships provides a basis for determining the impacts of project construction and operation, as well as facility construction and operation on the regional biota, and information on the upland, wetland, and aquatic communities that can be utilized for reclamation/mitigation purposes. The areas selected for quantitative evaluation within the plant communities under investigation met the following criteria:

- Must be relatively undisturbed and therefore, remnant or characteristic of pre-existing or existing plant communities; and
- Must be within a homogeneous area indicative of the plant community(s) situated onsite.

Nine vegetation transects were established on the site to quantitatively evaluate seven separate community types: mixed oak/pine woods, disturbed marsh, undisturbed marsh, old field, mixed hardwood swamp, maple swamp, and mixed shrub swamp. The transects were located in communities within the unmined areas of the site, some of which were potentially scheduled for power plant development.

After an area had been selected, the trees, shrubs, and ground cover were quantitatively sampled using standard sampling methodologies (Mueller-Dombois and Ellenberg, 1974). The following standard sampling techniques were used to evaluate three vegetative strata (herb, shrub, and tree) within each community type studied.

Herb--Vegetation transects were established across the most homogeneous, undisturbed areas of upland communities studied. Within wetland systems, the transects were initiated at the outermost edge of the subject community and extended directly waterward. Twenty 1-square meter (m^2) quadrats, typically spaced at 5-meter (m) intervals, were established along a linear transect within each area sampled that exhibited only a herbaceous layer (old fields, marshes). In systems that only contained herbaceous and shrub strata (overgrown fields, cutover forests, shrub swamps), the 1-m^2 quadrats were nested within 4- by 4-m shrub quadrats typically spaced at 4-m intervals (see Shrub). In wooded areas, the herbaceous quadrats were nested within shrub/tree quadrats situated at 10-m intervals. The termini of each transect were monumented with orange surveyor's flagging. The quantitative herbaceous sampling was either conducted in both the spring and summer or summer only. The general methodology consisted of overlaying a portable 1- by 1-m PVC frame over each sampling point in order to exactly define the spatial limits of each plot. By direct overhead visual inspection, the percent coverage of each species within the herb stratum was recorded in tabular form on field data sheets.

To qualify for inclusion, the individual herbaceous/woody plants within the herb quadrat had to fulfill the following criteria:

- Less than 0.5-m in height;
- Vascular;
- Rooted or floating within the quadrat;
- Aerial portions located within quadrat (e.g., individual plants rooted on raised hummocks and logs not included);

- Visible (e.g., material not visible during high water stages are not recorded); and
- Live material.

In addition, nonherbaceous items such as leaf litter, debris, etc., that occupied space within the herb stratum of the quadrat were recorded collectively.

Shrub--Within shrubby or wooded areas, a minimum of twenty 4- by 4-m shrub plots was established along linear transects. In wooded areas, these shrub quadrats were nested within 10- by 10-m tree quadrats spaced at 10-m intervals. In shrub swamps, and overgrown fields, shrub quadrats were spaced at contiguous intervals along a belt transect. Quantitative sampling of shrub quadrats was typically conducted in the spring or summer. The general methodology consisted of stretching a meter tape perpendicular to the linear transect to establish the spatial limits of each plot. By visual inspection, the percent coverage of each species within the shrub stratum was recorded on field data sheets.

To qualify for inclusion, the individual shrubs within the quadrat had to fulfill the following criteria:

- Greater than 0.5 m in height,
- Woody,
- Rooted within the quadrat,
- Aerial portions located within the quadrat,
- Live material, and
- Less than 10 cm diameter-at-breast-height (dbh).

Tree--Within each forested area selected, a minimum of twenty 10- by 10-m tree plots was spaced at contiguous intervals along a belt transect. Quantitative sampling of the tree canopy within each wooded area was typically conducted in the spring or summer. The general methodology consisted of stretching a meter tape perpendicular to the linear transect to establish the spatial limits of each plot. Each live tree ≥10 cm dbh was assessed for identity of species, general condition, and dbh.

All plant species that were easily identifiable in the field were identified to species level and recorded by vegetative stratum. For plant species not easily identifiable in the field, voucher specimens were collected, pressed, dried, and verified at the University of South Florida Herbarium.

Data collected during the study were analyzed to determine species' dominance, density, and frequency. Relative values were also calculated to determine overall species importance. Relative frequency was calculated by dividing the number of quadrats in which a species occurred by the total occurrence for all species. Relative dominance was determined by dividing the total percent cover for a species by the total percent cover for all species. The relative density of trees was calculated as the number of individual trees over the area sampled (density) for a species divided by the total density for all species. Importance values were calculated as either the sum of the relative frequency, relative dominance, and relative density (trees), or the sum of the relative frequency and relative dominance (shrub and ground layers). Combining these relative values into a single importance value reflects different measures of the importance of a species in each plant community studied on the project.

A series of vegetation association transects were also located within the unmined areas of the property on both the eastern and western tract in order to determine species composition by community type. A qualified botanist recorded all the plant species observed while walking along an imaginary linear transect crossing two or more discernable community types. The information was then compiled into a table provided in Appendix 11.10.2.

Fauna

This section describes the methodologies used in collecting wildlife data. Objectives and frequency of sampling are described for each group of species. Methodologies were consolidated to include as many species as possible by using each method. A majority of the information needed for endangered and threatened species was obtained while conducting studies on animal communities.

Sampling was conducted seasonally (wet and dry season) to determine variations in abundance and distribution of resident species and utilization of the site by migrant species. Each major seasonal survey was scheduled at a time when conditions were generally typical of that particular season.

Birds, mammals, reptiles, and amphibians were surveyed by appropriate qualitative techniques. Each observation was recorded in a field notebook by date and habitat type.

Mammals--Mammals of the site were sampled during spring and fall surveys. Small mammal trapping was conducted in five unmined areas which represented the most common terrestrial and wetland habitats on the site. The five communities sampled included two secondary-growth mixed oak/pine woods, two old fields, and one ephemeral marsh system. Twenty permanent sampling stations were established along flagged transects in each of the five communities. One large and a small Sherman live trap were placed at each of the stations. Altogether, 200 traps were set each evening and inspected each morning. Trapping occurred over a consecutive 5-day period in the spring and again in the late summer. There was a total of 1,000 trap-nights per event.

Captured mammals were identified to species with the aid of field guides and then released unharmed on the site. Larger mammal populations were identified by direct observations or indirect signs such as tracks, scats, dens, burrows, etc. Surveys of large mammals occurred during seasonal walkovers of the site.

Birds--Birds of the site were censused in the spring and fall during early morning and evening surveys along pre-established transects on different areas of the project site.

Birds were identified by direct sightings or calls during timed surveys in each of the principal onsite habitats by an experienced ornithologist.

<u>Amphibians and Reptiles</u>--Amphibians and reptiles of the site were identified during searches of suitable terrestrial and aquatic habitats. Such searches of suitable habitat (e.g. dead falls, burrows) were incidental to other field efforts.

Wetland Evaluations

A detailed analysis of the type, structure, extent, and functional status of onsite freshwater wetlands was also conducted. The purpose of the wetland evaluation was to identify and describe the wetlands associated with the site, to evaluate the functional quality of those wetlands, and to determine potential effects to offsite wetlands, which are adjacent or connected to onsite wetlands or are affected by the withdrawal of groundwater.

Wetlands onsite were evaluated with regard to the functions provided such as water storage, erosion control, maintenance of water quality, and wildlife habitat. The evaluation was based on wetland size and productivity as determined by percent vegetation cover, hydroperiod, species richness, degree of connection with other wetlands, and soil characteristics. The size and degree of connection of the wetlands was initially estimated with the aid of aerial photographs; the areas were then ground-truthed to determine the exact boundaries of wetlands. The landward extent of wetlands was determined using plant indicator species, soils, and hydrology as used by federal, state, and regional agencies in establishing their respective jurisdictional authorities. Wetland limits were mapped and acreages of potential impact were then calculated.

Consultations with FDER, SWFWMD, and USACE were conducted to establish each agency's respective jurisdictional authority over the wetlands and surface waters on the site.

Threatened and Endangered Species Analysis

Current listings of endangered and threatened species prepared by USFWS, FNAI, and FCREPA (plant and animal species); FGFWFC (animal species only); and FDACS (plant species only) were reviewed to determine potential occurrence within the study area based upon habitat suitability and range of distribution. Contacts were made with FGFWFC, USFWS, and FNAI to review current files/maps depicting any important species location records within or up to 1 mile outside of project boundaries. The property and adjacent lands were searched for important species from March to December 1991 and January to March 1992 during both quarterly and random episodes. The time expended during seasonal surveys varied depending on species characteristics and the probability of endangered species occurrence.

Pre-Existing Stress Surveys

Pre-existing stress surveys were also conducted to identify existing natural or man-made stresses which do, or have the potential to, adversely impact the ecological conditions, or alter the diversity, abundance, or distribution of plants and animals on the site and surrounding area. This stress survey was conducted during the late summer of 1991 to coincide with a period of maximum plant emergence and wildlife abundance. The purpose of such a survey was to document existing impacts prior to site clearing activities for the proposed facilities.

2.3.7 METEOROLOGY AND AMBIENT AIR QUALITY

2.3.7.1 Climatology/Meteorology

The central Florida climate is classified as subtropical with maritime influences from the Atlantic Ocean and the Gulf of Mexico. Summers are long, warm, and relatively humid, while winters are generally mild because of the southern latitude and the warming influence of the Gulf Stream.

Table 2.3.7-1 provides a summary of monthly mean and extreme temperatures based on NWS data collected at Bartow for the period-of-record 1941 through 1980 (NWS, 1990). Bartow, located 25 kilometers (km) northeast of the Polk Power Station, is the nearest NWS surface observation station. January exhibits the lowest mean minimum temperature (49.2°F) and the lowest normal mean monthly temperature (61.2°F). The highest normal mean maximum temperature (92.6°F) and the maximum normal mean monthly temperature (82.4°F) occur in August. The highest and lowest record temperatures of 103°F and 18°F were experienced in June 1977 and December 1962, respectively.

Based on the same 40-year record (NWS, 1990), normal annual rainfall is approximately 53 inches. The monthly statistics (see Table 2.3.7-1) show the rainy season to begin in May or June and end in early September. Summer rainfall is generally derived from local showers or thunderstorms. The highest normal monthly rainfall is 8.5 inches in July. November and December are the driest months, with an average of approximately 2 inches of precipitation. Record monthly precipitation occurred in July 1960, when 17.6 inches of rain were recorded.

While the NWS data collected at Bartow are adequate for climate characterization, the data are not usable as a basis for air dispersion modeling. The NWS station at the Tampa International Airport, 62 km northwest of the Polk Power Station, is the nearest first-order observation facility with a database adequate for dispersion modeling. Thus, consistent with FDER guidance, NWS surface and mixing height observations for Tampa were used as dispersion modeling input.

Table 2.3.7-1. Meteorological Data from Bartow, Florida (1941 to 1980)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
<u>Total Monthly Precipitation (inches)</u>													
Average	2.27	2.97	3.53	2.51	4.57	7.30	8.48	7.39	6.62	2.83	2.13	2.17	53.42
Maximum	7.79	8.42	11.53	8.40	13.05	15.03	17.58	14.39	15.59	9.10	7.40	11.38	83.44
Minimum	0.03	0.24	0.05	0.00	0.02	0.73	2.91	2.60	1.04	0.20	0.00	0.15	37.19
<u>Maximum Daily Precipitation (inches)</u>													
Average	1.00	1.44	1.31	1.24	1.61	2.34	2.07	1.86	2.10	1.23	1.10	1.05	
Extreme	3.36	4.07	4.72	3.56	4.30	9.82	4.00	4.64	6.75	5.06	4.57	3.49	
<u>Monthly Average of Daily Maximum Temperature (°F)</u>													
Maximum	83.1	82.3	87.3	90.3	94.4	95.4	94.9	95.3	93.5	88.6	85.0	79.9	89.1
Average	73.3	75.3	79.9	84.8	89.4	91.7	92.3	92.6	90.4	85.4	79.3	74.4	84.1
<u>Monthly Average of Daily Minimum Temperature (°F)</u>													
Minimum	37.0	43.5	49.4	53.5	60.7	66.8	69.3	68.3	66.5	59.2	48.8	44.5	55.5
Average	49.2	50.7	55.2	59.8	65.3	70.4	71.8	72.1	71.1	64.3	56.7	51.1	61.4

Source: NWS, 1990.

Table 2.3.7-2 provides a summary of monthly mean and extreme temperatures for Tampa. January exhibits the lowest mean minimum temperature (49.5°F) and the lowest normal mean monthly temperature (59.8°F). The highest normal mean monthly temperature (82.3°F) and the highest mean maximum temperature (90.3°F) occur in August. Table 2.3.7-2 provides a summary of monthly mean and extreme precipitation and relative humidity. The highest normal monthly precipitation (7.64 inches) occurs in August, and the lowest normal monthly precipitation (approximately 1.7 inches) occurs in November and April. Comparing the Tampa temperature and precipitation record with the Bartow records demonstrates that the two stations are climatologically very similar and that using Tampa meteorological data for dispersion modeling of the Polk Power Station is appropriate.

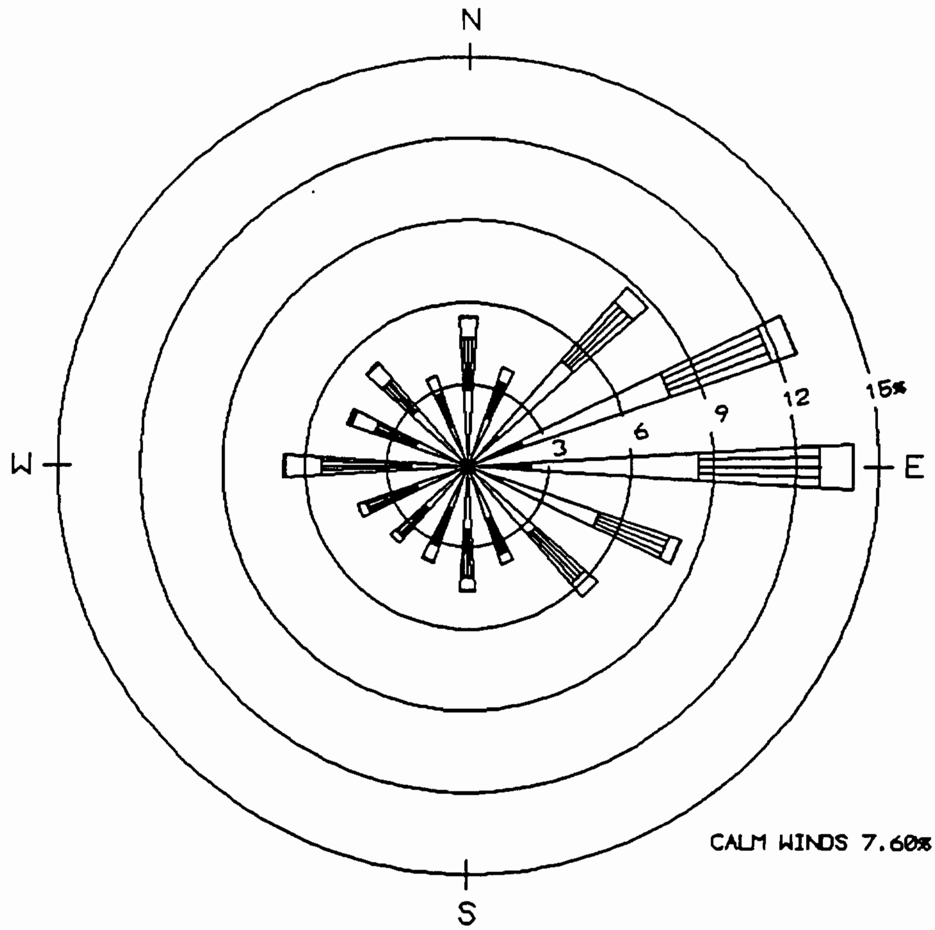
Figure 2.3.7-1 presents a 5-year annual wind rose (1982 to 1986) based on wind direction and windspeed observed at the Tampa International Airport. Figure 2.3.7-2 presents 5-year seasonal wind roses for the same station. The values presented in the figure represent the percent of the time that the wind blows from a particular direction at a given speed. The predominant wind direction during the 5-year period was from the east, which occurred approximately 14 percent of the time. Wind directions from the east-northeast, northeast, and east-southeast each occurred more than 8 percent of the time. March has the highest mean monthly windspeed of 9.7 miles per hour (mph). The lowest mean monthly windspeed of 7.2 mph occurs in August. An easterly prevailing wind direction is evident during most of the year. The annual average windspeed is 8.6 mph. The highest recorded windspeed was 67 mph in June 1964. Table 2.3.7-3 presents detailed annual windspeed and direction information.

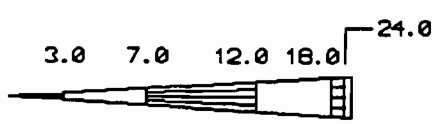
Table 2.3.7-4 presents the annual and seasonal pattern of atmospheric stability in the Tampa area, as determined by NWS. During the summer, unstable conditions are present approximately 38 percent of the time because of strong insulation. During the winter, the occurrence of unstable conditions is reduced to 16 percent of the time. Neutral stability is more common in the winter, occurring approximately

Table 2.3.7-2. Meteorological Data from Tampa, Florida (1951 to 1980)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
<u>Monthly Precipitation (inches)</u>													
Normal	2.17	3.04	3.46	1.82	3.38	5.29	7.35	7.64	6.23	2.34	1.87	2.14	46.73
Maximum	8.02	7.95	12.64	6.59	17.64	13.75	20.59	18.59	13.98	7.36	6.12	6.66	
Minimum	0.00	0.21	0.06	0.00	0.17	1.86	1.65	2.35	1.28	0.16	0.00	0.21	
<u>Maximum Daily Precipitation (inches)</u>													
Extreme	3.29	3.68	5.20	3.70	11.64	5.53	12.11	5.37	4.67	2.54	4.22	3.28	12.11
<u>Monthly Temperature (°F)</u>													
Normal	59.8	60.8	66.2	71.6	77.1	80.9	82.2	82.2	80.9	74.5	66.7	61.3	72.0
Average Maximum	70.0	71.0	76.2	81.9	87.1	89.5	90.0	90.3	88.9	83.7	76.9	71.6	81.4
Average Minimum	49.5	50.4	56.1	61.1	67.2	72.3	74.2	74.2	72.8	65.1	56.4	50.9	62.5
<u>Relative Humidity (percent)</u>													
Hour 01	85	83	83	82	82	84	85	87	86	85	86	85	84
Hour 07	86	86	86	87	86	87	88	91	91	88	88	88	88
Hour 13	59	56	55	51	53	60	63	65	62	57	57	59	58
Hour 18	73	69	67	61	62	69	73	76	75	71	74	74	70

Source: NWS, 1990.





WIND SPEED CLASS BOUNDARIES
(MILES/HOUR)

NOTES:
DIAGRAM OF THE FREQUENCY OF OCCURRENCE FOR EACH WIND DIRECTION. WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING. EXAMPLE - WIND IS BLOWING FROM THE NORTH 5.5 PERCENT OF THE TIME.

WINDROSE
STATION NO. 12842
Tampa, Florida
PERIOD: 1982-1986

FIGURE 2.3.7-1.

5-YEAR ANNUAL WIND ROSE FOR TAMPA INTERNATIONAL AIRPORT (1982-1986)
Source: ECT, 1992.

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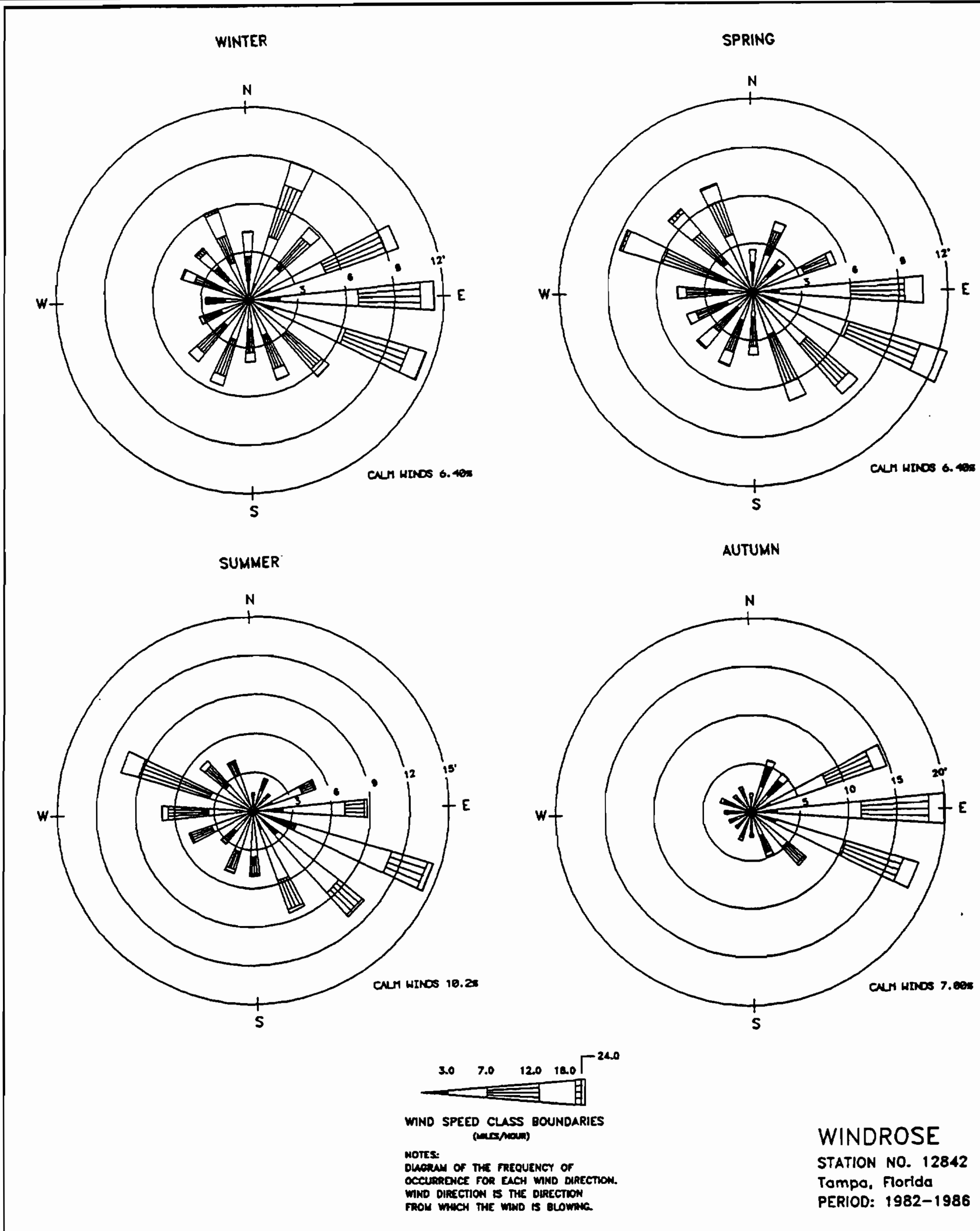

FIGURE 2.3.7-2.

5-YEAR SEASONAL WIND ROSE FOR TAMPA INTERNATIONAL AIRPORT (1982-1986)

Source: ECT, 1992.

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Table 2.3.7-3. Annual Average Frequency Distribution of Wind Direction and Windspeed for Tampa, Florida, from 1982 through 1986

	Frequency Distribution Speed (knots)						
Direction	0 to 3	4 to 6	7 to 10	11 to 16	17 to 21	than 21	Total
N	0.00744	0.02059	0.01917	0.00719	0.00034	0.00000	0.05473
NNE	0.00533	0.01372	0.01406	0.00502	0.00012	0.00000	0.03824
NE	0.01541	0.03640	0.02880	0.00710	0.00014	0.00000	0.08784
ENE	0.02158	0.05661	0.03911	0.00947	0.00021	0.00000	0.12699
E	0.02349	0.06095	0.04434	0.01198	0.00016	0.00007	0.14099
ESE	0.01364	0.03781	0.02677	0.00427	0.00007	0.00005	0.08261
SE	0.00747	0.02615	0.02424	0.00607	0.00012	0.00000	0.06405
SSE	0.00431	0.01639	0.01422	0.00356	0.00002	0.00000	0.03850
S	0.00552	0.01785	0.01753	0.00477	0.00034	0.00016	0.04617
SSW	0.00305	0.01353	0.01511	0.00568	0.00048	0.00009	0.03795
SW	0.00475	0.01661	0.01417	0.00251	0.00012	0.00002	0.03819
WSW	0.00414	0.01618	0.01965	0.00299	0.00007	0.00005	0.04307
W	0.00458	0.01620	0.03336	0.01278	0.00068	0.00025	0.06787
WNW	0.00553	0.01502	0.01611	0.00883	0.00142	0.00037	0.04727
NW	0.00729	0.02031	0.01481	0.00726	0.00075	0.00021	0.05063
NNW	0.00448	0.01123	0.01258	0.00657	0.00021	0.00000	0.03507
Total	0.13802	0.39556	0.35402	0.10605	0.00524	0.00126	1.00015

Note: Total relative frequency of calms distributed = 0.0760.

Source: ECT, 1992.

Table 2.3.7-4. Annual and Seasonal Average Distribution of Atmospheric Stability Classes for Tampa, Florida (1982 through 1986)

	Occurrence (%) of Stability Class					
Season	Very Unstable	Moderately Unstable	Slightly Unstable	Neutral	Slightly Stable	Moderately Stable
Winter	0.0	3.8	12.2	42.6	16.7	24.6
Spring	0.8	10.7	17.3	29.6	15.8	25.7
Summer	3.5	17.2	17.4	17.9	15.8	28.2
Fall	0.6	9.3	16.1	26.6	18.3	29.0
Annual	1.2	10.3	15.8	29.1	16.7	26.9

Source: NWS, 1986.

43 percent of the time. Stable conditions are uniformly distributed throughout the year, occurring 41 to 47 percent of the time.

The mixing height defines the upper limit of the surface boundary layer, and thus, is an important factor in determining the atmosphere's dispersion characteristics. The annual and seasonal averaging morning and afternoon mixing heights for Tampa, as calculated by NWS, are presented in Table 2.3.7-5. The lowest mixing heights occur in the morning in the winter and the highest mixing heights occur in the afternoon in the spring.

Thunderstorms are the most common severe weather in the area, occurring on an average of 87 days each year at the NWS Tampa observation station. Thunderstorms occur most frequently from late spring to early autumn, but may occur at any time during the year.

Hurricanes and tornadoes are types of severe weather that may occur in the area, but the probability of a hurricane or tornado passing over the Polk Power Station site is small. The possibility of any tropical storm crossing the Tampa Bay area is less than 10 percent in any given year. The possibility of a hurricane-strength tropical storm (winds greater than 117 km per hour) crossing the area is approximately 6 percent in any given year. The possibility of a hurricane with winds greater than 200 km per hour crossing the area in any given year is approximately 1 percent. Tornadoes also are reported rarely in the area, with June being the month of highest occurrence.

Wind, temperature, and precipitation measurements were collected on the Polk Power Station site from April 1, 1991, to March 31, 1992. The annual and seasonal wind roses for the site are presented in Figures 2.3.7-3 and 2.3.7-4. The wind data are also summarized in Table 2.3.7-6 and 2.3.7-7. Comparing these wind roses with the Tampa NWS wind roses presented in Figures 2.3.7-1 and 2.3.7-2 demonstrates that using the Tampa meteorological database for dispersion modeling is appropriate. This approach is further supported by comparing the onsite temperature and

Table 2.3.7-5. Annual and Seasonal Average Mixing Heights for Tampa, Florida (1982 through 1986)

Season	Mixing Height (meters)	
	Morning	Afternoon
Winter	464	1,041
Spring	562	1,500
Summer	760	1,428
Fall	565	1,305
Annual	588	1,320

Source: NWS, 1986.

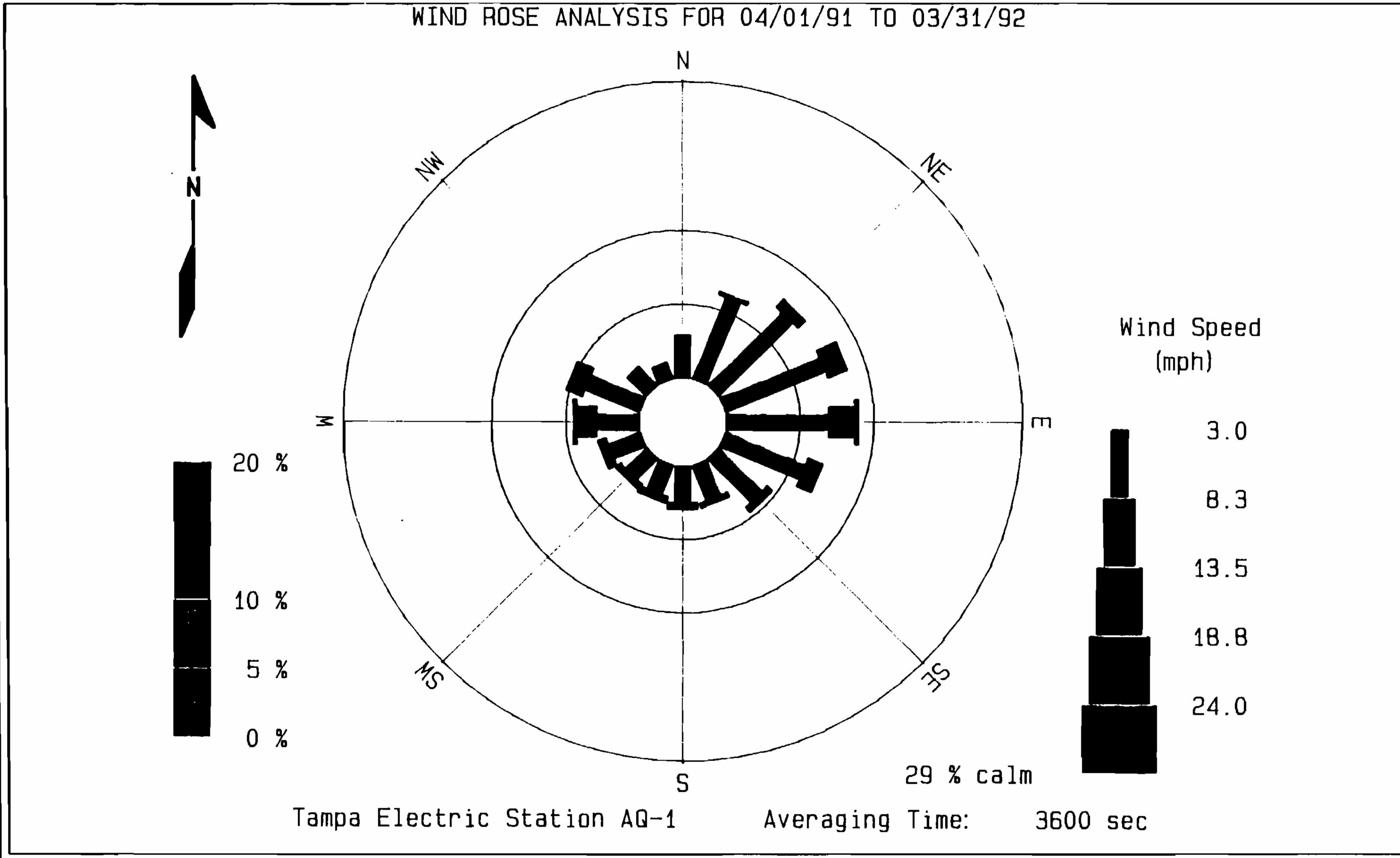

FIGURE 2.3.7-3.

ANNUAL WIND ROSE ANALYSIS FOR POLK POWER STATION SITE (APRIL 1991 THROUGH MARCH 1992)

Source: ECT, 1992.

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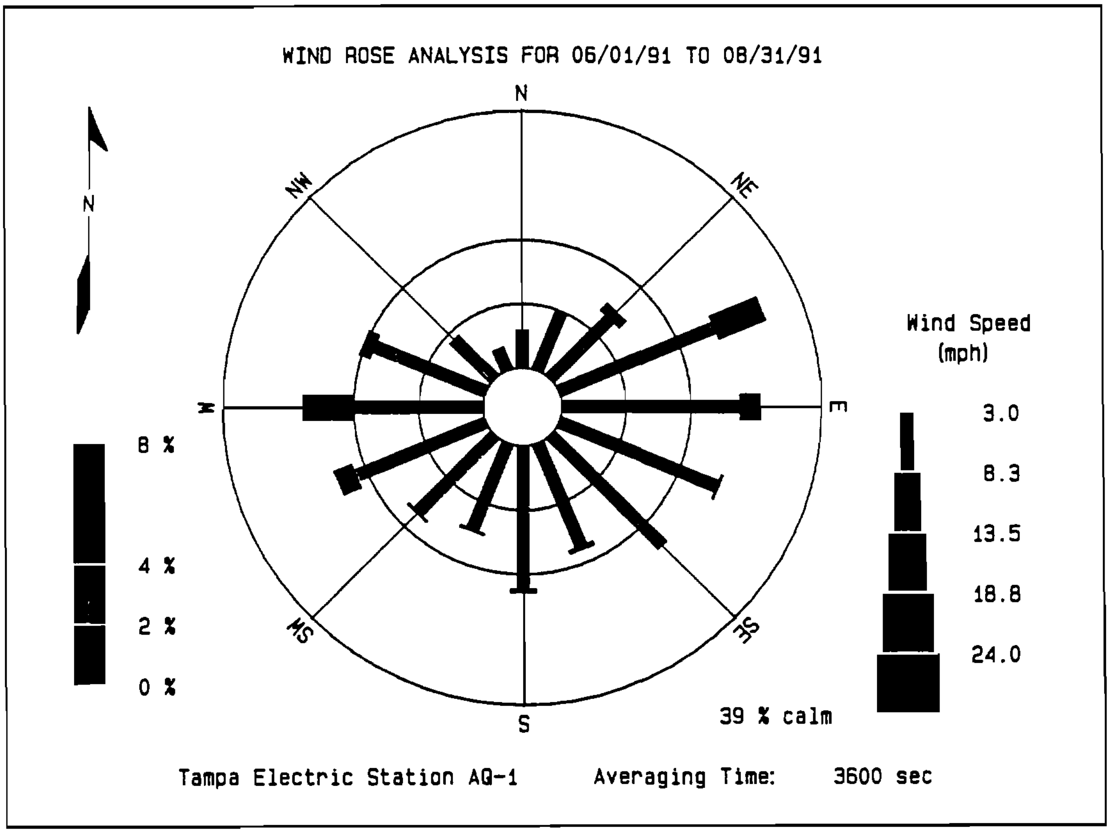

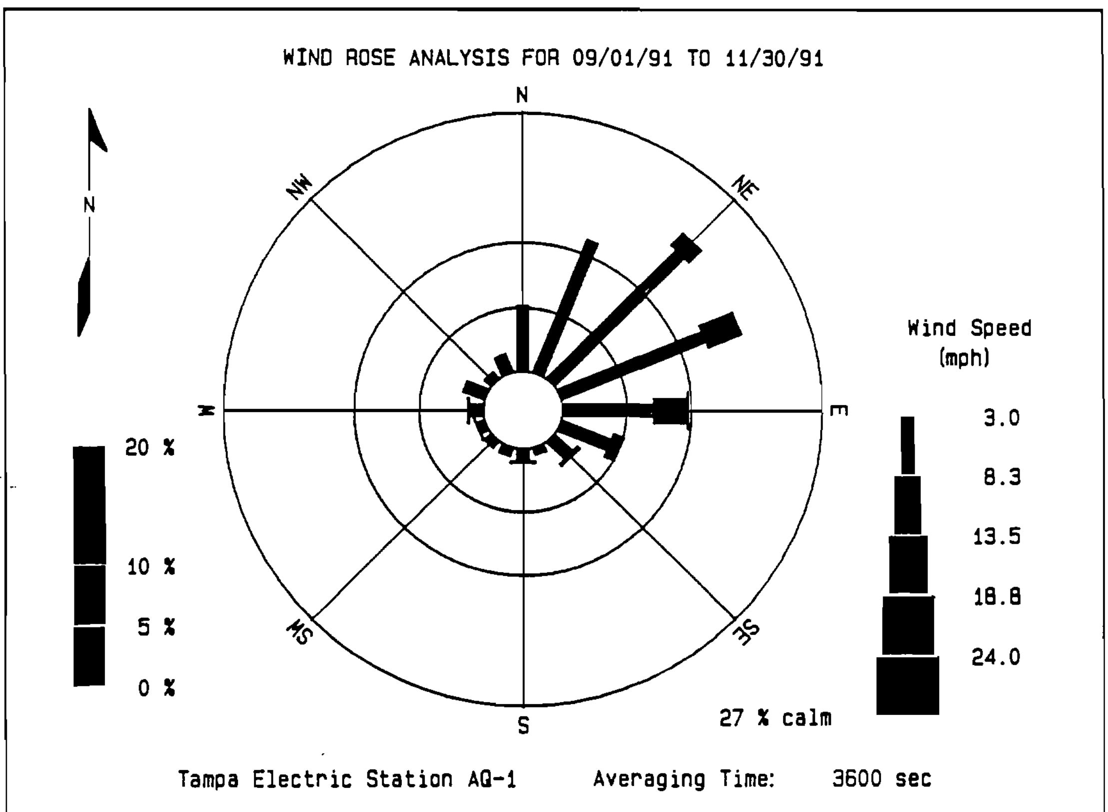

FIGURE 2.3.7-4.

SEASONAL WIND ROSE ANALYSIS FOR POLK POWER STATION SITE (SUMMER AND FALL) (PAGE 1 OF 2)

Source: ECT, 1991.

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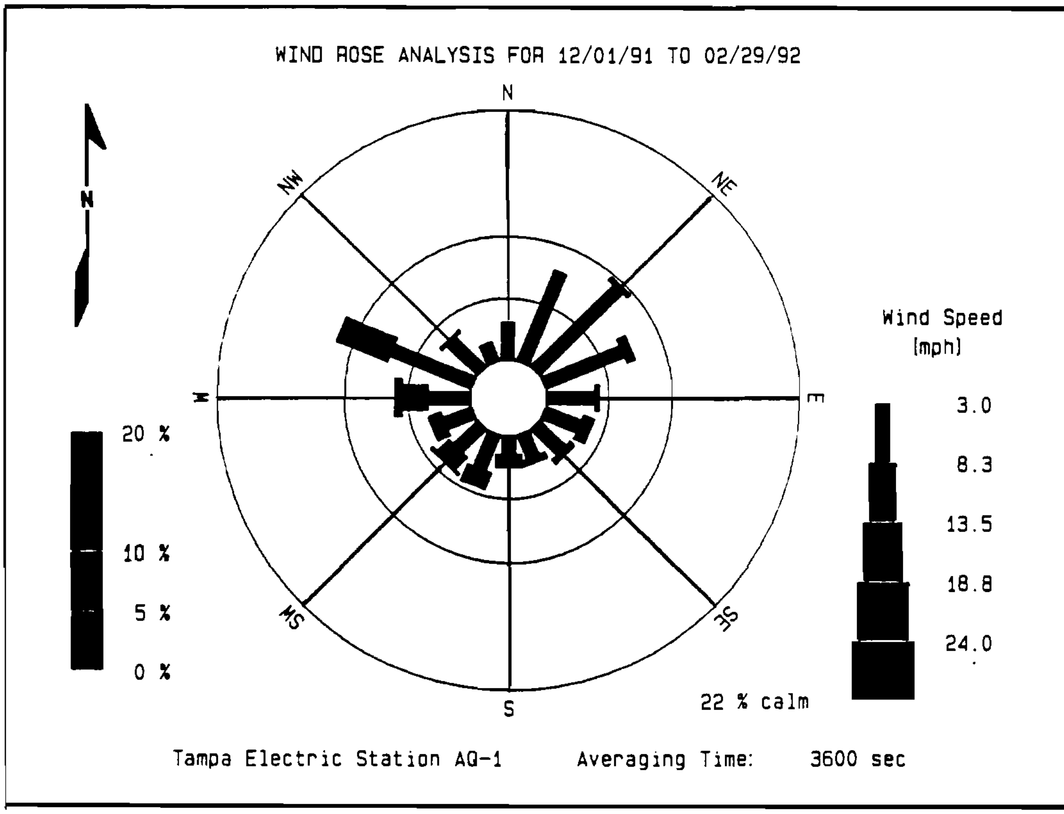

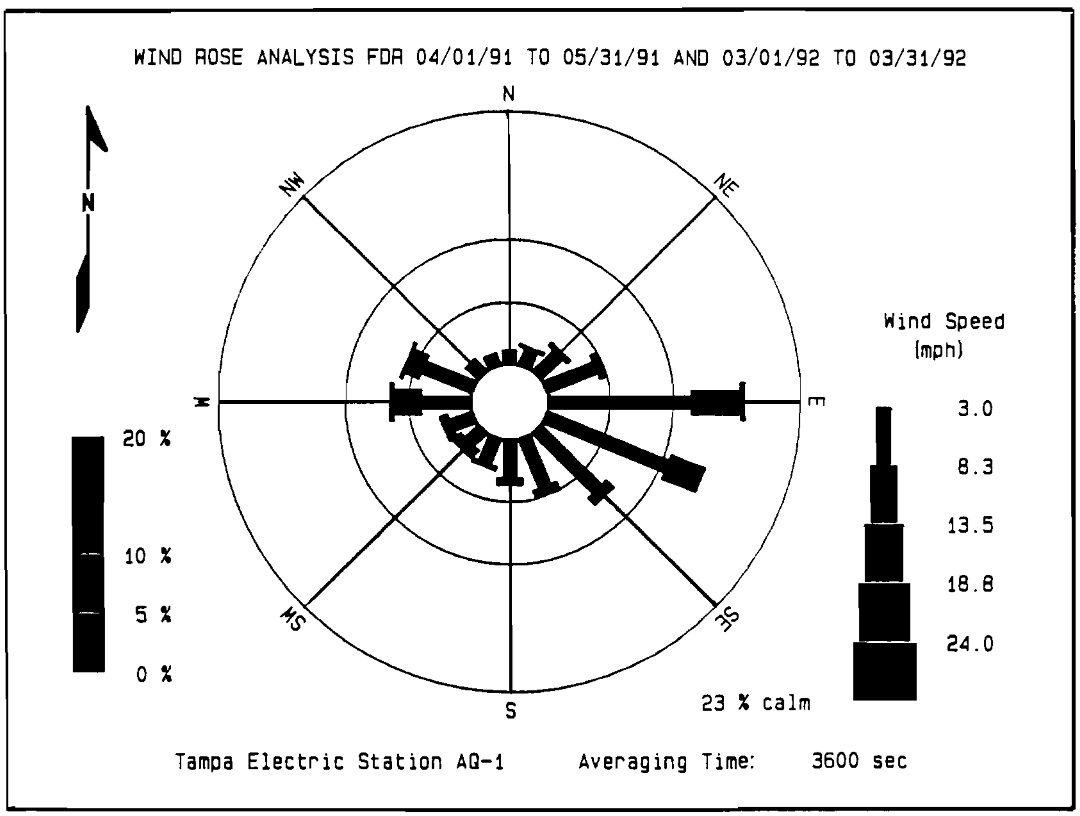

FIGURE 2.3.7-4.

SEASONAL WIND ROSE ANALYSIS FOR POLK POWER STATION SITE (WINTER AND SPRING) (PAGE 2 OF 2)
Source: ECT, 1991.

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Table 2.3.7-6. Average Frequency Distribution of Wind Direction and Windspeed for the Polk Power Station Site (April 1991 through March 1992)

Direction	Frequency Distribution Speed (mph) 3.0 - 8.3	8.3 - 13.5	13.5 - 18.8	18.8 - 24.0	>24.0
N	2.8	0.0	0.0	0.0	0.0
NNE	5.9	0.2	0.0	0.0	0.0
NE	7.0	0.6	0.0	0.0	0.0
ENE	7.2	1.4	0.1	0.0	0.0
E	6.9	1.8	0.2	0.0	0.0
ESE	5.8	1.1	0.0	0.0	0.0
SE	4.0	0.4	0.0	0.0	0.0
SSE	2.5	0.3	0.0	0.0	0.0
S	2.4	0.4	0.0	0.0	0.0
SSW	2.0	0.4	0.0	0.0	0.0
SW	1.9	0.4	0.1	0.0	0.0
WSW	2.3	0.6	0.0	0.0	0.0
W	2.9	1.3	0.2	0.0	0.0
WNW	3.9	1.1	0.0	0.0	0.0
NW	1.8	0.0	0.0	0.0	0.0
NNW	1.2	0.0	0.0	0.0	0.0
Total	60.5	10.0	0.6	0.0	0.0

Note: Calms = 30.9 percent.

Source: ECT, 1992.

Table 2.3.7-7. Summary of Monthly Mean, Maximum, and Minimum 1-Hour Windspeeds; Monthly Mean Wind Direction; and Monthly Mean Sigma Theta for the Polk Power Station Site (April 1991 through March 1992)

	Speed			Direction	Sigma Theta
Month	Mean (mph)	Maximum 1-hour (mph)	Date and Time	Mean (° true)	Mean (°)
April	5.6	17.0	04/23/91 14:00	150	17.3*
May	5.6	16.3	05/22/91 08:00	126	18.1
June	4.2	12.3	06/04/91 13:00	160	23.7
July	3.8	15.3	07/24/91 14:00	182	13.8†
August	3.6	11.5	08/23/91 16:00	168	23.6
September	4.2	11.1	09/18/91 14:00	97	20.3
October	4.8	13.5	10/25/91 11:00	98	17.2
November	4.9	15.9	11/29/91 12:00	115	16.2
December	4.5	17.2	12/20/91 13:00	127	16.4
January	5.0	15.7	01/23/92 13:00	166	16.5
February	5.4	16.3	02/26/92 15:00	171	16.3**
March	5.3	17.0	03/19/92 14:00	191	18.0

* Data capture was 58.8 percent.
† Data capture was 62.6 percent.
** Data capture was 62.5 percent.

Source: ECT, 1992.

precipitation data (Tables 2.3.7-8 and 2.3.7-9, respectively) with the Tampa and Bartow data presented previously. The onsite temperature data are presented graphically in Figure 2.3.7-5.

2.3.7.2 Ambient Air Quality

The area which includes the Polk Power Station site meets all state and federal ambient air quality standards (AAQS), as presented in Table 2.3.7-10. As a result, FDER has classified the area as attainment for all criteria pollutants, in accordance with Section 17-2.420, F.A.C.

Ambient air monitoring data are available with which to characterize the existing conditions in the vicinity of the site. FDER collected ambient total suspended particulate (TSP) data during 1989, 1990, and 1991 at several locations in the vicinity. These locations were:

1. Auburndale, approximately 43 km north, northeast of the site;
2. Nichols, approximately 20 km north of the site; and
3. Bartow Municipal Airport, approximately 25 km northeast of the site.

The monitoring results are summarized in Table 2.3.7-11. In all cases, the measured concentrations are well below TSP standards.

SO_2 concentrations have been measured by FDER at Nichols and in Mulberry, approximately 20 km north of the Polk Power Station. FDER data from 1989, 1990, and 1991 show that existing SO_2 concentrations in the area are well below AAQS (Table 2.3.7-12).

Ambient data for NO_x, CO, ozone (O_3), and lead have been collected by FDER only in the Tampa and Sarasota metropolitan areas and would not be representative of southwest Polk County. However, given the rural location of the site, existing concentrations of these pollutants, which are usually associated more closely with urban environments, should be well below the applicable standards.

Table 2.3.7-8. Summary of Monthly Mean, Maximum, and Minimum 1-Hour Temperatures (°C) for the Polk Power Station Site (April 1991 through March 1992)

Month	Mean	Maximum 1-hour	Date and Time	Minimum 1-Hour	Date and Time
April	22.8	32.4	04/29/91 15:00	10.1	04/02/91 04:00
May	25.2	32.8	05/16/91 13:00	19.3	05/31/91 04:00
June	25.7	34.3	06/28/91 15:00	17.4	06/11/91 05:00
July	25.9	33.6	07/07/91 15:00	21.5	07/12/91 02:00
August	26.5	33.4	08/17/91 14:00	21.1	08/30/91 17:00
September	26.2	34.2	09/06/91 16:00	15.7	09/27/91 05:00
October	22.9	31.4	10/05/91 13:00	8.9	10/17/91 06:00
November	17.8	28.5	11/30/91 15:00	3.1	11/26/91 00:00
December	17.5	29.2	12/02/91 15:00	3.4	12/05/91 06:00
January	14.5	27.4	01/29/92 14:00	0.1	01/17/92 06:00
February	17.0	29.0	02/17/92 14:00	3.8	02/02/92 03:00
March	18.0	28.9	03/09/92 16:00	5.5	03/12/92 01:00

Source: ECT, 1992.

Table 2.3.7-9. Summary of Monthly Precipitation, Hourly Averages (inches) at AQ-1 for the Polk Power Station Site (April 1991 through March 1992)

Date	Amount	Monthly Total
04/01/91	0.01	
04/06/91	1.84	
04/07/91	0.29	
04/08/91	0.01	
04/17/91	0.18	
04/18/91	0.57	
04/19/91	0.01	
04/20/91	0.62	
04/23/91	0.05	
04/25/91	0.66	
04/91 total		4.24
05/07/91	0.13	
05/09/91	0.16	
05/13/91	0.12	
05/14/91	0.05	
05/16/91	0.12	
05/17/91	0.01	
05/18/91	0.03	
05/19/91	0.13	
05/20/91	0.31	
05/21/91	0.02	
05/22/91	0.80	
05/23/91	0.18	
05/24/91	0.85	
05/26/91	2.04	
05/27/91	0.06	
05/28/91	0.01	
05/30/91	0.35	
05/91 total		5.35
06/05/91	2.03	
06/06/91	0.01	
06/17/91	0.55	
06/18/91	0.03	
06/19/91	0.02	
06/20/91	0.75	
06/21/91	0.01	
06/22/91	0.57	
06/23/91	0.14	

Table 2.3.7-9. Summary of Monthly Precipitation, Hourly Averages (inches) at AQ-1 for the Polk Power Station Site (April 1991 through March 1992) (Continued, Page 2 of 4)

Date	Amount	Monthly Total
06/24/91	0.02	
06/25/91	0.60	
06/26/91	0.01	
06/29/91	0.52	
06/30/91	0.61	
06/91 total		5.87
07/01/91	0.87	
07/02/91	0.34	
07/03/91	2.01	
07/04/91	0.01	
07/05/91	0.16	
07/06/91	0.17	
07/07/91	1.52	
07/09/91	0.47	
07/24/91	0.11	
07/25/91	0.03	
07/26/91	0.84	
07/28/91	0.24	
07/29/91	0.01	
07/30/91	0.28	
07/31/91	0.67	
07/91 total		7.73
08/01/91	0.12	
08/02/91	0.02	
08/06/91	0.01	
08/07/91	0.18	
08/09/91	0.94	
08/15/91	0.01	
08/16/91	0.01	
08/17/91	0.01	
08/18/91	0.11	
08/19/91	0.08	
08/20/91	0.19	
08/21/91	0.37	
08/23/91	0.05	
08/24/91	1.89	
08/27/91	0.08	

Table 2.3.7-9. Summary of Monthly Precipitation, Hourly Averages (inches) at AQ-1 for the Polk Power Station Site (April 1991 through March 1992) (Continued, Page 3 of 4)

Date	Amount	Monthly Total
08/28/91	0.03	
08/30/91	1.20	
08/31/91	0.01	
08/91 total		5.31
09/03/91	0.07	
09/06/91	0.43	
09/07/91	0.48	
09/08/91	0.76	
09/24/91	0.07	
09/25/91	0.35	
09/26/91	0.34	
09/29/91	0.04	
09/30/91	0.01	
09/91 total		2.55
10/01/91	0.08	
10/02/91	0.22	
10/04/91	0.01	
10/05/91	0.09	
10/06/91	0.17	
10/07/91	0.01	
10/10/91	0.01	
10/23/91	0.02	
10/25/91	0.08	
10/30/91	0.01	
10/91 total		0.70
11/03/91	0.02	
11/09/91	0.04	
11/20/91	0.05	
11/91 total		0.11
12/02/91	0.24	
12/03/91	0.19	
12/04/91	0.29	
12/24/91	0.01	
12/27/91	0.03	
12/91 total		0.76
01/01/92	0.06	
01/09/92	0.01	

Table 2.3.7-9. Summary of Monthly Precipitation, Hourly Averages (inches) at AQ-1 for the Polk Power Station Site (April 1991 through March 1992) (Continued, Page 4 of 4)

Date	Amount	Monthly Total
01/92 total		0.07*
02/26/92	0.02	
02/27/92	0.14	
02/92 total		0.16†
03/01/92	0.07	
03/02/92	0.06	
03/03/92	0.04	
03/04/92	0.15	
03/05/92	0.01	
03/08/92	0.05	
03/10/92	0.09	
03/11/92	0.01	
03/12/92	0.12	
03/13/92	0.06	
03/16/92	0.01	
03/17/92	0.05	
03/21/92	0.04	
03/22/92	0.46	
03/23/92	0.28	
03/30/92	0.27	
03/31/92	0.02	
03/92 total		1.79
Annual total		34.48

* Data capture was 61.3 percent.
† Data capture was 61.6 percent.

Source: ECT, 1992.

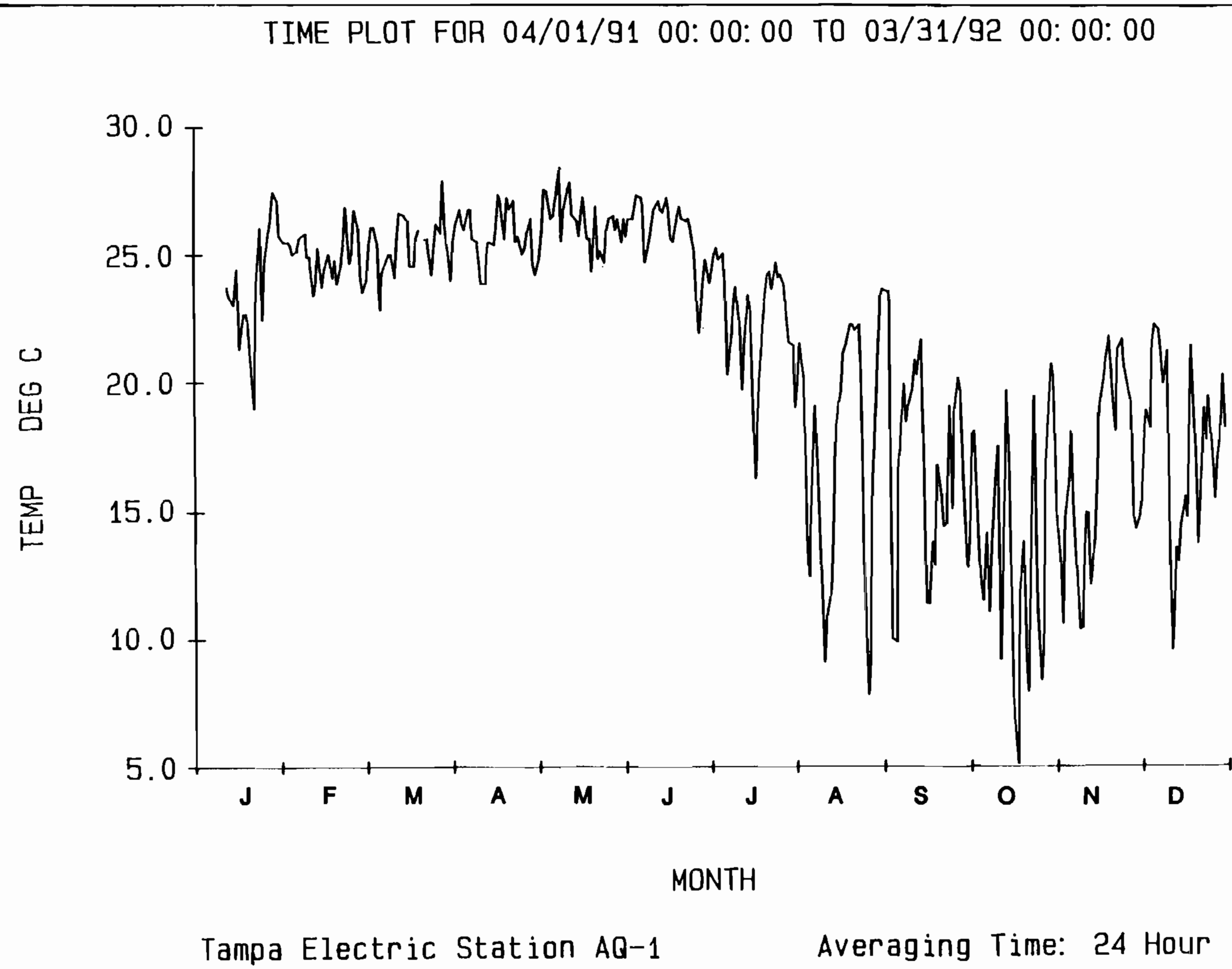

FIGURE 2.3.7-5.

DAILY TEMPERATURES FOR THE POLK POWER STATION SITE

Source: ECT, 1991.

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Table 2.3.7-10. National and Florida AAQS

Pollutant	Averaging Time	National AAQS Primary µg/m³	National AAQS Primary ppb	National AAQS Secondary µg/m³	National AAQS Secondary ppb	Florida AAQS µg/m³	Florida AAQS ppb
PM_{10}	Annual arithmetic mean	50	NA	50	NA	50	NA
	24-hour maximum*	150	NA	150	NA	150	NA
SO_2	Annual arithmetic mean	80	30	NA	NA	60	20
	24-hour maximum*	365	140	NA	NA	260	100
	3-hour maximum*	NA	NA	1,300	500	1,300	500
NO_2	Annual arithmetic mean	100	53	100	53	100	53
CO	8-hour maximum*	10,000	9,000	NA	NA	10,000	9,000
	1-hour maximum*	40,000	35,000	NA	NA	40,000	35,000
O_3	1-hour maximum†	235	120	235	120	235	120
Lead	Calendar quarter arithmetic mean	1.5	NA	1.5	NA	1.5	NA

Note: µg/m³ = micrograms per cubic meter.
ppb = parts per billion.
NO_2 = nitrogen dioxide.
NA = not applicable.

* Maximum concentration not to be exceeded more than once per year.
† The O_3 standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.

Sources: 40 CFR 50.
Chapter 17-2.300, F.A.C.

Table 2.3.7-11. Summary of FDER TSP Monitoring Near the Polk Power Station Site

Location	Site Identification Number	Year	24-Hour Measurement Highest ($\mu g/m^3$)	24-Hour Measurement Second-highest ($\mu g/m^3$)	Annual Geometric Mean ($\mu g/m^3$)
Auburndale	0120-001-F01	1989	98	90	38
		1990	169	68	44
		1991*	60	60	42
Bartow	0180-003-F01	1989†	49	46	28
		1990	78	66	29
		1991**	68	64	34
Nichols	3680-010-F02	1989	91	71	38
		1990	96	76	42
		1991**	65	63	36

Note: The 24-hour ambient TSP standard was 150 $\mu g/m^3$, not to be exceeded more than once per year; the annual ambient TSP standard was 60 $\mu g/m^3$, annual geometric mean. Ambient TSP standards have been replaced with standards for PM_{10}.

*January through April.
†October through December.
**January through July.

Source: FDER, 1989, 1990, 1991.

Table 2.3.7-12. Summary of FDER SO_2 Monitoring Near the Polk Power Station Site

Lactation	Site Identification Number	Year	Highest 3-Hour Average ($\mu g/m^3$)	Highest 24-Hour Average ($\mu g/m^3$)	Annual Average ($\mu g/m^3$)
Nichols	3680-010-F02	1989	356	63	10
		1990	341	66	9
		1991	179	67	10
Mulberry	2860-006-F02	1991*	203	42	12

Note: The 3-hour ambient standard is 1,300 $\mu g/m^3$, not to be exceeded more than once per year.
The 24-hour ambient standard is 260 $\mu g/m^3$, not to be exceeded more than once per year.
The annual ambient standard is 60 $\mu g/m^3$, arithmetic mean.

*February through December.

Source: FDER, 1989, 1990, 1991.

In addition to FDER data collected in the site vicinity, an FDER-approved onsite ambient air monitoring program was operated by Tampa Electric Company from April 1, 1991, through March 31, 1992. The monitoring network consisted of two stations. Ambient levels of SO_2 and O_3 were monitored continuously at one location. PM_{10} was monitored at two locations, with collocated samplers at one location. The PM_{10} samples were collected on a 6-day schedule, concurrent with the national sampling schedule.

A summary of the onsite ambient monitoring SO_2 data is presented in Table 2.3.7-13. The 3- and 24-hour averages for the monitoring year are presented in Figures 2.3.7-6 and 2.3.7-7, respectively. The onsite measured ambient SO_2 levels are well below all applicable AAQS.

A summary of the onsite ambient monitoring O_3 data is presented in Table 2.3.7-14. The 1-hour averages for the monitoring year are presented in Figure 2.3.7-8. The onsite measured ambient O_3 levels are well below all applicable AAQS.

A summary of the onsite ambient monitoring PM_{10} data is presented in Table 2.3.7-15. These levels are well below all applicable AAQS.

The annual report and data collected as a result of the onsite ambient air monitoring program are provided in Appendix 11.11.

2.3.7.3 Measurement Programs

Both the FEPPSA and the rules pertaining to prevention of significant deterioration (PSD) review identify the potential need for air quality data with which to characterize existing site conditions. The PSD review process, especially, imposes certain specific preconstruction monitoring requirements. EPA has provided guidance to determine the need for such monitoring (EPA, 1987). This guidance also includes procedures to design a monitoring program if one is required.

Table 2.3.7-13. Summary of Monthly Mean, Maximum 3-Hour, and 24-Hour SO_2 Concentrations (ppb) at AQ-1 for the Polk Power Station Site (April 1991 through March 1992)

Month	Mean	Maximum 3-Hour*	Ending Date and Time	Maximum 24-Hour*	Ending Date and Time
April	2	21	04/21/91 17:00	9	04/22/91 11:00
May	3	43	05/06/91 17:00	16	05/07/91 14:00
June	4	53	06/04/91 18:00	11	06/04/91 21:00
July	3	40	07/09/91 11:00	12	07/09/91 10:00
August	2	31	08/09/91 13:00	10	08/09/91 17:00
September	2	26	09/26/91 15:00	9	09/27/91 12:00
October	3	23	10/11/91 17:00	7	10/17/91 05:00
November	5	78	11/23/91 17:00	17	11/24/91 04:00
December	3	29	12/22/91 20:00	10	12/19/91 19:00
January	4	48	01/06/92 15:00	15	01/07/92 07:00
February	4	26	02/28/92 19:00	11	02/27/92 17:00
March	4	76	03/07/92 23:00	16	03/08/92 20:00

*Based on a rolling average.

Source: ECT, 1992.

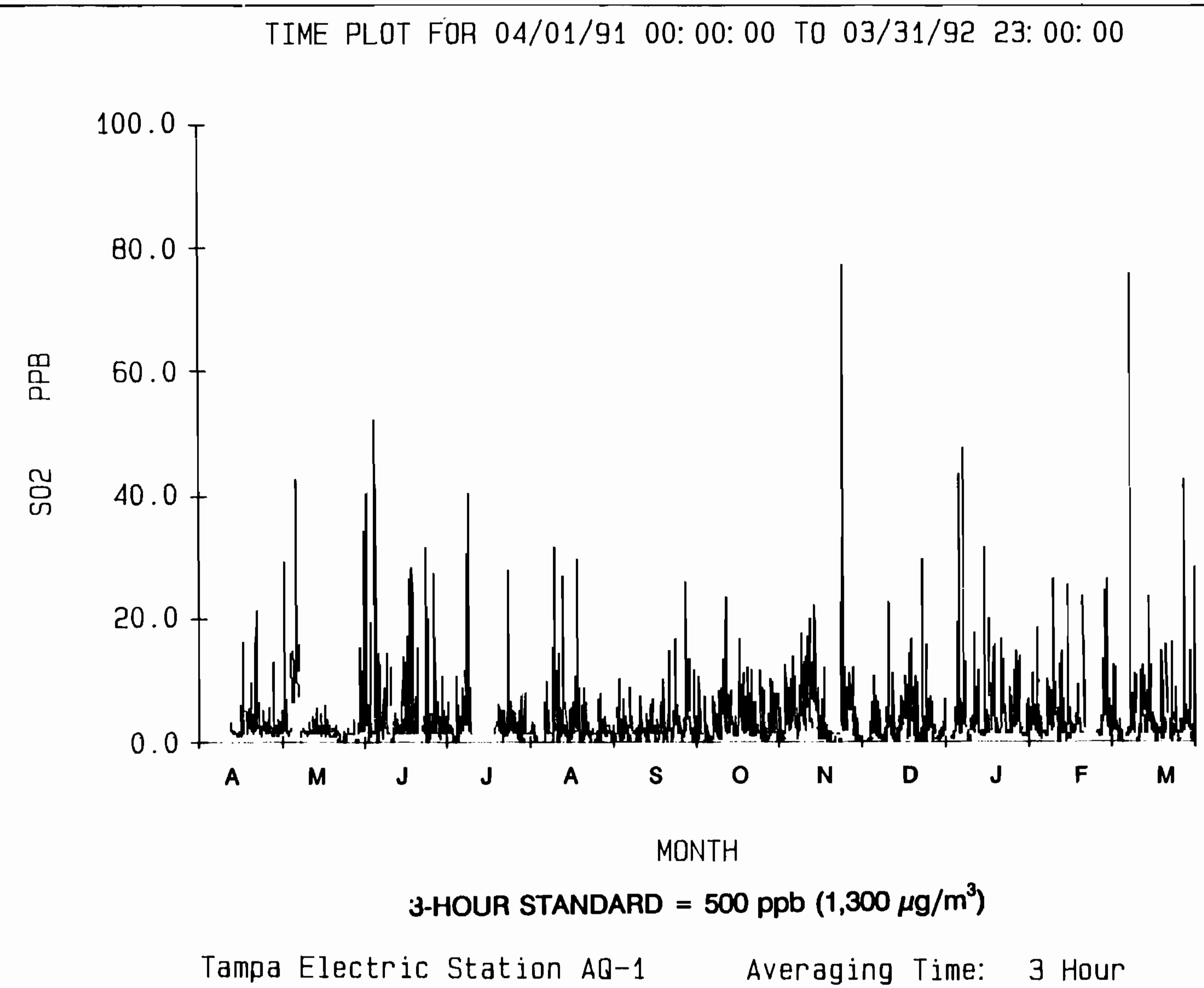

FIGURE 2.3.7-6.

MEASURED AMBIENT 3-HOUR SO_2 AVERAGES AT THE POLK POWER STATION SITE

Source: ECT, 1992.

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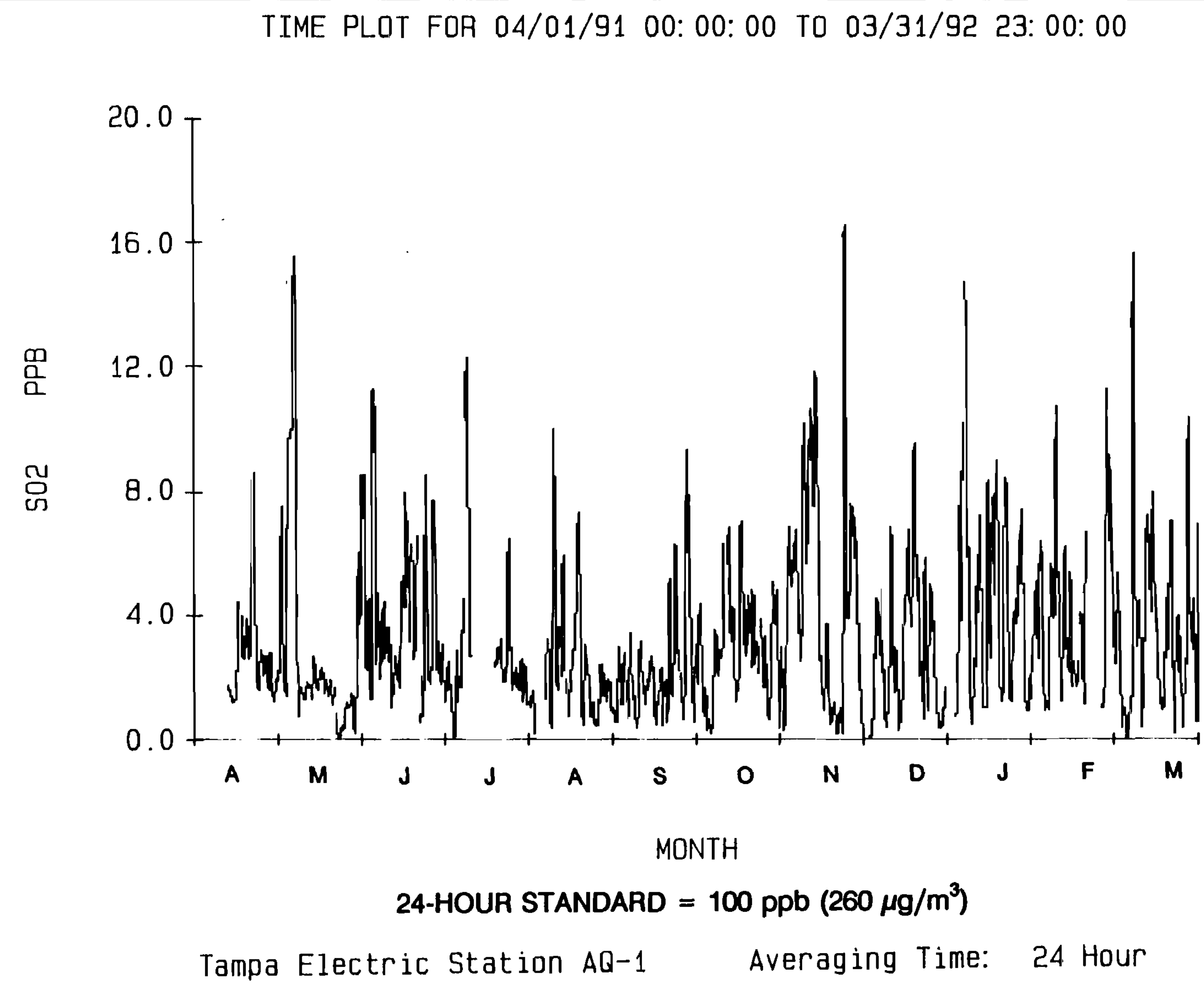

FIGURE 2.3.7-7.

MEASURED AMBIENT 24-HOUR SO_2 AVERAGES AT THE POLK POWER STATION SITE

Source: ECT, 1992.

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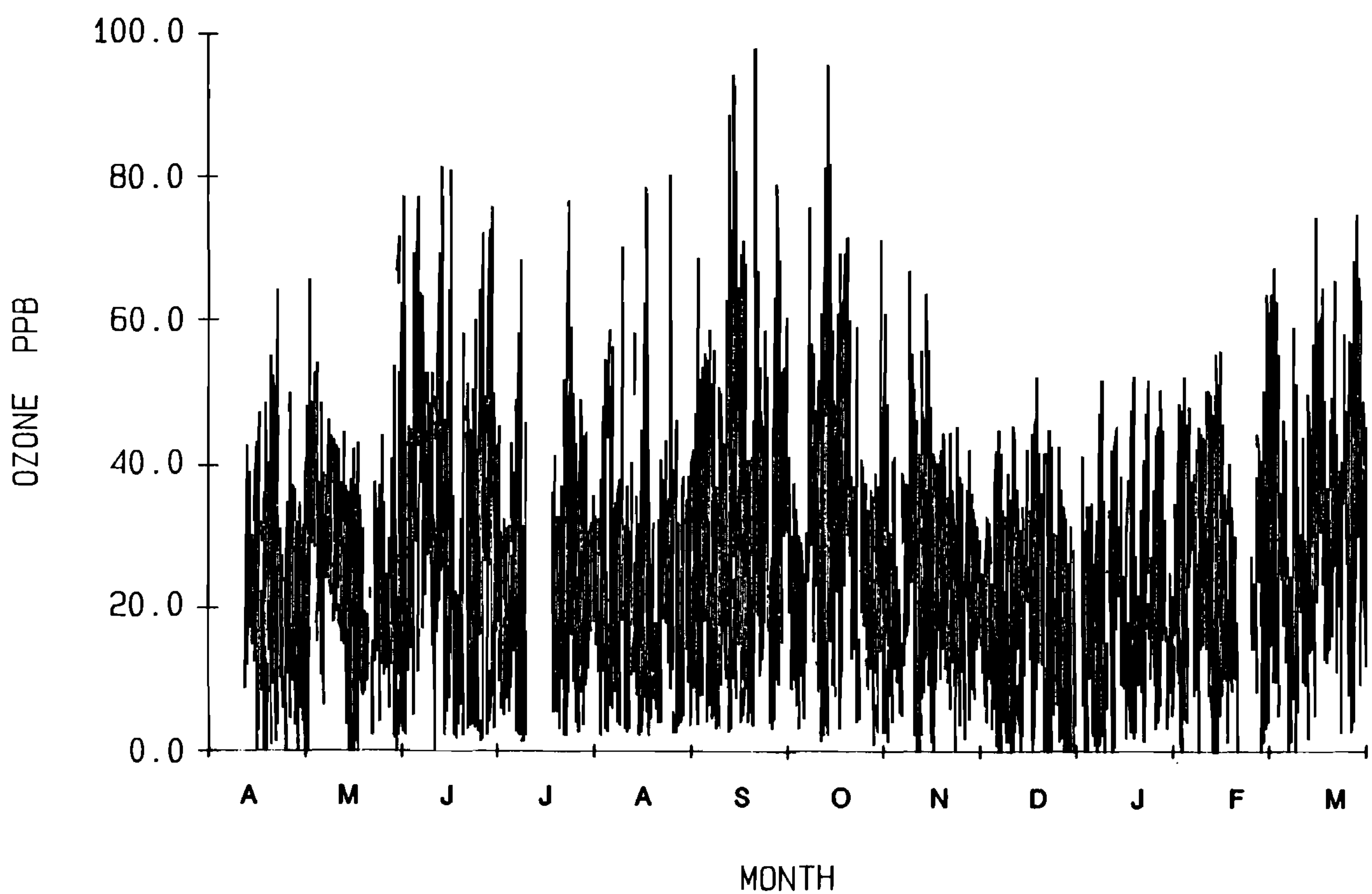
Table 2.3.7-14. Summary of Monthly Mean and 1-Hour Maximum O_3 Concentrations (ppb) at AQ-1 for the Polk Power Station Site (April 1991 through March 1992)

Month	Mean	Maximum 1-Hour	Date and Time
April	24	69	04/02/91 19:00
May	25	72	05/30/91 14:00
June	35	82	06/13/91 16:00
July	24	77	07/23/91 16:00
August	23	81	08/24/91 17:00
September	34	99	09/20/91 14:00
October	31	96	10/13/91 13:00
November	24	67	11/08/91 13:00
December	18	53	12/18/91 15:00
January	21	53	01/18/92 14:00
February	25	64	02/29/92 15:00
March	33	75	03/28/92 16:00

Source: ECT, 1992.

TIME PLOT FOR 04/01/91 00:00:00 TO 03/31/92 23:00:00



1-HOUR STANDARD = 120 ppb (235 μg/m³)

Tampa Electric Station AQ-1 Averaging Time: 1 Hour

FIGURE 2.3.7-8.

MEASURED AMBIENT 1-HOUR O_3 AVERAGES AT THE POLK POWER STATION SITE

Source: ECT, 1992.

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Table 2.3.7-15. Summary of PM_{10} Concentrations ($\mu g/m^3$) at AQ-1 and AQ-2 for the Polk Power Station Site (April 1991 through March 1992)

Date	PM_{10} Concentration by Site AQ-1	AQ-2C	AQ-2D
03/31/91	23.3	28.3	26.9
04/06/91	17.6	*	*
04/12/91	18.9	18.1	18.7
04/18/91	14.3	*	*
04/24/91	19.7	*	*
04/30/91	18.2	*	*
05/06/91	20.5	17.3	19.8
05/12/91	22.5	26.4	22.4
05/18/91	15.4	17.6	16.5
05/24/91	13.8	14.6	14.1
05/30/91	29.3	30.0	33.5
06/05/91	20.9	22.7	21.2
06/11/91	16.4	16.3	15.8
06/17/91	13.3	18.2	12.9
06/23/91	20.6	20.4	21.1
06/29/91	48.3	17.1	29.6
07/05/92	23.4	43.5	†
07/11/91	†	29.6	12.0
07/17/91	45.4	16.7	23.6
07/23/91	29.9	18.8	29.9
07/29/91	42.4	46.9	†
08/04/91	14.6	15.1	13.8
08/10/91	12.3	11.0	†
08/16/91	25.1	27.0	26.5
08/22/91	16.2	9.4	9.4
08/28/91	9.9	8.4	†
09/03/91	14.0	14.5	14.9
09/09/91	10.9	10.5	10.1
09/15/91	16.6	16.8	16.7
09/21/91	16.2	16.4	14.0
09/27/91	25.1	25.0	30.8
10/03/91	26.9	22.5	†
10/09/91	26.3	†	†
10/15/91	23.5	20.0	19.5
10/21/91	10.8	14.4	13.3
10/27/91	11.6	12.1	10.5
11/02/91	14.6	12.6	12.1
11/08/91	45.1	42.7	43.9

Table 2.3.7-15. Summary of PM_{10} Concentrations ($\mu g/m^3$) at AQ-1 and AQ-2 for the Polk Power Station Site (April 1991 through March 1992) (Continued, Page 2 of 2)

Date	PM_{10} Concentration by Site AQ-1	AQ-2C	AQ-2D
11/14/91	19.5	22.4	24.0
11/20/91	7.5	7.2	6.8
11/26/91	24.4	20.7	22.7
12/02/91	7.9	8.5	8.7
12/08/91	8.1	8.5	7.4
12/14/91	7.1	8.7	9.0
12/20/91	16.8	17.6	18.3
12/26/91	13.7	14.1	14.0
01/01/92	12.3	11.7	11.6
01/07/92	19.2	19.1	19.3
01/13/92	9.9	10.6	11.4
01/19/92	7.6	8.8	8.3
01/25/92	14.8	16.5	15.8
01/31/92	10.2	11.6	12.1
02/06/92	7.7	7.6	8.2
02/12/92	25.5	27.6	28.1
02/18/92	11.8	11.4	9.0
02/24/92	7.1	8.6	10.0
03/01/92	19.3	19.1	17.6
03/07/92	8.1	7.3	7.7
03/13/92	12.2	12.4	13.6
03/19/92	30.2	18.7	19.6
03/25/92	15.0	14.8	14.9
03/31/92	14.4	12.5	13.4
Highest	48.3	46.9**	43.9
Date	06/29/91	07/29/91	11/08/91
Second highest	45.4	43.5**	33.5
Date	07/17/91	07/05/91	05/30/91
Average	18.4	17.7	17.2

* Electrical problems.
† Invalid data.
** The data for AQ-2D were not valid on July 5 and 29, 1991.

Source: ECT, 1992.

Following the EPA guidance, a monitoring plan for PSD ambient monitoring at the Polk Power Station site, dated March 26, 1991 (ECT, 1991c), was prepared, submitted, and approved by FDER. The analysis described in the plan determined that preconstruction monitoring was required for SO_2, PM_{10}, and O_3. For all other pollutants subject to PSD review, either (1) the impacts of the proposed facility's emissions were predicted to be less than specified *de minimis* levels, (2) impacts due to existing sources' emissions would be less than *de minimis*, or (3) no acceptable ambient measurement method was available.

Based on the results of modeling analyses described in the monitoring plan, a two-station air quality monitoring network was implemented to satisfy the preconstruction requirements mandated by the PSD regulations. This monitoring approach was approved by FDER. Ambient levels of SO_2 and O_3 were monitored continuously at one location. PM_{10} was monitored at two locations, with collocated samplers at one location. The PM_{10} samples were collected on a 6-day schedule, concurrent with the national sampling schedule. A summary of the ambient monitoring network configuration is provided in Table 2.3.7-16. Station locations in Universal Transverse Mercator (UTM) coordinates are provided in this table. The station locations are shown in Figure 2.3.7-9. Table 2.3.7-17 summarizes the rationale behind the selection of each location.

Basic meteorological information was collected at one monitoring location (AQ-1). The parameters measured were windspeed and wind direction at 10 m, and ambient temperature and precipitation (collected at approximately 2 m).

A list of the sampling equipment used to monitor each parameter is presented in Table 2.3.7-18. Ambient concentrations of SO_2 and O_3 were measured continuously using monitoring equipment manufactured by Thermo Environmental Instruments, Inc. Thermo Environmental calibration systems for the gas analyzers were used. The air sampling probe heights were approximately 4 m aboveground. The PM_{10} samplers chosen for this monitoring network were manufactured by Sierra-Andersen,

Table 2.3.7-16. Polk Power Station Site Ambient Air Monitoring Station Configurations and Locations

Station Number	SO_2	O_3	PM_{10}	PM_{10} Col-located	Wind Velocity	Ambient Temper-ature	Precipi-tation	UTM Location East	UTM Location North
AQ-1	✓	✓	✓		✓	✓	✓	400.1	3,066.2
AQ-2			✓	✓				401.1	3,067.4

Note: ✓ = this parameter measured at this station.

Source: ECT, 1991a.

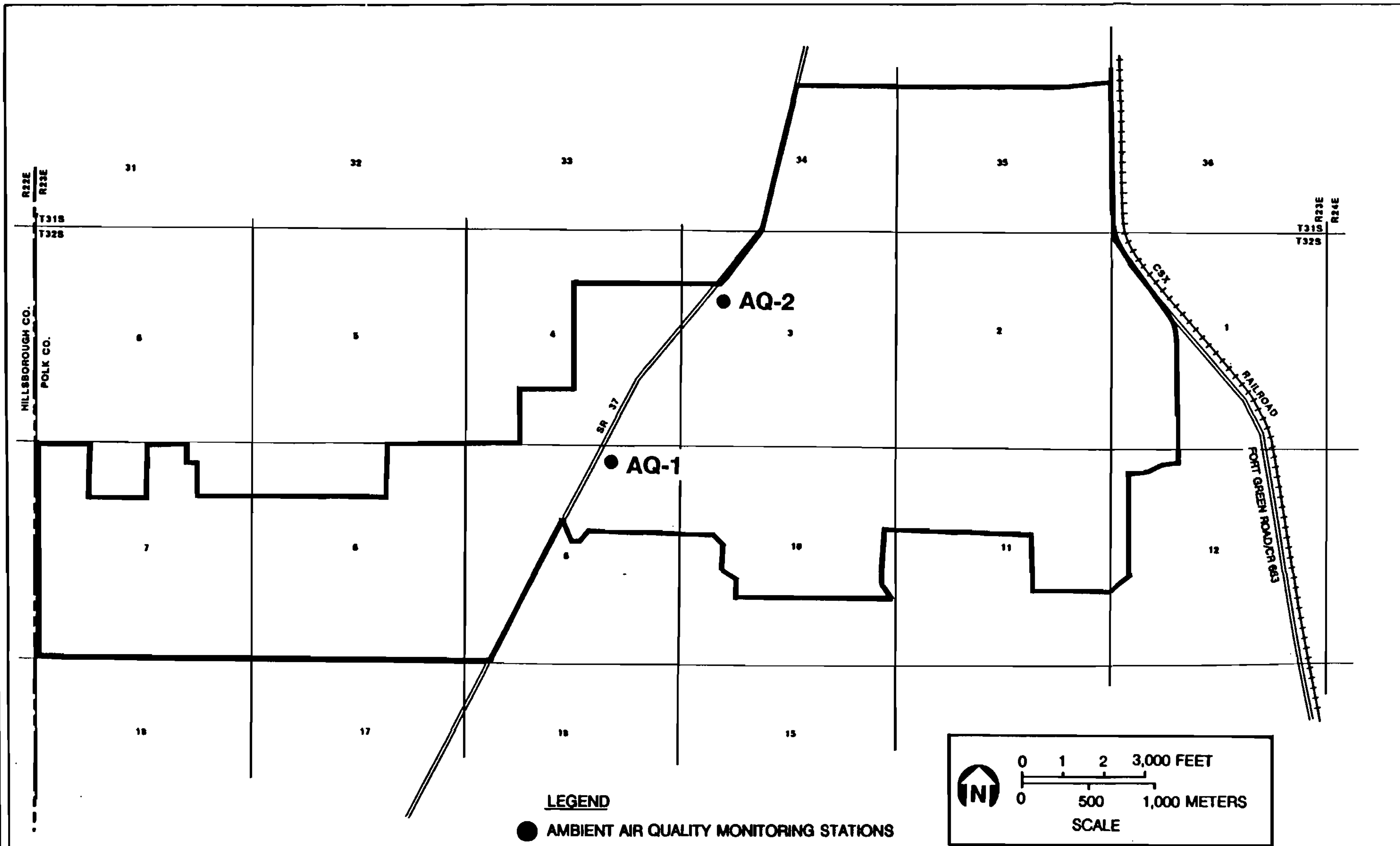

FIGURE 2.3.7-9.

AMBIENT AIR MONITORING STATIONS

Source: ECT, 1991a.

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Table 2.3.7-17. Rationale for Monitoring Locations

Station Number	Rationale
AQ-1	Projected high SO_2 impacts due to proposed facilities
	Hypothetical maximum combined impacts (proposed plus existing)
	Projected maximum particulate matter impacts (proposed facilities)
AQ-2	Projected high particulate matter impacts (proposed facilities)
	Particulate matter from automotive traffic
	Windblown dust from exposed areas and phosphate mining operations

Source: ECT, 1991a.

Table 2.3.7-18. Monitoring Equipment List for Polk Power Station Ambient Air Monitoring Program

Model Description	Manufacturer	Model Number
SO_2 analyzer	Thermo Environmental, Inc.	43A
O_3 analyzer	Thermo Environmental, Inc.	49
PM_{10} samplers	Sierra-Andersen, Inc.	SAUV-15H
Meteorological equipment	R.M. Young and Climatronics	Various
Data acquisition system	Odessa Engineering	DSM-3260
Gas calibration system	Thermo Environmental, Inc.	146
Three-pen chart recorder	Esterline-Angus	MS-413C
Two-pen chart recorder	Esterline-Angus	MS-412C

Source: ECT, 1991a.

Inc. Meteorological instrumentation (manufactured by R.M. Young Company and Climatronics Corporation) meeting PSD measurement specifications was used. The outputs of the continuous monitoring devices (i.e., SO_2 and O_3 monitors) and the meteorological sensors were connected directly to the data acquisition system inside the adjacent air quality monitoring shelter. The data acquisition system chosen for the project was manufactured by Odessa Engineering.

The equipment shelter chosen for the project was designed with no windows and sufficient insulation to maintain the conditioned environment required for proper operation of the monitoring equipment. The shelter was equipped with electric heaters and an air conditioner to maintain a temperature between 20°C and 30°C.

Continuous monitoring data, including meteorological parameters, were recorded concurrently using the DSM-3260 data acquisition system and analog strip chart recorders. Ten percent of the strip chart data were digitized for comparison to the data recorded by the DSM-3260. The data stored in the DSM-3260 were polled via a PC-modem system, downloaded onto floppy disk, and edited for completeness and validity as part of the data processing and reporting function.

The operation of the network was consistent with detailed standard operating procedures (SOPs) (ECT, 1991d). The SOP manual provided detailed descriptions of all monitoring equipment, specific procedures for their normal operation, quality assurance/quality control (QA/QC) procedures, and procedures for performance auditing.

The QA program was designed to conform with the PSD regulations as set forth in 40 CFR 58, Appendix B, QA Requirements for PSD Air Monitoring, and with FDER's State-Wide QA Air Program Plan. The five important elements that provided the basis for the QA program were:

1. Equipment calibration--calibration procedures and complete recordkeeping;
2. Independent audit program--independent performance and system audits as required and/or needed;
3. Data handling--field assessment and chain-of-custody procedures for transfer of samples and records between individuals and from the sampling site to the Project Data Manager;
4. Data reduction--editing and digitizing of data tapes and strip charts as well as data interpretation; and
5. Preparation and filing of data report--proper report preparation, thorough documentation, and retention of records.

QA procedures were implemented in accordance with the FDER approved SOP Manual and QA Plan. The QA Plan addressed QA requirements specified by Appendix B, CFR Part 58 and the FDER State-Wide QA Air Program Plan. Major components of the QA program included:

- Daily automated zero, span, and precision checks for the O_3 and SO_2 continuous monitors;
- Quarterly multipoint calibrations of the O_3, SO_2, and PM_{10} analyzers, strip chart recorders, and data acquisition system;
- Quarterly multipoint audits of the O_3, SO_2, and PM_{10} analyzers;
- Audit of the O_3, SO_2, and PM_{10} analyzers using EPA-furnished audit equipment (National Performance Audit Program);
- Monthly one-point flow rate checks of the PM_{10} samplers;
- Biannual calibration of the meteorological sensors; and
- Systems audit conducted by FDER personnel.

Four quarterly performance audits were conducted, the first by ECT and the last three by FDER personnel. An additional performance audit, using EPA furnished test equipment in accordance with the National Performance Audit Program, was performed by ECT. All audit results met the required accuracy criteria. A summary of the performance audits is shown on Table 2.3.7-19.

A systems audit was conducted by FDER personnel on August 13 and 14, 1991, at ECT's offices in Gainesville, Florida. FDER personnel also performed a systems audit of the PM_{10} filter processing procedures performed by PACE, Inc. on November 13, 1991, in Charlotte, North Carolina. Corrective action was taken to satisfactorily resolve all audit findings. FDER issued a final audit report on January 10, 1992, which stated: (a) an overall rating of satisfactory, (b) that all findings were properly addressed, and (c) that the audit was formally closed (FDER, 1992).

Table 2.3.7-19. Summary of Performance Audit Results

Audit Date	Agency	Pollutant	Audit Parameter	Audit Value (%)
05/21/91	ECT	O_3	Mean deviation	-4.5
		SO_2	Mean deviation	5.5
		PM_{10} - AQ1	Flow rate deviation	1.2
		PM_{10} - AQ2C	Flow rate deviation	0.8
		PM_{10} - AQ2D	Flow rate deviation	0.5
08/13/91	FDER	O_3	Mean deviation	13.2
		SO_2	Mean deviation	7.5
		PM_{10} - AQ1	Flow rate deviation	-1.0
		PM_{10} - AQ2C	Flow rate deviation	-1.0
		PM_{10} - AQ2D	Flow rate deviation	-0.6
12/03/91	FDER	O_3	Mean deviation	1.0
		SO_2	Mean deviation	4.1
		PM_{10} - AQ1	Flow rate deviation	0.5
		PM_{10} - AQ2C	Flow rate deviation	0.5
		PM_{10} - AQ2D	Flow rate deviation	2.8
01/16/92 (EPA equipment)	ECT	PM_{10} - AQ1	Flow rate deviation	-4.0
		PM_{10} - AQ2C	Flow rate deviation	-3.5
		PM_{10} - AQ2D	Flow rate deviation	-2.8
02/13/92 (EPA equipment)	ECT	O_3	Mean deviation	4.2
		SO_2	Mean deviation	-7.6
02/19/92	FDER	O_3	Mean deviation	5.0
		SO_2	Mean deviation	-1.1
		PM_{10} - AQ1	Flow rate deviation	0.3
		PM_{10} - AQ2C	Flow rate deviation	-0.7
		PM_{10} - AQ2D	Flow rate deviation	0.4

Source: ECT, 1992.

2.3.8 NOISE

Noise conditions in the Polk Power Station site area are described in terms of A-weighted decibels (dBA), using the following common descriptors: (1) equivalent sound level for 24-hour periods [$L_{eq}(24)$] and (2) day-night sound level (L_{dn}). The former may be considered a time weighted average, while the latter is weighted more heavily for noise during the night [Edison Electric Institute (EEI), 1984]. While there are no federal, state or local noise standards applicable to the site, existing conditions can be compared to EPA noise guidelines, which were developed to protect public health and welfare (EPA, 1974). These guidelines are summarized in Table 2.3.8-1.

The Department of Housing and Urban Development (HUD) has established a set of guidelines for noise levels in residential areas. These categories of acceptability have been defined: acceptable if the L_{dn} is less than 65 dBA, normally unacceptable if the L_{dn} is greater than 65 dBA and less than 75 dBA, and unacceptable if the L_{dn} is greater than 75 dBA (HUD, 1979). According to EPA studies, the majority of people complain when the L_{dn} exceeds 65 dBA (EPA, 1973).

To characterize the existing noise environment, a noise monitoring program was conducted for the Polk Power Station site during the period of June 8 through 12, 1991. The four monitoring locations are shown in Figure 2.3.8-1. The monitor locations were determined by the location of noise-sensitive receptors. In this case, the noise-sensitive receptors were identified as residential areas. Figure 2.3.8-1 shows the three major groups of residences in the vicinity of the site. The following table provides the approximate distances in feet between each group and the power block center.

Residential Area	Power Block Center (ft)	Number of Residences
1	22,250	53
2	10,125	45
3	8,250	1

Table 2.3.8-1. Summary of Noise Levels Identified as Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety

Effect	Level	Area
Hearing loss	$L_{eq}(24)$ = 70 dBA*	All areas.
Outdoor activity interference and annoyance	L_{dn} = 55 dbA	Outdoors in residential areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
	$L_{eq}(24)$ = 55 dBA	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor activity interference and annoyance	L_{dn} = 45 dBA	Indoor residential areas.
	$L_{eq}(24)$ = 45 dBA	Other indoor areas with human activities such as schools, etc.

*Based on annual averages of the daily level over a period of 40 years.

Source: EPA, 1974.

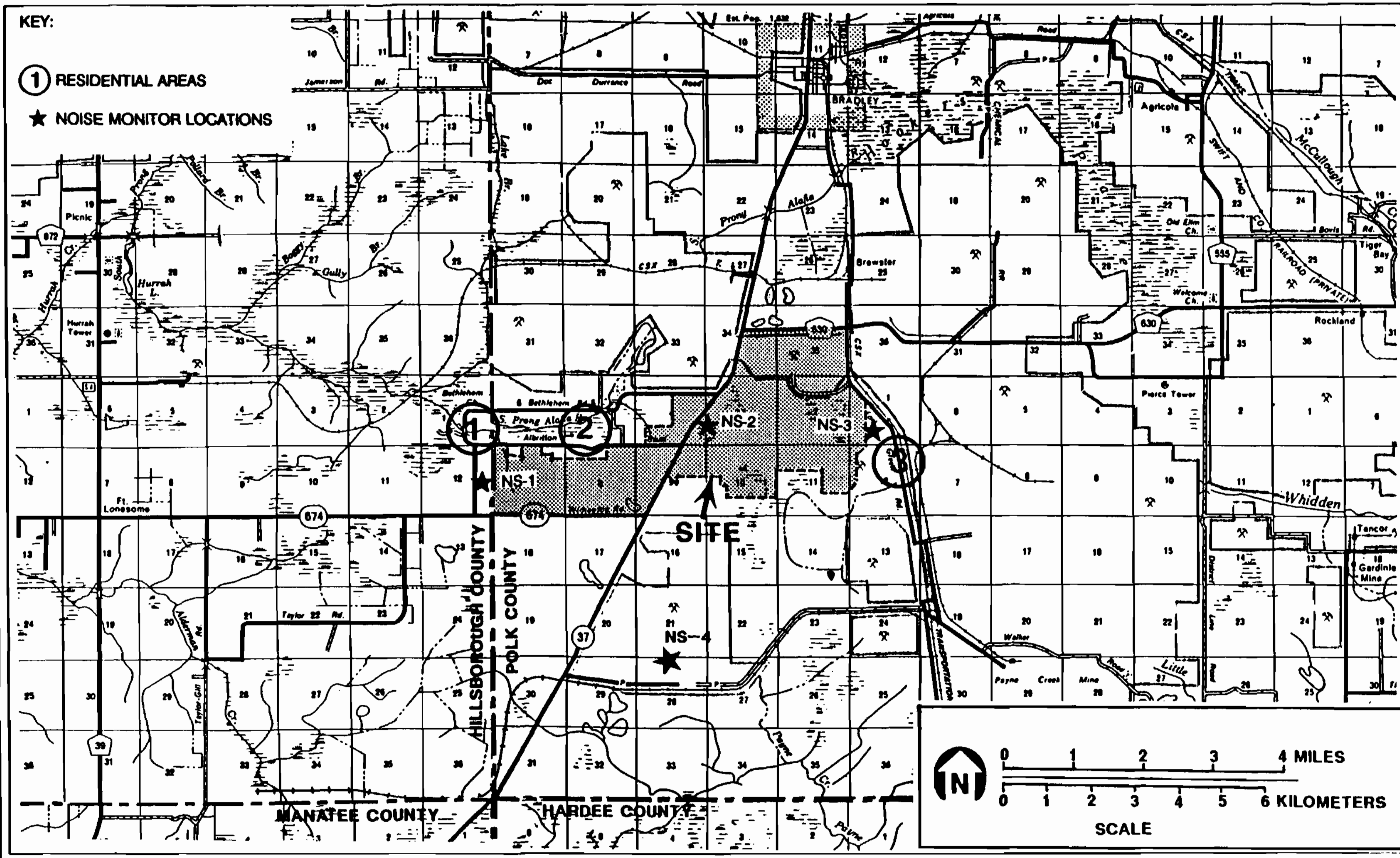

FIGURE 2.3.8-1.

LOCATIONS OF RESIDENTIAL AREAS AND NOISE MONITORS

Source: FDOT Map, FL. ECT, 1992.

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NS-4 was located at the Agrico Fort Green Mine south of the site to develop a thorough description of noise levels in the area. Other portions of the study area include citrus groves, recently mined areas, older mined areas, and reclaimed and unreclaimed areas. Draglines and the Agrico Fort Green Mine are the primary sources of industrial noise in the area. Traffic on SR 37 and the CSX railroad are major sources of noise in this area. General aviation and commercial aircraft also impact the entire study area.

Table 2.3.8-2 provides the monitored hourly equivalent noise levels from the June 1991 program. The highest $L_{eq}(24)$ and the highest L_{dn} were observed at the Agrico Fort Green area (NS-4). The influence of automobile traffic was observed at NS-2 where the $L_{eq}(24)$ and L_{dn} were slightly lower than at NS-4. At NS-1, the noise levels showed variability due to the constant operations of the dragline approximately 0.25 mile from the site. NS-3 was exposed to some automobile traffic on Fort Green Road, train traffic on the CSX, and activities in the citrus groves.

Data collected during the noise monitoring program are provided in Appendix 11.12

Table 2.3.8-2. Ambient Noise Survey Data Hourly Equivalent Sound Level (dBA)

Hour of Day	Noise Monitoring Location and Start Date NS-1 06/08/91	NS-2 06/08/91	NS-3 06/09/91	NS-4 06/09/91
1000	--	55.0	--	--
1100	--	56.2	45.0	--
1200	49.9	53.8	43.1	--
1300	49.5	54.1	44.7	56.2
1400	48.1	52.8	45.1	53.3
1500	49.4	55.6	41.5	55.0
1600	50.4	54.4	41.4	53.5
1700	51.6	55.6	42.9	53.4
1800	51.6	55.5	42.7	53.8
1900	50.9	56.0	47.7	54.2
2000	49.3	56.9	44.2	55.8
2100	52.1	56.9	48.6	58.2
2200	52.3	57.3	60.1	57.1
2300	51.6	55.8	48.9	58.2
2400	50.9	53.7	48.6	57.4
0100	51.8	54.2	49.4	56.2
0200	51.4	55.1	46.2	56.8
0300	51.2	52.6	51.2	54.1
0400	50.3	48.7	52.9	53.9
0500	48.8	50.6	48.3	53.2
0600	50.4	58.5	48.3	53.5
0700	48.3	56.0	50.7	58.2
0800	49.3	56.8	43.7	55.5
0900	49.5	57.1	59.9	54.1
1000	47.8	--	55.4	56.3
1100	48.8	--	--	55.3
1200	--	--	--	55.6
$L_{eq}(24)$	50.4	55.4	51.7	55.7
L_{dn}	57.4	61.4	59.1	62.3

Note: -- = no monitoring data collected.

Source: ECT, 1992.

2.3.9 OTHER ENVIRONMENTAL FEATURES

The previous sections have provided detailed descriptions of the environmental features of the Polk Power Station site and surrounding areas. No other special or significant environmental features exist on the site which require additional information in this section.

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