PMLevyCOLPEm Resource

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Cc:	Snead, Paul; Rose, Dana
Subject:	Levy Nuclear Plant Groundwater Hydro-geologic Testing and Monitoring Plans
Attachments:	NPD-MISC-2012-015 -- Final with Attachments only.pdf

An advance copy of the letter submitting the Levy Nuclear Plant Groundwater Hydro-geologic Testing and Monitoring Plans is attached. Please note that the attached file includes the cover letter, the environmental monitoring plan, the aquifer performance testing plan, and a comment resolution matrix. The appendices associated with the comment resolution matrix are not included with this message due to their large file size. The formal distribution will include the entire response, with the appendices being provided in electronic format.

Tillie Wilkins
Nuclear Plant Licensing
New Generation Programs & Projects
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Progress Energy

Serial: NPD-MISC-2012-015
June 4, 2012

Mr. Osvaldo Collazo
Chief, North Permits Branch
Department of the Army
Jacksonville District Corps of Engineers
Panama City Regulatory Office
1002 West 23rd Street, Suite 350
Panama City, FL 32405-3648

Re: Progress Energy Florida (PEF)/Levy Nuclear Plant (LNP) – SAJ-2008-00490(IP-GAH)
Groundwater Hydro-geologic Testing and Monitoring Plans

Dear Mr. Collazo:

Attached, please find the following two plans:

1) Levy Nuclear Plant Well Field Environmental Monitoring Plan (TMEM-133); and
2) Levy Nuclear Plant Well Field Aquifer Performance Testing Plan (TMEM-135).

Also attached is a Comment Resolution Matrix with appendices which details how each of the Corps' comments provided to PEF by Mr. Gordon Hambrick via electronic mail on May 4, 2012 were addressed and/or incorporated into the two plans noted above. The comments the Corps provided were a result of the Corps' review of the draft plans that had been submitted to you via letter dated April 5, 2012, Serial NPD-MISC-2012-011. These draft plans were the subject of a site tour and meeting held with you and your staff on April 11^{th}.

PEF will be glad to address any additional questions that you and your staff may have after reviewing the attached plans. PEF would also be glad to meet with you and your staff to discuss this topic as warranted.

If you have any further questions, or need additional information, please contact Paul Snead at (919) 546-2836 or me at (919) 546-6992.

Sincerely,

Robert Kitchen
Manager, Nuclear Plant Licensing
New Generation Programs & Projects

Progress Energy Florida, Inc.
P.O. Box 14042
St. Petersburg, FL 33733

Attachments/Enclosure:

1) Levy Nuclear Plant Well Field Environmental Monitoring Plan (TMEM-133)
2) Levy Nuclear Plant Well Field Aquifer Performance Testing Plan (TMEM-135)
3) Comment Resolution, USACE Review of Draft LNP EMP and APT, April 2012 (with associated appendices provided on the enclosed disk)

cc : Gordon Donald Hambrick, USACE
Donald Habib, USNRC
Mallecia Sutton, USNRC
Patrick Madden, USNRC
Paul Gagliano, EPA
David Pritchett, EPA
Marti Moore, SWFWMD
Cindy Mulkey, FDEP

Tech Memo Approval Form

Tech Memo Number: 338884-TMEM-133
Revision: 0
Project: 338884
Review Date: 05/29/2012

Tech Memo Title: Levy Nuclear Plant Well Field Environmental Monitoring Plan

Revision History:

Revision Number	Description	Approval Date	Affected Pages
0	Initial Submittal	05/29/2012	All

Document Review and Approval

Originator:	Steven Eakin/Project Scientist	05/29/2012
	Name/Position	Date
	Martha Burlingame for Steve Eakin	
	Signature	
Reviewer:	Martha Burlingame/Biologist	05/29/2012
	Name/Position	Date
	Martha Klein Burlingame	
	Signature	
Technical Manager:	Lorin Young/Program Manager	05/29/2012
	Name/Position	Approval Date
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	Signature	

Levy Nuclear Plant Well Field Environmental Monitoring Plan

Prepared for

Progress Energy Florida

Prepared by

CH2MHILL

May 2012

Contents

Figures **Page**

Table

Attachment

Acronyms and Abbreviations

ANOVA	Analysis of Variation
APT	aquifer performance tests
CFBC	Cross Florida Barge Canal
COC	Conditions of Certification
CR 40	County Road 40
CWA	Clean Water Act
EMP	Environmental Monitoring Plan
FAC	facultative
FACU	facultative upland
FACW	facultative wetland
FDEP	Florida Department of Environmental Protection
GIS	geographic information systems
gpm	gallons per minute
LNP	Levy Nuclear Plant Units 1 and 2
MFL	minimum flow and level
mgd	million gallons per day
NGVD	National Geodetic Vertical Datum
NP	normal procedure
OBL	obligate
PEF	Progress Energy Florida, Inc.
SAS	surficial aquifer system
SWFWMD	Southwest Florida Water Management District
TBW	Tampa Bay Water
UMAM	Unified Mitigation Assessment Method
UPL	upland
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WAI	Wetland Affinity Index
WAP	Wetland Assessment Procedure

1.0 Introduction

1.1 Purpose

Progress Energy Florida, Inc. (PEF), is planning to build and operate a nuclear-powered electric generating facility in Levy County, Florida. The plant will be known as the Levy Nuclear Plant Units 1 and 2 (LNP). The Florida Electrical Power Plant Siting Act mandates a site certification process for obtaining a single site-related license that will include all state, regional, and local requirements for construction and operation of an energy facility of the type and magnitude being proposed by PEF. PEF's Site Certification Application was approved by the State Siting Board on August 11, 2009, and the project was certified on August 26, 2009.

The purpose of the Environmental Monitoring Plan (EMP) described in this document is to provide a framework for monitoring the hydrology and ecology in the vicinity of the LNP site that could potentially be affected by operation of the LNP well field. Section C.II.A.2 of the Conditions of Certification (COCs) adopted by the "Final Order on Certification for the PEF LNP Units 1 and 2," dated August 26, 2009 (as modified January 25, 2011), requires PEF to develop an Environmental Monitoring Plan (EMP) for the proposed LNP well field.

In addition to meeting the State requirements as stipulated in the COCs for LNP, this EMP is also designed to address the requirements of the U.S. Army Corps of Engineers (USACE) for information required to support Section 404 review.

1.2 Regulatory Requirements

Regulatory requirements for assessment of potential impacts to the environment and ecological communities within the vicinity of the LNP well field are provided through the USACE Section 404 permit conditions and the Florida Department of Environmental Protection (FDEP) COCs for Progress Energy Florida Levy Nuclear Power Plant (as modified January 25, 2011).

1.2.1 Federal

The USACE Regulatory Program maintains jurisdiction over waters of the United States, including wetlands. Discharges of pollutants to jurisdictional wetlands and waterways require permits under Section 404 of the Clean Water Act (CWA).

The USACE has required approval of PEF's groundwater testing and monitoring plans relative to its groundwater withdrawal, prior to issuance of the Section 404 permit for the project. PEF acknowledges and anticipates a special condition in its Section 404 permit requiring continuous monitoring of the effects, if any, of groundwater withdrawal on wetlands. Monitoring results will support regulatory decisions to adjust water withdrawal operations as part of the adaptive managment plan sanctioned by the permit.

1.2.2 State of Florida

COC Section C.II.A.2 requires the monitoring and mitigation of environmental impacts associated with permitted groundwater withdrawals for LNP. An Environmental Assessment will be performed to monitor the surface waters and wetlands in areas potentially affected by water withdrawals. As part of the Environmental Assessment, an EMP will be prepared and submitted to the Southwest Florida Water Management District (SWFWMD) for approval. The following requirements of COC Section C.II.A.2 are addressed in this LNP Well Field Environmental Monitoring Plan in the sections identified.

- Section C.II.A.2 Environmental Impacts, Monitoring, and Mitigation

  Described in Sections 3.0 and Table 1 of this EMP:

  a. *Environmental Assessment*

     i. *Environmental Monitoring Plan*

     An Environmental Monitoring Plan (EMP) shall be submitted no less than 3 years prior to any production well use in excess of 100,000 gallons per day (annual average) for production purposes. The EMP shall be approved and implemented a minimum of one-year prior to initial use of the first production well in excess of 100,000 gallons per day (annual average) for production purposes. The monitoring plan, at a minimum, shall utilize the District's Wetland Assessment Procedure to evaluate the relative condition of surface and wetlands in areas potentially affected by water withdrawals of the Licensee. Upon District approval, the plan shall be implemented and monitoring reports shall be provided in the annual monitoring report required by Section C. Plant Specific Conditions, Condition II. Southwest Florida Water Management District, A. Special Conditions 2.a.v. After five years of monitoring following groundwater use rising to more than 1.25 million gallons per day (average annual daily withdrawal quantity) from all the wells included in this site certification, the Licensee may request the District release the Licensee from monitoring. If the District concurs with the request, the District will request DEP modify the conditions of certification to remove the monitoring condition.

  Described in Sections 3.2, 3.4, 3.5, and 5.0 of this EMP:

     ii. *Data Collection*

     Licensee shall maintain and monitor the environmental monitoring sites included in the approved monitoring plan. Water levels for monitor wells, staff gauges, and piezometers for the sites included in the monitoring plan shall be referenced to National Geodetic Vertical Datum (NGVD) and reported in a form acceptable to the District by the 10th day of each month for the preceding month. The time and date that the elevation is taken shall be included. Any changes to the methods or frequency of monitoring for any of these data collection programs must be approved by the District.

  Described in Sections 3.4 of this EMP:

     iii. *Staff Gauges*

     Licensee shall install and thereafter maintain District-approved staff gauges and shall report measurements of water levels, as indicated in the monitoring plan. Water levels shall be recorded and reported to the District on or before the tenth day of the following month. To the maximum extent possible, water levels shall be recorded as indicated in the

monitoring plan. The frequency of recordings may be modified by the District as necessary to ensure protection of the resource.

Described in Sections 3.4 of this EMP:

iv. *Monitoring Wells and Piezometers*

Licensee shall monitor water levels in the monitor wells and piezometers as specified in the monitoring plan. Reports of the data shall be submitted to the District in a form acceptable to the District. All data shall be referenced to NGVD. The frequency of water-level recordings may be modified by the District as necessary to ensure the protection of the resource.

Described in Sections 5.0 of this EMP:

v. *Annual Environmental Monitoring Reports*

Following implementation of the EMP, the Licensee shall submit an annual environmental monitoring data summary by January 1st of each year for the preceding water year (October 1 – September 30). The Annual Monitoring Report shall include all raw data, essential graphs, tables, and text. Monitoring progress at each site shall be summarized in the Annual Monitoring Report, as specified below. Licensee shall submit three copies of the Annual Monitoring Report each year. Interpretive reports of environmental conditions shall incorporate all environmental monitoring sites used. The Annual Monitoring Report shall assess relationships between water level fluctuations, well pumpage, atmospheric conditions, and drainage factors related to the environmental condition of the wetlands and surface waters in the vicinity of the Levy Nuclear Plant. Pumpage data, wetland, water level data collected from the aquifer and for the region, and environmental parameters collected at the monitoring sites and in the region (SWFWMD data shall be used for information of the region) shall be used for the report results. Statistical trend analysis, such as double-mass curve analysis, multiple linear regression, time series analysis, and/or factor analysis shall be performed to analyze the interactions of rainfall and pumpage on surficial water levels, potentiometric levels in the semi-confined aquifers, surface waters, and wetland water levels, rate of soil subsidence, and evidence of vegetational succession. Data shall be obtained through field measurements and aerial photo interpretation. A brief summary of any recommended changes to the monitoring requirements shall be provided. Upon review of those recommended changes, SWFWMD may approve changes to the monitoring requirements under the approved Environmental Monitoring Plan.

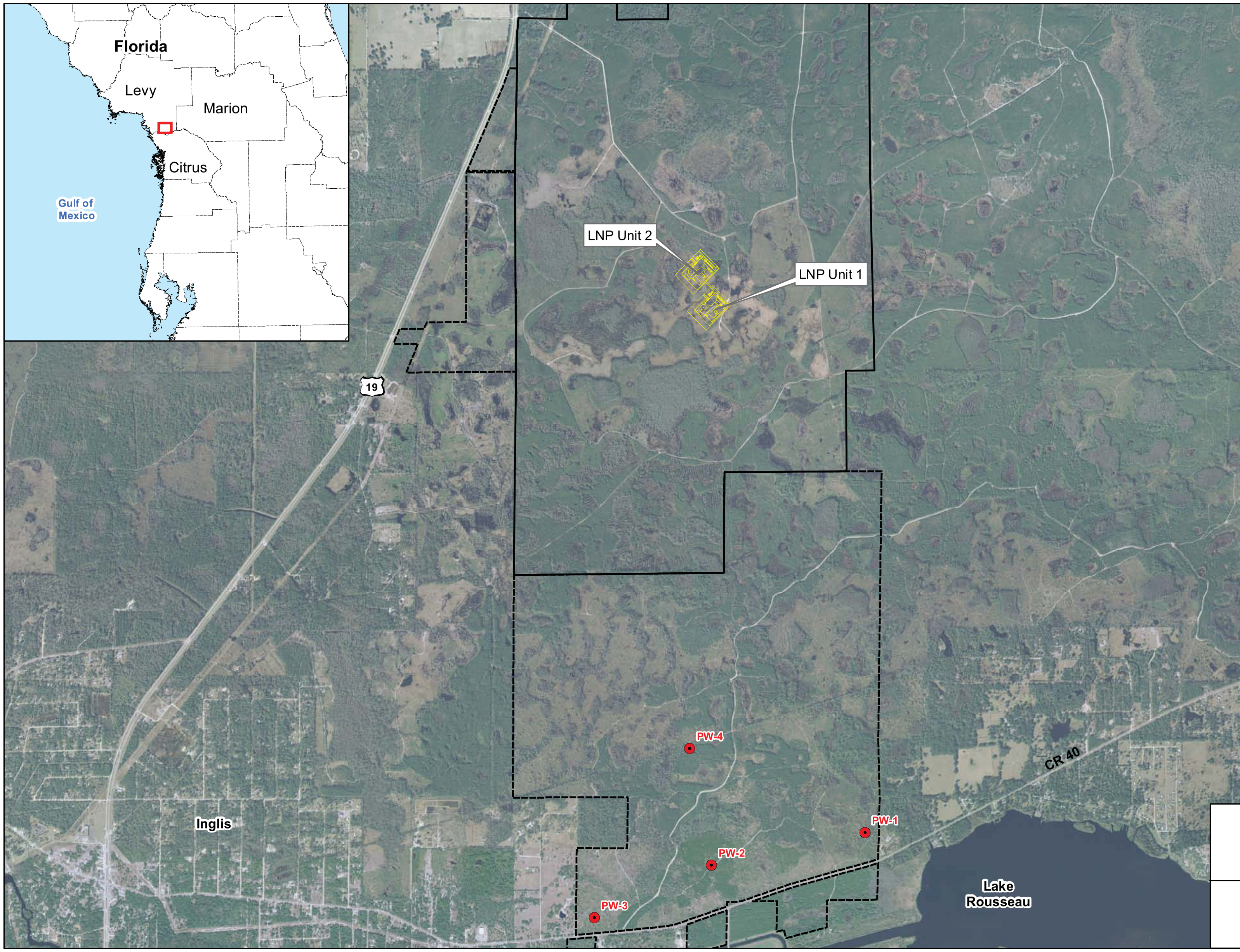
2.0 Background and Site Description

The fresh groundwater well field design consists of four wells spaced a minimum of 2,500 feet apart located in the southern portion of the LNP property (see Figure 1). Three wells are parallel to County Road 40 (CR 40), with one well located to the north, on the east side of the proposed heavy haul road. Each well will have a pumping capacity of 1,100 gallons per minute (gpm) using vertical turbine pumps. Each well will average 0.4 million gallon per day (mgd) on an annual average basis as a result of well rotation, based on an assumed total average day withdrawal from the well field of 1.58 mgd. The fresh water needs of the two nuclear units are a result of four systems that require fresh water. These systems are the potable water supply, service tower makeup, demineralizer makeup, and fire protection systems. The projected demands are based on the Westinghouse AP1000 design water balance. The average day flow is projected to be 1.58 mgd, which includes a 25 percent design contingency.

The most conservative maximum day pumping rate for the LNP facility is 5.8 mgd. This estimate is the summation of maximum pumping rate projections for each of the four main systems that use the fresh water supply. The facility design capacities for each water system were used to calculate the maximum pumping rate capacity for the well field. It is assumed that both nuclear units are out of service, maximum service water is required, and two fires are being fought simultaneously. While it is highly unlikely that all four systems would be pumping at their maximum design capacity at the same time, the well field must be designed to meet this improbable scenario. Under this conservative maximum day condition, the four wells would be assumed to be operating simultaneously for 1 week.

Wetlands are common features within the LNP property. Wetland types found within the vicinity of the LNP well field are predominantly forested communities and include cypress, wet planted pine, mixed forests, and mixed hardwoods.

Most of the LNP site was previously managed for pine silviculture production. Silviculture activities (rows, bedding, surface water modifications) have impacted the hydrology and vegetative communities of most wetlands. Additionally, wetlands in the southern portion of the LNP property exhibit evidence of long-term reduction in groundwater levels that is likely the result of the construction of the Cross Florida Barge Canal (CFBC), south of CR 40. These drawdown effects, which include oxidized soils, atypical vegetative zonation, and leaning cypress trees, are most evident along the southwest property boundary and decrease toward the northeast across the site, relative to the distance from the CFBC.



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Levy Nuclear Plant Units 1 and 2 LNP Well Field EMP

Site Layout

FIGURE 1

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3.0 Monitoring

This section describes the monitoring program designed to evaluate the groundwater and ecological systems that could be affected by operation of the LNP well field.

3.1 Monitoring Overview

The purpose of this EMP is to describe the field data collection process that will be used to identify potential effects on wetlands within the vicinity of the LNP well field from the proposed groundwater withdrawals. Monitoring parameters will include water levels within the surficial aquifer system (SAS), wetland hydrology, wetland vegetative community composition and condition, soil profile, and regional climatic conditions.

Monitoring data collected will be used to answer the following questions:

- What are the baseline ranges of wetland hydroperiods for the systems potentially affected by well field pumpage?
- Are wetland water levels and hydroperiods changing relative to baseline, and if so, are these changes the result of regional factors (such as precipitation patterns, cumulative groundwater pumping in the area, or disruption in surface water hydrology), or PEF well field pumping?
- Is well field pumping affecting wetland water levels or hydroperiods?,
- Are shifts in vegetation type occurring and are these changes due to observed decreases in hydroperiod stage and duration?
- Has there been any evidence of subsidence in wetlands attributable to groundwater pumping?
- Is well field pumpage adversely affecting wetlands?

Monitoring locations (assessment areas) will focus on wetlands within the near vicinity of the production wells where potential drawdown impacts, if any, are likely to be detected first. In addition, wetlands at a moderate distance from the production wells and at locations outside of the modeled groundwater drawdown influence will be monitored. Baseline monitoring of these assessment areas will begin a minimum of 2 years before operational production wells are installed.

Monitoring will be conducted within representative wetlands using the SWFWMD and Tampa Bay Water (TBW) Wetland Assessment Procedure (WAP) (2005). Enhancements to the WAP methodology in this EMP include increased hydrologic monitoring at wetland transects, increased frequency of vegetation monitoring (semi-annual), additional quantitative vegetation data collection, and an annual land elevation survey (NGVD) to identify potential soil subsidence, if any, along wetland transects. The data will be collected, evaluated, and presented in monthly and annual reports. The monitoring program will be adaptive with the reduction or expansion of individual elements as appropriate and approved by regulatory agencies responsible for permitting.

This EMP was designed to conform with or exceed the monitoring activities for other wellfield EMPs approved throughout the SWFWMD and other Florida water management districts.

3.2 Assessment Areas

Assessments of local hydrology and wetland ecological conditions will be performed along permanent monitoring transects within representative wetlands in the vicinity of the LNP well field. Final transect locations will be established prior to the baseline monitoring period. Transect setup will be based on WAP methodology (SWFWMD and TBW, 2005).

A minimum of twelve monitoring transects will be established prior to the baseline monitoring period: seven near-field, two far-field, and a minimum of three background transects. All monitoring transects will be established within the LNP property boundary except for the background transects, to reduce access issues and minimize the potential impacts of other land uses on measured parameters.

The following general criteria will be used in siting the transects:

- Seven near-field transects are located within 2,000 feet of the production wells within representative wetlands, where the potential for wellfield-related drawdown is the highest based on groundwater models. Potential near-field transects are labeled M1 through M7 on Figure 2.
- Two far-field monitoring transects are located between 2,000 feet and 5,000 feet of each production well within representative wetlands. These distances represent areas of moderate modeled drawdown from groundwater pumpage. Potential far-field monitoring transects are labeled M8 and M9 on Figure 2.
- A minimum of three background transects are located outside of the modeled drawdown influence on properties adjacent to the LNP property. These background transects will serve to represent ambient regional environmental conditions. Background transects represent wetland community types and conditions similar to those selected for monitoring within the LNP property. Additional background transects may be established to represent wetlands that are being impacted from existing regional hydrologic modifications (CFBC and Lake Rousseau). Potential background monitoring transects are labled B1 through B3 on Figure 3.

Representative wetlands should encompass the range of site wetland hydrology, vegetation communities, and condition. The specific location of each monitoring transect proposed by PEF will be approved by the USACE and SWFWMD before the start of baseline monitoring. Proposed monitoring transect locations will initially be selected randomly using geographic information system (GIS) software within the near-field and far-field zones. Potential transect locations will then be screened according to the following conditions through a desktop review and then a field review process. The need for additional background monitoring transects will be evaluated during the field review prior to the baseline period, once the current site conditions are established. To the extent possible, the following conditions will be avoided in the selection of representative wetlands:

- Evidence of surface water modifications (ditching, silviculture rows or bedding)
- Evidence of flowing surface waters (creeks, sediment deposition, channels)

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Levy Nuclear Plant
Units 1 and 2
LNP Well Field EMP

Potential Wetland Monitoring Locations

FIGURE 2

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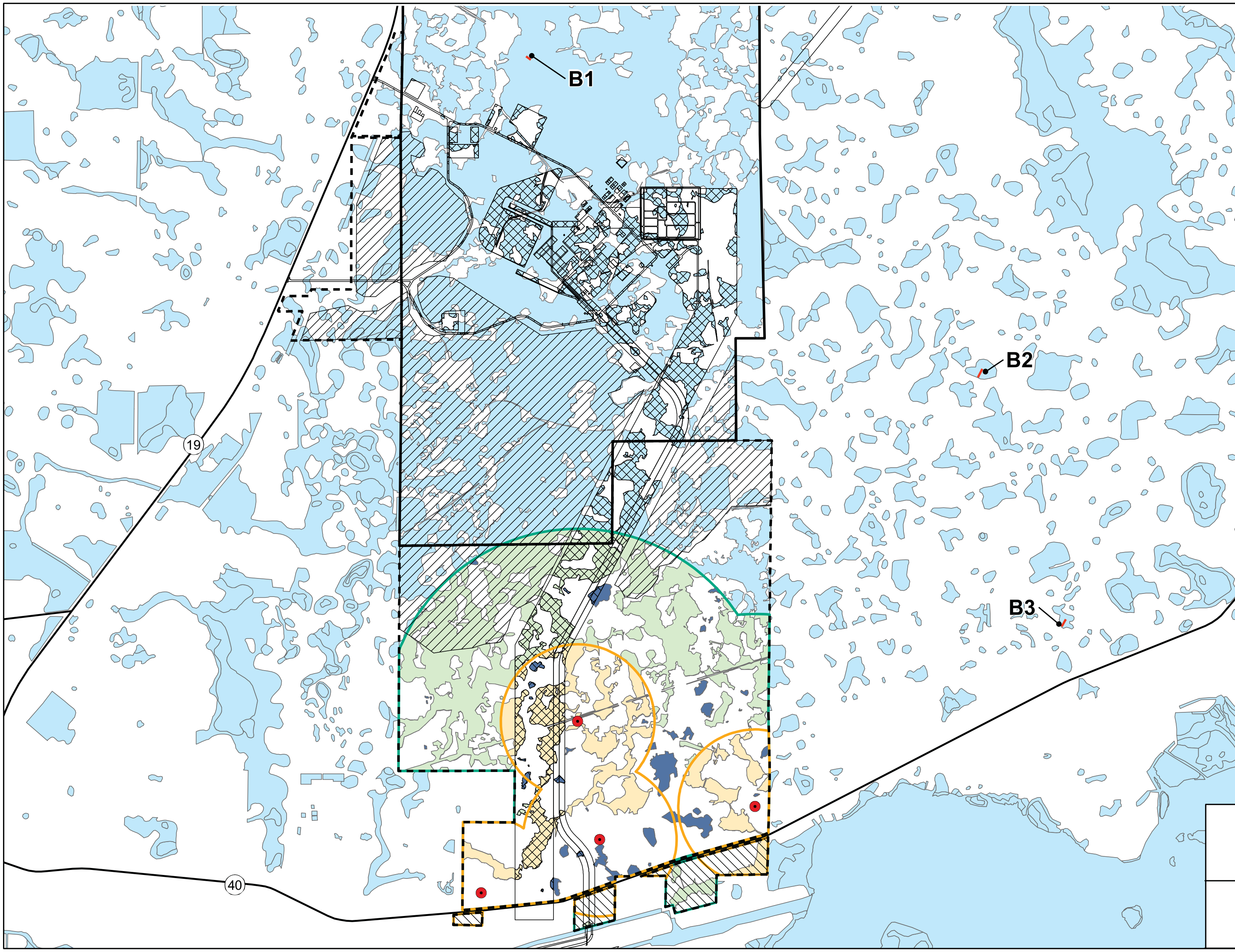


Progress Energy Florida

Levy Nuclear Plant Units 1 and 2 LNP Well Field EMP

Potential Background Wetland Monitoring Locations

FIGURE 3

Rev 0

- Extensive community of invasive/nuisance plant species
- Observance of particularly shallow or deep wetlands, or those with steep transitions from uplands to wetland interiors
- Associations with other permitted activities for the LNP, such as construction areas, mitigation areas, and site access areas

Typical wetlands transects will be between 98 and 164 feet (30 and 50 meters) (maximum) in length, and will vary in orientation (cardinal) depending on the specific conditions of the wetland in which they are located. Transects will be established from the historical wetland edge along a topographic gradient to the deepest point in the wetland's interior, as required by the WAP. Each transect will include the hydrogeological and wetland monitoring parameters described in further detail in the following sections.

3.3 Hydrologic Monitoring

This section describes the monitoring program designed to evaluate the groundwater systems that could be affected by operation of the LNP well field.

3.3.1 Monitoring Well Construction and Staff Gauge Installation

3.3.1.1 Surficial Aquifer System Monitoring Wells

SAS wells will be installed to monitor the effects of groundwater usage on water levels in nearby wetlands in the vicinity of the LNP well field. One SAS monitoring well will be installed at each of the 12 monitoring transects. The SAS well will be located outside of the wetland in the adjacent upland, as close as possible to the monitoring transect, to facilitate access. These SAS monitoring wells will fully penetrate the SAS underlying the associated wetland.

Each SAS monitoring well will be screened within the surficial aquifer system. Based on site boring logs, each well will be screened at a depth of approximately 20 to 30 feet below ground surface with 10–foot-long screens. To the extent possible, the well screen will be positioned such that seasonal variations in water level will not result in the well screen being above the water table.

3.3.1.2 Wetland Piezometers and Staff Gauges

Shallow wetland piezometers and staff gauges will be installed to monitor surface and subsurface water within wetlands in the vicinity of the LNP well field.

One wetland piezometer and one staff gauge will be installed at each of the 12 monitoring transects. Both the wetland piezometer and the staff gauge will be located within the wetland interior, near the terminus of the monitoring transect. The staff gauge will be installed directly adjacent to the wetland piezometer for quality assurance verification during periods of available surface water.

All well and staff gauge locations and vertical elevations will be surveyed by a registered land surveyor. Vertical elevation data will be recorded in NGVD.

3.3.2 Pre-Construction (Baseline) Hydrologic Monitoring

The pre-construction (baseline) hydrologic monitoring program will begin following monitoring well installation activities and at least 2 years prior to the installation of LNP production wells. The timing of the start of the pre-construction (baseline) hydrologic monitoring will allow for a minimum of 2 consecutive years of monitoring data to be collected, fully encompassing each year's wet and dry seasons.

The pre-construction (baseline) hydrologic monitoring program will consist of continuous water-level measurements at the SAS monitoring wells and wetland piezometers. Data loggers (water-level recorders) will be installed in the SAS monitoring wells and wetland piezometers, and programmed to collect water-level readings at a minimum of 1-hour intervals. All water-level recorders will be downloaded monthly. The SAS well, staff gauge, and wetland piezometer measurements will be recorded on the same days each month when possible.

3.3.3 Operational Hydrologic Monitoring

The operational hydrologic monitoring program will consist of extending pre-construction monitoring for a period of 10 years after startup of the well field. PEF may request release from or modification to monitoring requirements after 5 years of monitoring if wetland impacts associated with groundwater withdrawals are not detected. The need for modifications to the monitoring program (for example, changes in monitoring stations or frequency of collection) will be assessed over the duration of the operational monitoring period and any recommendations for changes to the program will be documented in Annual Monitoring Reports (see Section 5.0). Any program modifications will be discussed with SWFWMD and USACE and implemented based on a determination that these modifications are necessary in order to meet COC or Section 404 permitting requirements.

3.3.4 Rainfall Monitoring

Rainfall data will be obtained from the LNP meteorological tower/weather station and Goethe State Forest for the monitoring period associated with the Annual Monitoring Report. Rainfall data will be used to assess environmental conditions in the monitored wetlands in conjunction with the data evaluation performed for the Annual Monitoring Report.

3.3.5 Pumpage Data

Daily total pumpage data will be obtained from each of the LNP wells. Pumpage data will be used to assess data collected from SAS monitoring wells, wetland piezometers, and staff gauges in conjunction with other hydrologic inputs such as rainfall. An analysis of hydrologic parameters and trends will be included in each Annual Monitoring Report.

3.3.6 Data Analysis

Hydrologic data collected during the pre-construction (baseline) period will be used to establish typical ranges of values for the measured parameters. Wetland hydroperiods and stage duration curves will be prepared for wetlands at each of the 12 monitoring transects. These baseline data, along with documented climatic information and background data, will be compared to operational monitoring data each quarter. Hydrologic data collected during the pre-construction (baseline) period will be used to establish management threshold

values, which are linked to a sequence of intervention measures designed to prevent adverse effects on wetlands.

The management thresholds will be based on the SWFWMD approach to establishing minimum flows and levels (MFLs) for palustrine cypress wetlands, using site-specific baseline water level trends in the monitored wetlands. The palustrine cypress MFL was first established, pursuant to Section 373.042(1) of the Florida Statutes, for wetlands in the Northern Tampa Bay area that were experiencing reduced surficial aquifer levels from associated well field withdrawals. Researchers reviewed 20 years of wetland vegetation, soils, and hydrologic data to ascertain the relationship between long-term hydrologic patterns and wetland conditions. A specific goal was to identify a hydrologic threshold, below which it would be reasonable to expect "significant harm" in a wetland (SWFWMD, 1999). The long-term median water level (p50), was monitored to accommodate natural fluctuations in precipitation over time. By evaluating stage duration data from both healthy and stressed wetland systems over 6 years, a p50 value was extrapolated that represents the minimum median water level that maintains key wetland functions. Wetland harm may be expected if the wetland p50 value falls below this minimum value.

A similar methodology will be used to establish management thresholds for the wetlands monitored as part of this EMP. Three management thresholds will be developed for each monitored wetland that represent departures from the wetland's p50 value, but are above the minimum value. These management thresholds are levels at which there is concern for wetland hydrology, but before harm is expected to occur. The thresholds will be based on the range of water levels established for each monitored wetland during the baseline monitoring period. A description of how these thresholds are developed will be provided in the baseline monitoring report for review by regulatory agencies. During the quarterly data evaluation, if the p50 value for the operational period has fallen below a threshold as a result of LNP groundwater withdrawals (after consideration of reference wetland data), PEF will notify the SWFWMD and the USACE; implement intervention measures, such as well field optimization or pumping rotation; and increase the frequency of hydrologic data evaluations to monthly. These management thresholds represent an additional, protective step in advance of a transition to an alternative water supply. A transition to an alternative water supply will occur if required by either SWFWMD or USACE. Provisional management threshold values and the decision matrix for implementing management strategies are presented in Section 4.0.

The wetlands in the well field vicinity have been adversely impacted to varying degrees by pre-existing stressors, and the individual management threshold values will be based on hydrologic data for each monitored wetland. The goal of the monitoring program and the management strategies is to prevent further harm to wetlands resulting from groundwater withdrawals by maintaining existing hydrologic conditions.

The data collected during the pre-construction (baseline) and operation monitoring periods will provide a data set that will allow for the statistical analysis of trends and comparisons. Baseline data for the monitored wetlands will be extended through regression analysis with regional background lake, wetland or surficial aquifer system wells with long periods of record, and used to hindcast a historic data range, with the objective of estimating a long-term baseline of approximately twenty years. This method, termed the line of organic correlation, is an accepted technique used for the estimation of extensions of flow records

(Helsel and Hirsch, 2002) and has been used by SWFWMD for estimating historic stage records for MFL analyses, including a recent analysis of a wetland-fringed lake in Sumter County (e.g., SWFWMD, 2006). This approach directly addresses the need for a long-term period of record necessary to span wet and dry cycles in Florida wetlands when the available baseline of new information is limited.

Statistical trend analysis, such as double-mass curve analysis, multiple linear regression, time series analysis, and/or factor analysis will be performed to analyze the interactions of rainfall and pumpage on surficial water levels, potentiometric levels in the semi-confined aquifers, surface waters, and wetland water levels. Results of these analyses will be provided in each Annual Monitoring Report, in addition to the current data sets.

3.4 Ecological Monitoring

This section describes the monitoring program designed to identify and evaluate the ecological conditionof the wetlands that might be affected by the construction and operation of the LNP well field.

Wetland ecological monitoring will be based on the WAP and supplemented as described in this section. The WAP was originally developed by the SWFWMD to identify the effects of groundwater withdrawal on isolated cypress wetlands. In this context, "isolated" is defined as "lacking significant and regular channelized inflow" (SWFWMD and TBW, 2005). The *Wetland Assessment Procedure Instruction Manual for Isolated Wetlands* (SWFWMD and TBW, 2005) describes how to apply the WAP to wetlands.

In addition to the WAP methodology for vegetative monitoring, quantitative elements will be conducted as part of this EMP. Modifications to the WAP method include increased frequency of vegetation monitoring (semi-annual), higher resolution in the collection of cover range values for vegetation strata, (nearest 10 percent or better), and calculation of a Wetland Affinity Index (WAI) to estimate shifts in wetland vegetation zonation. The increased data collection frequency and additional evaluation of vegetation community trends will allow for a statistical comparison of the wetland transect vegetation data sets (baseline and operational) once a minimum number of monitoring events are completed. Changes in vegetation zonation will be considered, along with hydrologic parameters, in implementing adaptive management strategies.

Wetland vegetation community data, soils assessments, and observations of wildlife utilization will be used to determine if ecological responses to any detectable changes in wetland hydrology are being expressed within the representative wetlands. The background monitoring transects will reflect regional ecological responses to climatic conditions, which will also influence LNP monitored wetlands. The following subsections summarize the WAP activities and enhanced monitoring planned for the LNP site.

3.4.1 Initial Monitoring Wetland Setup

Initial wetland setup for the WAP monitoring program consists of a historical assessment and transect selection and setup.

3.4.1.1 Historical Assessment

A history will be established for each wetland selected for WAP monitoring at the LNP site. The wetland history will include a review of historical aerial photography and previous

hydrologic studies in the vicinity of the LNP site, and initial field visits to establish long-term biological indicators of past and current hydrologic conditions. The purpose of the historical assessment is to provide information on the wetland condition, historical stressors, and potential existing stressors. The requirements of the historical assessment are described in further detail in the WAP manual (SWFWMD and TBW, 2005).

3.4.1.2 Monitoring Transect Setup

Representative wetlands will be selected for the establishment of monitoring transects as described in Section 3.3. Preliminary transect locations are shown in Figure 2 and Figure 3. The final locations will be established through field site visits prior to the beginning of the pre-operational (baseline) period, and subject to USACE and SWFWMD approval.

Wetland transects will be set up according to methodologies described in the WAP Manual (SWFWMD and TBW, 2005) provided in Attachment A. A WAP transect is a straight line from the historical wetland edge to the wetland interior. The WAP transects will be chosen to provide the best opportunity to assess aspects of the wetland while considering practicalities, such as access, the need to minimize disturbance, and lines of sight.

WAP transects will be approximately 10 meters wide (minimum) but may be widened according to specific site conditions. Once WAP transects are established, locations of the following features will be identified and permanently marked along each transect:

- Historical Wetland Edge
- Wetland Interior
- Historical Normal Pool (NP)
- NP-6 (historical NP minus 6 inches)
- NP-12 (historical NP minus 12 inches)
- Wetland Piezometer and Staff Gauge

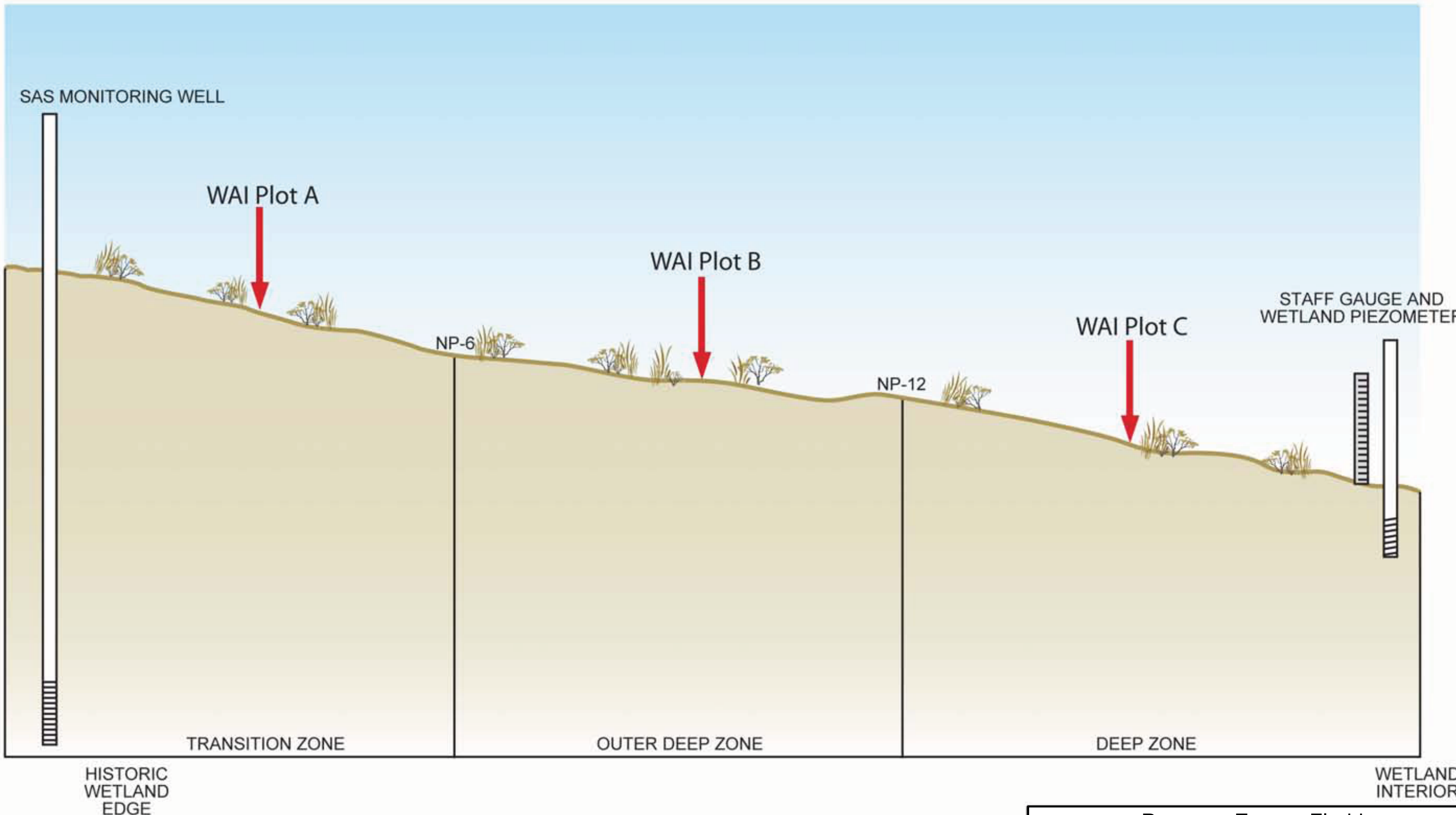
The definition and determination of the each of these transect features are provided in the WAP manual. The establishment of the historical NP median elevation typically requires a minimum of five indicators along each monitoring transect, which are listed in Appendix C of the WAP manual. All established transect characteristic permanent locations and vertical elevations will be surveyed by a registered land surveyor and recorded in NGVD.

As described in the WAP manual, the area between the historical wetland edge marker and the NP-6 marker will be designated as the transition zone. The area between the NP-6 marker and the NP-12 marker will be designated as the outer deep zone. The area between the NP-12 marker and the wetland interior marker will be designated as the deep zone. Figure 4 depicts a typical wetland monitoring transect profile.

The establishment of the WAP transects and supporting elevations will be documented using the form provided in the WAP. If a WAP transect requires repositioning during the course of the monitoring periods, all supporting elevations will be re-established and the establishment of the new WAP transect will be documented using the form provided.

3.4.1.3 Soils Assessment

Soils within and in the vicinity of the monitoring transect will be evaluated for signs of soil loss including oxidation, subsidence, soil compaction, and general soil disturbance. Any observations of initial karst features, such as sinkholes, will also be noted. Any significant findings will be added to the wetland history information.



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Typical Wetland Cross Section

FIGURE 4

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A survey of soil elevations along the established monitoring transects will be performed during the initial setup and annually throughout the operational monitoring period. The baseline survey will be performed along the length of one edge of each monitoring transect. Soil elevations will be recorded at 20-foot intervals along the transect and where notable changes in wetland communities occur. Vertical soil elevations will be surveyed by a registered land surveyor and recorded in NGVD.

3.4.2 Well Field Pre-Construction (Baseline) and Operational Monitoring

This section describes the monitoring activities that will occur following the initial monitoring wetland setup. The pre-construction (baseline) and operational wetland monitoring periods will coincide with the hydrologic monitoring periods as described previously in Sections 3.4.2 and 3.4.3.

The pre-construction (baseline) wetland monitoring program will begin following the initial wetland transect setup and at least 2 years prior to the installation of the LNP production wells. The timing of the start of the pre-construction (baseline) hydrologic monitoring will allow for a minimum of 2 consecutive years of monitoring data to be collected. Data collected during the pre-construction (baseline) period will be included as part of the historical wetland assessment.

The operational hydrologic monitoring program will consist of extending pre-construction monitoring for 10 years after startup of the well field. PEF may request release from or modification to monitoring requirements after 5 years of monitoring if no impacts are detectable. The need for modifications to the monitoring program (for example, changes in monitoring stations or frequency of collection) will be assessed regularly over the duration of the operational monitoring period.

3.4.3 Monitoring Methodology

Monitoring at representative wetlands will be performed twice annually, in the March/April and August/September timeframes. Several other activities will be performed at a frequency of every 5 years. Table 1 provides a list of WAP parameters and the frequency in which they are monitored. An effort will be made to monitor wetlands during the same month each year for both the pre-operational (baseline) and operational monitoring periods.

3.4.3.1 Semi-annual Wetland Monitoring

Semi-annual wetland monitoring will occur at each of the twelve representative wetlands and will include the following activities:

- **Documentation** - The monitoring event will be documented, including identification of the organization and personnel performing the assessment; date and time of the assessment; the well associated with the WAP monitoring program; and wetland transect identification. Data collected from each monitoring transect will be recorded on WAP data sheets.

- **Ground Photography** - Digital photos will be taken of the wetland interior at the staff gauge, the transition zone at the NP-6 marker, and the entire wetland to the extent possible from upland locations. These locations will serve as permanent photo stations. At each photo stations, four photographs will be taken in each of the cardinal (compass) directions.

- **Water Levels** - Water levels at each of the wetland piezometers and staff gauges will be monitored as described in Sections 3.4.2 and 3.4.3. In addition to downloading wetland piezometer water-level recorders and recording staff gauge measurements, estimates of the percentage of wetland inundation or, if there is no standing water, soil moisture or saturation will be recorded.

- **Vegetation Zonation** - The composition and zonation of the most common ground cover, shrub, and tree species will be assessed along the WAP transects. This assessment will include identification of species that occur in each wetland zone, an estimate of the percent cover of each species, identification of the wetland zone classification for each species (based on WAP), and categorization of the zonation of each vegetation type. The data will be used to calculate the WAP "zonation" value for each wetland transect. Trends in these "zonation" values will provide a semi-quantitative evaluation of changes in wetland vegetation toward drier or wetter communities. Detailed vegetation zonation monitoring methods and species lists along with category designations are provided in the WAP manual (SWFWMD and TBW, 2005).

  In addition to the WAP monitoring methodology described previously, a more quantitative survey of wetland vegetation will be performed during the semi-annual WAP monitoring events. At each transect, a permanent 10-meter by 10-meter plot will be established near the center of each zone (transition zone, outer deep zone, deep zone) for a total of three plots per transect (Figure 4). Within each plot the percent cover (nearest 10 percent or better) of each species within each stratum (canopy, shrubs, herbs, and vines) will be estimated. A WAI will then be calculated for each plot and organized by stratum within the plant communities. The WAI determines a weight for each plant species cover estimate by assigning a numeric value according to wetland indicator classification (FDEP). Weights to be assigned are: obligate wetland (OBL = 1.0), facultative wetland (FACW = 1.5), facultative (FAC = 2.0), facultative upland (FACU = 2.5), and upland (UPL = 3.0). The WAI is calculated for each individual plot stratum as follows:

  $$WAI = \frac{\sum WeightedSpeciesPercentCover}{\sum UnweightedSpeciesPercentCover}$$

  WAI values calculated for each stratum occurring within each plot will range from 1.00 (dominated by OBL species) to 3.00 (dominated by UPL species). The method used to calculate the WAI was adapted from the National Wetland Inventory (U.S. Fish and Wildlife Service [USFWS], 1988).

- **Additional Information** - Information will be collected on other aspects of the condition of the wetland, such as disturbance, vegetation stress, and wildlife use. Indicators of vegetation stress include changes in vegetative community composition, as well as declining conditions in wetland vegetation, such as yellowing or wilting of leaves. Observations of federally or state-listed wildlife or plant species and wetland-dependent species will be recorded during monitoring events. Observations of relevant changes to the local watershed, such as major land use changes, will also be documented.

3.4.3.2 5-year Wetland Monitoring

Activities to be performed at least every 5 years include the following:

- **Wetland History Update** - Updates to the wetland history based on the results of the WAP monitoring program will be completed at least every 5 years. In addition, wetland histories will be updated at the conclusion of the monitoring program.
- **Land and Marked Location Survey** – The vertical (NGVD) elevation of permanently marked locations established at wetland monitoring transects will be re-surveyed every year for soil subsidence evaluations and quality control of data collection. The permanently marked locations include wetland transect characteristics, SAS wells, wetland piezometers, staff gauges, and soil surface elevations.

3.4.4 Data Analysis

Data for wetland monitoring parameters collected during the pre-construction (baseline) period will be used to determine ambient conditions and typical ranges of values for the measured parameters, assuming normal climatic conditions. These data include the identification of dominant species within each of the wetland transect zones, percent cover and zonation of species and stratum, occurrence of appropriate species, and elevation of soils at each of the 12 monitoring transects. The ecological data from wetland transects during the pre-construction (baseline) period will provide the basis of semi-quantitiative comparisons of data collected during the operational monitoring period.

Plot WAI scores will be evaluated after completion of semi-annual monitoring events to determine whether there are statistically significant changes between baseline and operational periods. The results of the quantitative vegetation monitoring will be evaluated as part of the adaptive management of the LNP wellfield. Data sets will be updated for each new monitoring report with the semi-annual data collected, and analyses re-run to determine whether existing trends persist or new trends are developing. Based on similar studies using quantitative WAI data sets, statistical analyses performed on the various data levels collected (plot, transect, well field, wetland type, season) may include one or more of the following : Analysis of Variation (ANOVA), Wilcoxon Rank Sum Comparison, Mann-Kendall Trend Evaluation, and/or Wilcoxon Signed-Rank Test (CH2M HILL, 2010).

The wetland vegetation data collected represent the ecological responses to regional climatic conditions and groundwater pumpage. These changes in wetland hydroperiod are expected to first be detectable through the hydrologic monitoring program. It would be expected that changes to wetland communities will be slower to develop over time compared to measured water levels within the wetlands and the SAS. The wetland vegetation community data will be evaluated with the background monitoring transect data and climatic information to identify any trends potentially resulting from groundwater pumpage. Statistical trend analysis, such as multiple linear regression, time series analysis, and/or factor analysis, will be performed to analyze the rate of soil subsidence, if any, or evidence of vegetational succession. Results of this analysis will be presented in each annual report (see Section 5.0).

3.5 Monitoring Parameters and Frequency

Table 1 provides a list of monitoring parameters and the frequency at which each parameter will be collected and reported.

TABLE 1
EMP Monitoring Parameters, Collection and Minimum Reporting Frequency

Parameter	Collection Frequency	Reporting Frequency
Hydrologic Monitoring		
Water Levels – SAS Wells	Continuous, 1-hour intervals	Monthly
Water Levels – Wetland Piezometers	Continuous, 1-hour intervals	Monthly
Staff Gauges	Monthly	Monthly
Rainfall	Daily	Annual
Pumpage	Daily	Annual
Wetland Monitoring		
Historical Assessment	Once during baseline Every 5 years during operation	As Updated
Vegetation	Semi-annual	Annual
Photography	Annual	Annual
Listed or Wetland Dependent Species Observations	Semi-annual	Annual
Survey and Land Elevation Monitoring		
Soils	Annual	Annual
Wells, Staff Gauges	Once during baseline Every 5 years during operation*	Annual
Wetland Transects	Once during baseline Every 5 years during operation*	Annual

*Also, as needed if changes in elevation are noted during routine monitoring..

3.6 Aquifer Performance Test

In accordance with the COCs, aquifer performance tests (APTs) will be conducted on the well field, after the baseline monitoring period (CH2M HILL, 2012). SAS monitoring wells will be incorporated and evaluated as part of the APT. If the APT reveals significantly different transmissivity or leakance values than previously modeled, the groundwater model and groundwater impact analysis would be revised based on the new information. At that time this EMP will be reviewed and revised in consideration of the field-verified transmissivity values. These revisions may include changes (additions or reductions) to the monitoring area of extent, monitoring components, and adaptive management measures, depending on the APT results. The revised monitoring plan will replace the current EMP upon USACE and SWFWMD approval.

4.0 Adaptive Management

This EMP provides a process by which the monitoring and data collection efforts are linked to the implementation of management strategies to prevent wetland functional losses, if any, resulting from groundwater withdrawals. These management strategies will precede a transition to an alternative water supply, if required. The stepwise process of implementing these adaptive management strategies is presented in the decision flowchart, included as Figure 5, and is described as follows:

1. The first level of evaluation is quarterly comparison of the baseline established normal pool (NP) elevation to the running median stage frequency value (p50) for the operational period data set from each wetland piezometer. Decreases in the p50 stage value greater than an established management threshold will initiate an increase in the frequency of data investigations. The hydrologic data will then be compared to background monitoring data sets along with rainfall and wellfield pumpage data to determine if the decreases in the median stage frequency are atypical for the current climatic condition. If the condition persists and the decrease is not attributed to climatic conditions, a management action will be triggered, based on the magnitude of the decrease. The magnitude of the p50 value decrease will be compared to management threshold values established for wetland water levels during the pre-construction (baseline) period. These management thresholds will be determined based on the range of water levels established for each monitored wetland during the baseline period.
2. In addition to the routine quarterly hydrologic data evaluations, semi-annual comparison of the baseline plot WAI scores to the operational period WAI scores will be conducted. Statistically significant changes in WAI scores that are not also observed in background monitoring datasets will initiate an evaluation of hydrologic data (as described previously) associated with the transects where the changes in WAI values are detected. Adaptive management strategies, as shown in the decision matrix in Figure 5, will then be implemented.
3. The intial management threshold will be established at a level designed to provide an indication of hydrologic changes before ecological harm (beyond existing conditions) takes place. At this initial management threshold, monthly monitoring of hydrologic data will continue and monthly data evaluations will be implemented. If the condition persists and is not associated with regional climatic conditions, then monthly data evaluations will continue for a specified period; one additional month during the wet season (May – September) and two additional months during the dry season (October – April). If the p50 value rises above the initial threshold during this evaluation period, then normal monitoring and quarterly data evaluations will resume. If the condition persists beyond the specified evaluation period, then a management strategy is triggered.
4. The secondary threshold will be established at a water level within the measured range of water levels for that wetland, and between the initial and tertiary threshold levels.If this level of decrease in the p50 value is reached and that decrease is not associated with climatic conditions, a management strategy is immediately implemented. The

management strategy will continue to be implemented as long as the p50 value remains below the initial threshold and is above the tertiary threshold described below. If the p50 value rises or falls to exceed other thresholds, then data evaluation and/or management strategy associated with that threshold will be implemented.

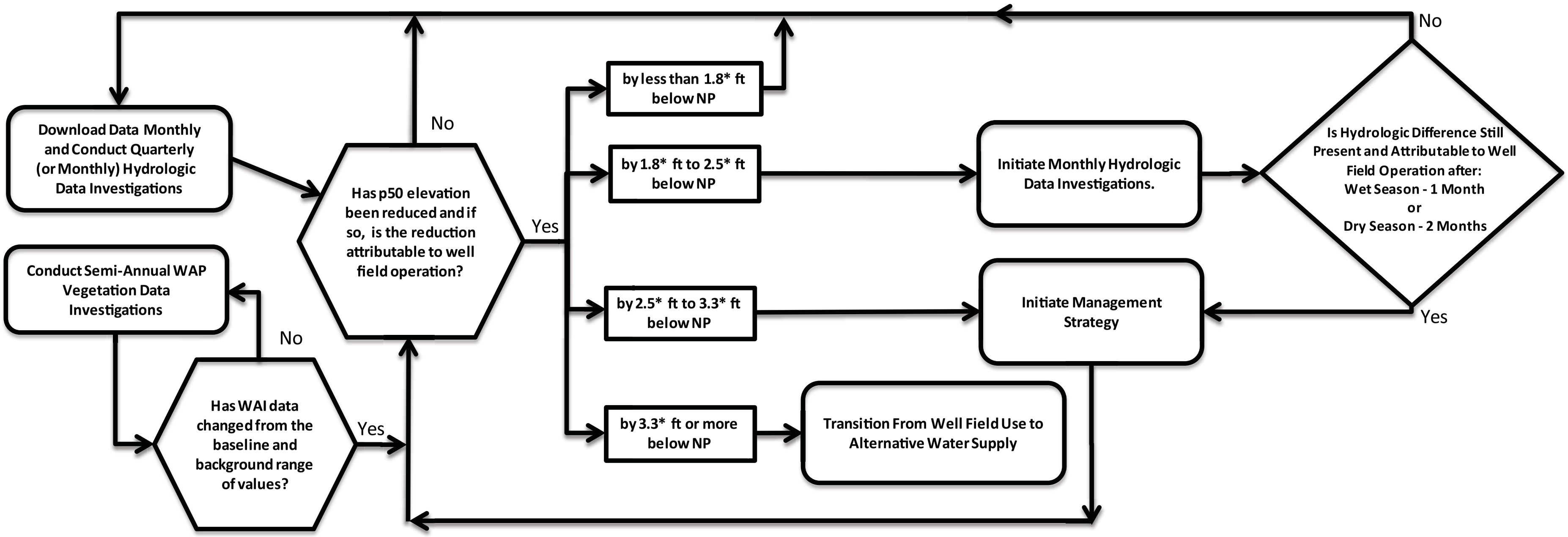
5. The third threshold will be established at a water level below which further harm is expected to occur to wetlands, if the trend is allowed to continue long term. If this threshold is reached, then groundwater pumping in the vicinity of the affected piezometer(s) will be suspended and the transition to an alternative water source will be initiated.
6. The WAP methodology will be employed to evaluate the wetland transects for evidence of harm. Vegetative species composition and indicators of vegetation stress will be assessed.

If water levels fall below any of the thresholds as a result of LNP groundwater withdrawals, based on the evaluations above, PEF will notify the SWFWMD and the USACE, initiate a data review, and implement intervention measures. The general sequence of water level management strategies follow:

1. Reduce groundwater withdrawals or modify pumpage rotation between the production wells.
2. Evaluate the feasibility of using reuse water to reduce groundwater withdrawals.
3. Manage water use in the facility to improve efficiency.
4. Revise the well field layout.
5. Deepen production wells to withdraw from deeper intervals of the aquifer to moderate SAS drawdown, if suitable water quality is found.
6. Transition to alternative water supply strategies.

The transition to alternative water supply will begin if management strategies have failed to restore water levels in the affected wetlands and p50 levels have remained below threshold values, after factoring in climatic conditions. An overall evaluation of well field operations and water usage will be conducted and well field pumpage will be curtailed while design and construction of the new water supply source are initiated. A desalination plant is proposed to be included as part of the Section 404 permit for the LNP, to minimize the transition period.

After a period of 5 years, if no adverse impacts to wetlands are detected, PEF may request release from or modification to monitoring requirements through the regulatory agencies. Any changes to the monitoring plan approved by regulatory agencies will be documented in the Annual Monitoring Reports.



Note: *Provisional threshold values subject to verification based on baseline monitoring period evaluation.
NP = Normal Pool
WAP = Wetland Assessment Procedure
WAI = Wetland Affinity Index

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Management Strategy Decision Flowchart

FIGURE 5

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5.0 Reporting

The monitoring program described in this plan will be implemented as approved by the USACE and the SWFWMD. This EMP will comply with requirements as stipulated in the State of Florida's COCs for LNP, along with the requirements of the USACE for information required to support Clean Water Act, Section 404 review. Reporting requirements for this EMP are summarized in the following subsections.

5.1 Baseline Reporting

The pre-construction (baseline) wetland monitoring program will begin following the initial wetland transect setup and at least 2 years prior to the installation of the LNP production wells. Reporting during the baseline period will consist of monthly data submittals and a single baseline monitoring report at the completion of the baseline period.

5.1.1 Monthly Data Submittals

During implementation of this plan, PEF will submit SAS monitoring well and wetland piezometer data along with wetland staff gauge readings to the SWFWMD by the tenth day of the month following the month of data collection or download. The time and date of each measurement will be included in the data submittal. Data will be submitted using the SWFWMD online data submittal tool, or using another method acceptable to the SWFWMD. Elevation data submitted to the SWFWMD will be based on NGVD.

5.1.2 Baseline Monitoring Report

Following the baseline period of implementation of this EMP, PEF will prepare an environmental monitoring summary report. PEF will submit three copies of the baseline monitoring report to the SWFWMD and USACE. The baseline monitoring report will consist of the following elements:

- All raw data, essential graphs, tables, and text.
- A summary of monitoring progress at each assessment area, including the following:
  - Monitoring results, including WAP and groundwater monitoring results, and other site-specific monitoring data.
  - Assessment of water level fluctuations, climatic conditions, and other environmental conditions of the wetlands and surface waters in the vicinity of the LNP
  - A description of the development of management thresholds, which will be determined based on the range of water levels established for each monitored wetland during the baseline period.

5.2 Operational Monitoring

Reporting during the operational period will consist of monthly data submittals and an annual monitoring report. Reporting may also occur as appropriate based on the results of quarterly hydrologic data evaluation.

5.2.1 Monthly Data Submittals

During implementation of this plan, PEF will submit SAS monitoring well and wetland piezometer data along with wetland staff gauge readings to the SWFWMD by the tenth day of the month following the month of data collection or download. The time and date of each measurement will be included in the data submittal. Data will be submitted using the SWFWMD online data submittal tool, or using another method acceptable to the SWFWMD. Elevation data submitted to the SWFWMD will be based on NGVD.

5.2.2 Quarterly Hydrologic Data Evaluation

Wetland piezometer and SAS monitoring well data will be evaluated quarterly for decreases to the median (p50) stage exceedence values. The evaluation will include a comparison to background monitoring transect data, rainfall and well field pumpage data, and established management thresholds. If decreases to the median stage exceedence values exceed management thresholds and are not attributable to climatic conditions or regional hydrologic conditions, the SWFWMD and the USACE will be notified within 7 days. The notification will be in the form of a written description of the affected assessment areas (monitoring transects), measured water levels compared to management thresholds, and the implemented management strategy. The SWFWMD and USACE will be notified of the results of the subsequent monthly data evaluations until median water levels rise above management threshold values.

5.2.3 Annual Monitoring Report

During the operational period of implementation of this EMP, PEF will prepare an annual environmental monitoring data summary by January 1 of each year for the proceeding water year (October 1 through September 30). PEF will submit three copies of each annual monitoring report to the SWFWMD and USACE. The annual monitoring report will consist of the following elements:

- All raw data, essential graphs, tables, and text.
- A summary of monitoring progress at each assessment area, including the following:
  - Monitoring results, including well field withdrawals, WAP and groundwater monitoring results, and other site-specific monitoring data.
  - Assessment of water level fluctuations, well pumpage, climatic conditions, and other environmental conditions of the wetlands and surface waters in the vicinity of the LNP.
  - Statistical trend analysis, such as the development of stage duration curves, double-mass curve analysis, multiple linear regression, time series analysis, and/or factor analysis, will be used to analyze the interactions of rainfall and pumpage on SAS and wetland water levels, soil subsidence rates, and any vegetational succession. Statistical trend analysis will be completed only after a sufficient number of monitoring events have been completed to make the analysis meaningful.
- A summary of recommended changes to the monitoring requirements, if any.

6.0 References

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ATTACHMENT A

Wetland Assessment Procedure (WAP) Manual

WETLAND ASSESSMENT PROCEDURE (WAP)

INSTRUCTION MANUAL FOR ISOLATED WETLANDS

March 2005

Prepared by:

Southwest Florida Water Management District

and

Tampa Bay Water, a Regional Water Supply Authority

Table of Contents

WETLAND ASSESSMENT PROCEDURE (WAP) INSTRUCTION MANUAL FOR ISOLATED WETLANDS (2005 REVISION)

1.0. INTRODUCTION

This instruction manual is designed to guide the user through the steps necessary to apply the Wetland Assessment Procedure (WAP), including the installation of wetland transects and the performance of the periodic evaluations. The WAP was originally developed in 2000 as part of the Environmental Management Plan (EMP – March 4, 2000) – a plan used to collect data to be used in the management of the Central System wellfields included in Tampa Bay Water's Consolidated Water Use Permit. This instruction manual constitutes the first revision of the original WAP, and replaces Attachments C through F of the EMP.

Note that certain words and phrases used throughout this manual (presented in bold type) are defined in Appendix B. Abbreviated definitions are sometimes included within the text of this instruction manual, but the user should review the more detailed definition of terms in Appendix B. Please be aware that some definitions have been modified for the WAP and may deviate from generic definitions.

The objective of the WAP is to collect information on vegetation, **hydrology**, soils, and other pertinent variables in monitored wetlands to accurately characterize the ongoing biological condition and health of each wetland. This information will be used for a variety of water management purposes, including wellfield management considerations, the development of minimum flows and levels, and the assessment of recovery in areas that have experienced historic hydrologic and biologic impacts due to ground-water withdrawals. It is important to understand that although the WAP seeks to document and monitor many aspects of wetland health, many of these aspects are not the procedure's focus. Many wetlands are also subject to negative health impacts caused by surrounding land management and drainage practices, encroaching development, cattle operations, **exotic plant** species introduction, disease, and other variables, but the WAP attempts to focus on the collection of data that will be used to assess biologic changes caused by the hydrologic effects of ground-water withdrawals.

Note that as of 2005, this WAP methodology is appropriate for isolated wetlands only. The Southwest Florida Water Management District (SWFWMD) suggests that evaluators continue assessing flow systems as appropriate, but evaluators should not apply this revised method to flow systems. An assessment methodology for flow systems will be addressed at a later date.

The results of the WAP include health assessment scores, data collection, observations, and other general information. One critical aspect of the procedure is the written documentation requested to explain various decisions made by the evaluator, as well as a written, ongoing history of each site. The written explanations and comments are intended to document the evaluators logic in deriving scores, provide a basis for ongoing quality control (as well as future correction of errors), and provide the evaluator the ability to document potentially important wetland health-related observations that may not be fully included in the current procedure. Therefore, it is important to realize that the written explanations, comments, and history are essential products of the WAP, and should not be considered optional.

An attempt has been made to make the following instructions as comprehensive as possible. However, if an evaluator finds a situation that is apparently not included in these instructions, the situation should be documented, and the documentation forwarded as soon as possible to Tampa Bay Water and/or the SWFWMD for clarification or resolution before long-term decisions are made.

2.0. DATA REPORTING AND FORMATS

The type and format of data to be submitted to Tampa Bay Water and/or the SWFWMD will be dependent on the current databases and data processing tools. Therefore, the details of data reporting and formatting will be addressed in a separate document, based on procedures agreed upon by both the SWFWMD and Tampa Bay Water. Data to be submitted will include:

a. Wetland history information (see Appendix E)
b. Documentation of transect, well, and **staff gage** installations (see Appendix F)
c. Soils information (see Section 4.1 below)
d. Annual WAP data (see Section 5.0 below)

3.0. ACTIVITIES TO BE PERFORMED FOR INITIAL WETLAND SETUP

3.1. Historical Assessment

A history of the wetland should be established (referred to as the "wetland history" throughout this document). The wetland history should include an initial evaluation of the status of the wetland condition based on several factors, which may include: 1) study of **historical** aerial photography, 2) interviews with previous evaluators, 3) review of previous studies in the area, and 4) initial field visits to the wetland (including documentation of long-term biologic indicators of past hydrologic conditions). The purpose of the **historical** assessment is to provide information on the wetland condition, **historical stresses**, and potential existing **stresses** in the area. See Appendix E for a more detailed discussion of information that should be included in the wetland history.

3.2. WAP Transect Selection and Setup

Once a wetland is chosen for monitoring, the following steps are necessary to establish the **WAP Transect**. Unless the **WAP Transect** needs to be moved or reestablished, this process should only need to be performed once. See Appendix F for a detailed list of information that should be included in the documentation of the transect setup.

WAP Transect selection. All vegetation assessments will be conducted along a **WAP Transect**. The **WAP Transect** is a straight line from the **historic wetland edge** to the **wetland interior**, and should be chosen such that it provides the best opportunity to fully assess all aspects of the wetland, including the **transition zone** (see below). Practical considerations, such as access issues, existing disturbance, minimizing vegetation disturbances while monitoring, and lines of sight, should also be taken into account when choosing a **WAP Transect**. If a **wetland well**, **upland well**, and/or a **staff gage** have been previously established, consideration should be given to including their location in the **WAP Transect**. If wells and/or a **staff gage** have not been established, they should be installed as close to the **WAP Transect** as possible.

The area to be assessed from the **WAP Transect** will be referred to as the **Assessment Area**. Whenever possible, the width of the **Assessment Area** will be approximately ten meters in width (including ten meters beyond the **wetland interior**). If the evaluator determines that critical information concerning the **zonation** condition of the wetland exists beyond the standard ten meter-wide **Assessment Area**, a wider **Assessment Area** may be used (up to the entire area of the wetland). However, when an **Assessment Area** greater than ten meters is used, the evaluator must 1) justify the larger transect size on the field sheet and in the database, 2) approach all critical areas at a distance from which elevations and species identification can be readily determined, and 3) accurately describe the size of the **Assessment Area** on the field sheet and in the database. Future evaluators should use the **Assessment Area** established by previous evaluators unless there is strong evidence to do otherwise. Evaluators should stay on the **WAP Transect** as much as possible to avoid unnecessary trampling of vegetation, but can walk throughout the wetland if critical for an accurate evaluation.

Establishment of Historic Normal Pool and other reference points. Once the location of the **WAP Transect** is chosen, the **historic normal pool** and **historic wetland edge** need to be established. Appendix C contains the definitions and procedures necessary to make these determinations. Once these elevations are determined, the elevations six-inches below **historic normal pool** (**NP-6**) and twelve-inches below **historic normal pool (NP-12)** should be established along the **WAP Transect**. The **NP-6** and **NP-12** elevations must be permanently marked for future reference. If possible, markers should also be placed at the **historic wetland edge**, as well as the **wetland interior**. The **staff gage** can serve as the **wetland interior** marker if it is placed appropriately. All four points should also be recorded using the Geographic Positioning System (GPS), and documented with detailed notes, for future reference.

The **NP-6** elevation, **NP-12** elevation, **historic wetland edge**, and **wetland interior** will be used to designate the three **wetlands zones** used in the WAP analysis. The area within the **Assessment Area** between the **historic wetland edge** and the **NP-6** marker is referred to as the **transition zone**. The area within the **Assessment Area** between the **NP-6** marker and the **NP-12** marker is referred to as the **outer deep zone**. The area within the **Assessment Area** between the **NP-12** marker and the **wetland interior** marker is referred to as the **deep zone**. Note that the **NP-6** and **NP-12** elevations may not necessarily coincide with existing vegetational indicators if the **hydrology** of the wetland has been altered, or due to natural short-term fluctuations.

If the **transition** or **outer deep zones** of the wetland are very narrow, an assessment of these **zones** may not be practical or appropriate. The **transition zone** or **outer deep zone** can be naturally narrow, can become narrow due to disturbance by surrounding land use activities, or can have become narrow due to **subsidence** in the wetland. If possible, the **WAP Transect** should be chosen in a portion of the wetland with a **transition zone** and **outer deep zone** that are wide enough for adequate monitoring. However, if no such area exists, or if an existing **WAP Transect** has a narrow **transition zone** or **outer deep zone**, and the assessor determines that the value of the maintaining the existing **WAP Transect** outweighs the value of moving the **WAP Transect**, the narrow **transition zone** or **outer deep zone** should not be monitored. In this case, the situation should be clearly discussed in the wetland history. A **zone** that is too narrow for practical evaluation is generally considered to be one meter or less in width (from the **historic wetland edge** to the **NP-6** elevation for the **transition zone**, or from the **NP-6** elevation to the **NP-12** elevation for the **outer deep zone**), but the determination of whether or not a **zone** is too narrow for evaluation is a decision of the assessor (subject to SWFWMD and Tampa Bay Water consensus).

In very shallow wetland systems, it may not be possible to establish an **NP-6** or **NP-12** elevation (i.e., the wetland has no **deep zone** and/or **outer deep zone**). In these cases, the situation should be clearly discussed in the wetland history.

The **WAP Transect** and supporting elevations should be fully documented (using the worksheet in Appendix F). Based on the documentation and specific wetland situation, an on-site verification may be required. If the **WAP Transect** needs to be moved during the course of wetland monitoring, all appropriate elevations should be re-established, and the information on the new **WAP Transect** must be documented.

4.0. ACTIVITIES TO BE PERFORMED AT LEAST EVERY FIVE YEARS

4.1. Soils Assessment

The evaluator should perform a thorough assessment of the condition of the soils. Any significant findings should be added to the wetland history.

The assessor should attempt to walk the entire wetland, looking for signs of soil loss or **oxidation, subsidence** caused by karst activity, soil lowering caused by compaction, or disturbance caused by other activities. Indications of the spatial distribution and depth of soil impacts should be documented. The following should be used as guidance:

- Substantial soil **subsidence/oxidation**: This condition occurs when **subsidence** greater than or equal to six inches is observed.
- Moderate soil **subsidence/oxidation**: This condition occurs when **subsidence** greater than two inches but less than six inches is observed.
- Little or no evidence of soil **subsidence/oxidation**: This condition occurs when **subsidence** less than two inches is observed, and when no other evidence of oxidized conditions is apparent.

See Appendix B for more details.

4.2. Wetland History Update

Update the original wetland history with any significant new observations based on the annual evaluations, soils assessments, and other information. The evaluator is encouraged to update the wetland history on a frequent basis, but at least every five years. Information recorded in the "Additional Information" section can be used for this purpose (see Section 5.0 below). See Appendix E for a discussion of information that should be included in the wetland history.

5.0. ACTIVITIES TO BE PERFORMED ANNUALLY

The following information must be collected annually during the May/June time period. All of the data must be entered into an approved electronic database. A form for use in data collection in the field will be provided in a separate document. The following describes the information to be collected during the annual evaluations.

WELLFIELD/PROPERTY Identify wellfield associated with the wetland assessment (if any). If none, state property monitored, project, or regional control.

STATION ID Identify the wetland station ID.

HISTORIC FLUCCS CODE Identify the **historical** Florida Land Use, Cover and Forms Classification System (**FLUCCS**) code for the wetland. A table is provided in the EMP that cross-references the **FLUCCS**, Florida Natural Areas Inventory (FNAI) and SWFWMD codes.

WETLAND TYPE Identify wetland type from Appendix D that most closely represents the wetland being assessed .

PERSONNEL Identify organization and person(s) conducting the wetland assessment.

DATE Date (within the May/June time period).

TIME Time of arrival

GROUND PHOTOGRAPHY

Photos As a minimum, photos should be taken of the **wetland interior** at the **staff gage**, of the **transition zone** at the **NP-6** marker, and of the entire wetland from outside the wetland (as practical). If useful, photos should be taken in each cardinal direction at each location. Optionally, if the wetland has been monitored for several years, photos should be taken at previously-chosen photo points. In this case, the photo points must be clearly described in the wetland documentation and identified by accurate latitude and longitude coordinates (if possible) to assure photo views are the same for each assessment. The photography must be digital format, and the resolution of the submitted image files must be at least the equivalent of those obtained by a three megapixel camera at full resolution. Digital image files should be clearly labeled with wetland ID, location, and date, and stored in an appropriate database.

WATER LEVEL

Describe water level conditions in the wetland at the time of the assessment. Water levels from the **staff gage** should be noted, and an estimate of the percent of the wetland inundated should be mentioned. If there is no standing water in the wetland, an estimate of soil moisture or saturation, and, if possible, depth to water, should be made. Saturation can be determined by rolling a golf ball-

sized ball of soil in your palm. If soil is saturated moisture will appear on the soil and in your palm. Depth to water can be estimated by the degree of soil saturation, or through the use of the **wetland well**. The goal of this evaluation is to provide a general description of water level conditions at the time of the assessment.

VEGETATION ZONATION

The following section provides direction to assess the **composition** and **zonation** of the most common **groundcover**, **shrub**, and **tree** species in the monitored wetland. The vegetation assessment will be conducted within the **Assessment Area** from the **WAP Transect** (unless the **Assessment Area** goes beyond the standard ten-meter width, as described earlier). The purpose is to assess vegetation characteristics and distribution with respect to **hydrology**. It is assumed that normal **composition** and **zonation** of species are a result of normal wetland **hydrology**. Altered **hydrology** is assumed to affect plant community **composition** and plant species **zonation**.

Groundcover is defined as all woody species less than one meter in height, and all non-woody species (regardless of height), rooted in the ground. **Vines** originating from within the **historic wetland edge** (but not on **hummocks**) should be considered **groundcover**. For clarity, *Eupatorium* spp., *Typha* spp., and *Rubus* spp., and certain other species generally thought of as herbaceous will only be assessed as **groundcover** regardless of their height.

Shrubs and small trees are defined as woody plants greater than one meter in height and less than four centimeters **Diameter at Breast Height** (**DBH**). Shrubs usually have multiple permanent stems. When greater than one meter in height, *Hypericum* spp. and *Ilex glabra* are considered shrubs. *Myrica cerifera*, and *Lyonia* spp., and other woody plants with multiple stems that are greater than one meter tall are always assessed as **shrubs and small trees**. Cabbage palms with trunks greater than one meter tall but less than six meters are considered **shrubs**. Only **shrubs and small trees** rooted in the ground (not on **hummocks**) will be considered.

Trees are defined as woody plants that are greater than or equal to one meter in height and greater than or equal to four centimeters **DBH**. *Myrica cerifera*, *Lyonia* spp. and other woody plants with multiple stems that are greater than one meter tall are assessed as **shrub and small trees**. Cabbage palms with trunks greater than one meter tall but less than six meters are considered **shrubs**. Some non-forested wetlands such as marshes may have enough **trees** to provide useful information. The **tree** category should be scored in marsh and wet prairie systems if the evaluator believes that useful information can be obtained from scoring. Only **trees** rooted in the ground (not on **hummocks**) will be considered.

The species found in Appendix A have been determined to be common species in west-central Florida that are useful in determining the status of wetland **zonation**. Each species has been designated a **wetland zone** classification as follows:

> **Upland (U)** – Plant species that are not expected to be seen in wetlands. It is possible that a few of these species may be found along wetland edges, but are not expected throughout the **transition zone**.
>
> **Adaptive (AD)** – Plants species designated as FAC or Upland by DEP, but commonly seen in the **transition zone** in limited numbers. When **adaptive** plants are found in the **outer deep** or **deep zones**, they should be treated the same as **transition zone** plants.

Transition (T) – Plant species commonly found in the **transition zone**, and designated either FACW or OBL by DEP.

Outer Deep (OD) – Plant species commonly found in the **outer deep zone**, and designated either FACW or OBL by DEP.

Deep (D) - Plant species commonly found in the **deep zone**, and designated either FACW or OBL by DEP.

For each category of vegetation (**groundcover**, **shrub and small tree**, and **tree)**, the assessment should be performed as follows:

1) The assessor should walk along the **WAP Transect** and list the species that occur within each **zone** (within the **Assessment Area**), keeping the following in mind:

a. Only rooted vegetation growing within the **historic wetland edge** should be included in the assessment. **Floating vegetation** should not be considered in the **zonation** evaluation, but may be noted.
b. Vegetation growing on **hummocks** or upland islands should not be considered.
c. Vegetation overhanging from the uplands, such as saw palmetto, should not be considered. Keep in mind that the **historic wetland edge** is typically uneven and meandering.
d. **Vines** in the **canopy** that originate from outside the **historic wetland edge**, or from **hummocks**, should not be included in the assessment.
e. Only consider living, non-dormant vegetation in the assessment.
f. It is possible that there may be topographically higher areas within the wetland. For example, there can be areas of the wetland within the **deep zone** that are shallow enough to become less than **NP-6**. In this case, that area should be considered to be part of the **transition zone**. This may not be easy to distinguish visually, so great care should be taken to identify and document such areas.
g. If the wetland does not have a **transition zone**, **outer deep zone**, or **deep zone**, NA (not applicable) should be written in the appropriate area of the field sheet, and an explanation should be included.
h. Evaluators should stay on the **WAP Transect** to avoid unnecessary trampling of vegetation, but can walk throughout the wetland if critical for an accurate evaluation.

Scientific names should always be used when listing species. Comments and/or notes on the observed vegetation species, including those not to be considered in the **zonation** evaluation, are encouraged in the documentation. Identification in the field, even for the plants on the limited list given in Appendix A, can be very difficult. It is strongly recommended that when the assessor is unsure of determination, small non-destructive samples be taken for further study or expert identification. Useful references for species identification include Wunderlin and Hansen (2003), Tobe and others (1998), and http://www.plantatlas.usf.edu

2) Estimate the percent **cover** of each species. Each percentage should be the percent of the wetland **zone** covered by the specific species. If the entire **cover** of a species includes only one or two plants, denote the **cover** as one or two plants rather than as a percentage. When coverage is greater than one or two plants, estimate the coverage as either 5 percent, or increments of 10 percent (10, 20, 30, etc.). Note that **cover** that is significantly disturbed by paths or trails used to

enter the wetland should not be considered in the assessment. Add any notes necessary to explain the results of the percentage estimates.

3) Indicate the **wetland zone** classification for each species found in Appendix A. If the species is not found in Appendix A, no **wetland zone** designation should be assigned.

4) Using the Ranking Scale and Guidance below, indicate the category that best describes the **zonation** of each vegetation type (**groundcover**, **shrubs and small trees**, and **trees**), and provide an explanation that clearly outlines the reasons for your choice. A species is considered to have "moved" when a species with a **wetland zone** classification closer to the **historic wetland edge** is found in a **zone** closer to the **wetland interior**. Assigning half points between categories is not acceptable. For all categories evaluated, a choice of 1-5 must be made, or **NA** must be chosen.

Ranking Scale

1. Species with an **upland** classification have moved into the **deep zone** in high numbers and distribution.

Guidance:

a. For **groundcover**, "high numbers" usually means greater than 25 percent **cover**.
b. For **shrubs and small trees**, and **trees**, "high numbers" usually means greater than 5 to 10 specimens.
c. "High distribution" usually means located throughout the **zone**.

2. Species have moved in two **zones** in high numbers and distribution, and/or some species with an **upland** classification have moved into the **deep zone**.

Guidance:

a. For **groundcover**, "high numbers" usually means greater than 25 percent **cover**.
b. For **shrubs and small trees**, and **trees**, "high numbers" usually means greater than 5 to 10 specimens.
c. "High distribution" usually means located throughout the **zone**.
d. A "2" should be chosen if any species have moved in three **zones**, regardless of numbers and distribution.

3. Species have moved in one **zone** in high numbers and distribution, and/or some plants have moved in two **zones**.

Guidance:

a. For **groundcover**, "high numbers" usually means greater than 25 percent **cover**.
b. For **shrubs and small trees**, and **trees**, "high numbers" usually means greater than 5 to 10 specimens.
c. "High distribution" usually means located throughout the **zone**.
d. A "3" should be chosen if any species have moved in two **zones**, regardless of numbers and distribution.

4. Species have moved in one **zone** in enough numbers and distribution to be of concern, and/or species with an **adaptive** classification are **extensive** in numbers and distribution in the **transition zone**.

<u>**Guidance**</u>:
a. For **groundcover**, "enough numbers" usually means greater than 5 percent **cover** for all species.
b. For **shrubs and small trees** and **trees**, "enough numbers" usually means two or three specimens.
c. "Enough distribution" or "**extensive** distribution" usually means located beyond a few feet of the appropriate **zone**.
d. For **adaptive species** in the **transition zone**, "**extensive** in numbers" usually means greater than 25 percent.

5. Normal **zonation**. Some species may have migrated inward one **zone**, but they are small in number and/or right along the **zone** edge. **Adaptive species** in the **transition zone** are not considered abnormal if they are not **extensive** in numbers and distribution.

<u>**Guidance**</u>: Choose a "5" if:
a. All identified species are in their appropriate **zone**, or
b. All **groundcover** species in inappropriate **zone**s combine for less than 5 percent coverage, or
c. All species in inappropriate **zones** are within approximately one foot of the appropriate **zone**. Any topographic changes in the deeper **zone** should be carefully considered when making this decision.

NA Not enough **cover** to make evaluation

<u>**Guidance**</u>: If you feel there is not enough of the **cover** to make a meaningful score, choose NA.

Examples of species moving two **zones** include species with an **upland** classification being found in the **outer deep zone**, or species with an **adaptive** or **transition** classification being found in the **deep zone**. Examples of a species moving one **zone** include species with an **upland** classification being found in the **transition zone**, species with an **adaptive** or **transition** classification being found in the **outer deep zone**, or species with an **outer deep** classification being found in the **deep zone**.

5) Provide an explanation and any necessary comments to describe your choices.

The main factors in the rank chosen must be documented in the **explanation** section. If **NA** is chosen, clearly explain the reason, and, if a permanent condition, include in the updated wetland history.

ADDITIONAL INFORMATION

This section seeks additional information concerning the state and condition of the wetland. This information collected in this section can be used to help update the wetland history.

Some of this information may directly relate to the hydrologic condition of the wetland, while the relationship of some information to the hydrologic condition of the wetland may be unclear. Some of the information requested may assist in the eventual interpretation of wetland health. Please answer all questions to the best of your ability based on your observations – no in-depth analysis or expertise in each issue is expected. Update the wetland history with any pertinent information, especially if the new condition appears to be permanent.

Disturbance

Check the following only if it is your considered opinion that such an extensive amount of physical alteration of the wetland (clearly not related to ground-water withdrawals) has occurred that you do not believe it makes sense to use the wetland data for purposes such as MFL development, recovery assessment, etc. Such impacts could include **extensive** fill, **extensive** clearing, severe fire damage, significant fragmentation by roads or other construction, etc. If this comment is checked, please fully explain, and include the explanation in the wetland history.

____ Future users of this data may not want to analyze/compare this data with other wetlands due to the **extensive** level of non-ground-water withdrawal related disturbance.

Check the following only if it is your considered opinion that such an extensive amount of subsidence of the wetland has occurred that you do not believe it makes sense to use the wetland data for purposes such as MFL development, recovery assessment, etc. Such impacts could include severe soil loss, karstic activity that has substantially lowered the wetland bottom, etc. If this comment is checked, please fully explain, and include the explanation in the wetland history.

____ Future users of this data may not want to analyze/compare this data with other wetlands due to the **extensive** level of **subsidence**.

Vegetation Health

The following section provides direction to assess the status of **stress** and death of **shrub and small tree** and **tree** species within the wetland. As part of this section of the wetland assessment, the evaluator is asked to decide if a species is **appropriate** or **inappropriate**. A **shrub and small tree** or **tree** is **appropriate** if it is growing in a **wetland zone** appropriate for its **zone** classification. A **shrub and small tree** or **tree** is **inappropriate** if it is growing in a **zone** that is inappropriate for its **zone** classification. For example, since *Myrica cerifera* is classified as a **transition zone** species, it would be **appropriate** if it is found growing in the **transition zone**, but **inappropriate** if it is found growing in the **outer deep** or **deep zones** (assuming it is not on a **hummock**).

Stress of Appropriate Shrubs and Small Trees
In the space provided in the field sheet, indicate the category below that best describes the **stress** of all **appropriate species** of **shrub and small trees**. Include any standing **shrubs and small trees** that are dead. Do not include species growing in **hummocks**. Finally, explain your choice, including a listing of the species you consider to be **appropriate**, the **zone**s in which they are found, and the nature/symptoms of the **stress**.

____ showing little to no signs of stress
____ showing noticeable signs of stress
____ showing significant signs of stress
____ NA

Stress of Inappropriate Shrubs and Small Trees
In the space provided in the field sheet, indicate the category below which best describes the **stress** of all **inappropriate species** of **shrubs and small trees**. Include any standing **shrubs and small trees** that are dead. Do not include species growing in **hummocks**. Finally, explain your choice, including a listing of the species you consider to be **inappropriate**, the **zones** in which they are found, and the nature/symptoms of the **stress**.

____ showing little to no signs of stress
____ showing noticeable signs of stress
____ showing significant signs of stress
____ NA

Stress of Appropriate Trees
In the space provided in the field sheet, indicate the category below that best describes the **stress** of all **appropriate species** of **trees**. Unlike with **shrubs and small trees**, <u>do not</u> include any standing **trees** that are dead. Do not include species growing in **hummocks**. Finally, explain your choice, including a listing of the species you consider to be **appropriate**, the **zones** in which they are found, and the nature/symptoms of the **stress**.

____ showing little to no signs of stress
____ showing noticeable signs of stress
____ showing significant signs of stress
____ NA

Stress of Inappropriate Trees
In the space provided in the field sheet, indicate the category below that best describes the **stress** of all **inappropriate species** of **trees**. Include any standing **inappropriate trees** that are dead. Do not include species growing in **hummocks**. Finally, explain your choice, including a listing of the species you consider to be **inappropriate**, the **zones** in which they are found, and the nature/symptoms of the **stress**.

____ showing little to no signs of stress
____ showing noticeable signs of stress
____ showing significant signs of stress
____ NA

Dead and Leaning Trees
In the space provided in the field sheet, indicate the category below that best describes the presence of **leaning** and/or dead **trees** within the entire wetland. Include standing dead **trees**, **trees** that are dead on the ground, and **trees** that are known to have died during the period of wetland observation and are no longer in the wetland. Do not include any timbered **trees**, or **trees** growing on **hummocks**. Restrict the analysis to **appropriate species**. Finally, explain your choice, including your best estimate of the number or percentage of **dead and leaning trees**.

____ Little to no (normal amount of) dead and/or leaning trees
____ Noticeable amount of dead and/or leaning trees
____ Significant amount of dead and/or leaning trees
____ NA

Signs of Tree Recovery

Are young **appropriate trees** starting to grow in wetland locations in such a way that would suggest hydrologic recovery? Yes ____ No ____ Not Sure _____ Not applicable_____

Please explain your answer, including the species to which are referring, and the **zones** in which they are found.

Vines

Are **inappropriate vines** dropping leaves or dying in a way that would suggest hydrologic recovery?
Yes ____ No ____ Not Sure ____ Not applicable ____

Please explain your answer, including the species to which are referring, and the **zones** in which they are found.

The following questions can be answered for either the Assessment Area or for the entire wetland. Please include comments to explain the area being described.

Are any of the following conditions apparent and obvious (explain any checks)?

Wetland edges have been filled or disturbed	Yes ____ No____ Not Sure _____
Excessive dumping or trash in wetland	Yes ____ No____ Not Sure _____
Hog disturbance	Yes ____ No____ Not Sure _____
Significant impact from cattle (trampling, etc.)	Yes ____ No____ Not Sure _____
Vehicles driving though wetland (including bicycles)	Yes ____ No____ Not Sure _____
Insect damage	Yes ____ No____ Not Sure _____
Disease	Yes ____ No____ Not Sure _____

Are there signs of fire (comment on approximate year, expanse, and intensity)?
Yes ____ No____ Not Sure _____

Hydrology

Does the wetland have **augmentation** equipment in place? Yes __ No __ Not Sure __
If yes, was **augmentation** taking place at the time of your visit? Yes __ No __ Not Sure __

Is there clear evidence of direct stormwater inflow via a ditch or other manmade conveyance? Yes __ No __ Not Sure __

Is there clear evidence of direct drainage from the wetland via ditch or other manmade conveyance? Yes __ No __ Not Sure __

Is there a borrow pit or retention pond in the vicinity of the wetland? Yes __ No __ Not Sure __

Are there any other drainage activities in the area of note? Yes __ No __ Not Sure __

Soils

Are there any new signs of soils **oxidation** or **subsidence** (since last 5-year review)? Yes __ No __ Not Sure __

For lakes only

Indicate the category that best describes the docks for the entire lake.

Ranking Scale

1. Docks completely out of the water.
2. Docks touching the water or with <50% of the dock over water.
3. Docks >50% over water.

Is the littoral **zone** stranded? Yes ______ No ______

Protected Wildlife and Plants

Note any **protected species** of plants and animals that are observed directly or can be identified by call, tracks or scat during the wetland assessment. Also include the activity noted such as nesting, foraging, feeding, mating, resting, burrowing, etc. and any additional notes or observations.

Note any **wetland dependent species** of animals that are observed directly or can be identified by call, tracks, or scat during the wetland assessment. List birds, fishes, reptiles, mammals or amphibians.

Activity codes (M = mating, F = foraging, FT = flyover/traveling, N = nesting, OT = other)
Observation codes (O = observed, S = sign [scat, tracks, call or other signs of presence])

Appendix A. Plant list used for WAP methodology.

Botanical Name	Common Name	Synonymy	Wetland Zone
Acer rubrum	red maple		OD
Amaranthus australis	southern amaranth		T
Ambrosia artemisiifolia	common ragweed		U
Amorpha fruticosa	Bastard indigobush; false indigobush		T
Ampelopsis arborea	Peppervine		AD
Amphicarpum muhlenbergianum	blue maidencane		OD
Andropogon glomeratus	bushy bluestem		T
Andropogon glomeratus var. glaucopsis	purple bluestem		OD
Andropogon virginicus	broomsedge bluestem		AD
Andropogon virginicus var. decipiens	broomsedge bluestem		AD
Andropogon virginicus var. glaucus	chalky bluestem		U
Axonopus spp.	Carpetgrass		AD
Baccharis spp.	silverling, groundsel tree, sea myrtle		AD
Bacopa caroliniana	lemon bacopa; blue waterhyssop		OD
Berchemia scandens	alabama supplejack; rattan vine		T
Callicarpa americana	American beautyberry		U
Campsis radicans	trumpet creeper		T
Carex longii	long's sedge		T
Celtis laevigata	sugarberry; hackberry		T
Centella asiatica	Spadeleaf		T
Cephalanthus occidentalis	common buttonbush		D
Cinnamomum camphora	Camphortree		U
Cirsium nuttallii	Nuttall's thistle		T
Commelina diffusa	common dayflower		T
Conyza canadensis var. pusilla	Canadian horseweed		AD
Cornus foemina	swamp dogwood; stiff dogwood		OD
Cynodon dactylon	Bermudagrass		U
Dichondra caroliniensis	Carolina ponysfoot		AD
Digitaria floridana	Florida crabgrass		U
Diodia virginiana	Virginia buttonweed		OD
Diospyros virginiana	common persimmon		AD
Drymaria cordata	drymary; West Indian chickweed		AD
Eclipta prostrate	false daisy	*Eclipta alba*	T
Eleocharis baldwinii	Baldwin's spikerush; roadgrass		T
Erechtites hieraciifolius	American burnweed; fireweed		AD
Erythrina herbacea	coralbean; Cherokee bean		U
Eupatorium capillifolium	Dogfennel		AD

Appendix A (continued). Plant list used for WAP methodology.

Botanical Name	Common Name	Synonymy	Wetland Zone
Eupatorium leptophyllum	falsefennel		OD
Eupatorium mohrii	Mohr's thoroughwort	*Eupatorium recurvans*	AD
Eupatorium serotinum	lateflowering thoroughwort		AD
Euthamia caroliniana	slender flattop goldenrod	*Euthamia minor*	AD
Fraxinus caroliniana	Carolina ash; water ash; pop ash		D
Galactia elliottii	Elliott's milkpea		U
Gordonia lasianthus	loblolly bay		OD
Gratiola ramosa	branched hedgehyssop		T
Hydrocotyle umbellata	manyflower marshpennywort		OD
Hypericum fasciculatum	sandweed; peelbark St. John's-wort		OD
Hypericum mutilum	dwarf St. John's-wort		T
Hypericum myrtifolium	myrtleleaf St. John's-wort		T
Hypericum tetrapetalum	fourpetal St. John's-wort		AD
Ilex cassine	dahoon		OD
Ilex glabra	inkberry; gallberry		AD
Itea virginica	Virginia willow; Virginia sweetspire		OD
Leersia hexandra	southern cutgrass		OD
Lindernia grandiflora	Savannah false pimpernel		T
Liquidambar styraciflua	sweetgum		T
Ludwigia peruviana	Peruvian primrosewillow		OD
Lycopus rubellus	taperleaf waterhorehound		OD
Lyonia ligustrina var. foliosiflora	maleberry		T
Lyonia lucida	fetterbush		T
Magnolia virginiana	sweetbay		OD
Melaleuca quinquenervia	punktree		AD
Melothria pendula	creeping cucumber		T
Mikania spp.	hempvine		T
Myrica cerifera	southern bayberry; wax myrtle		AD
Nyssa sylvatica var. biflora	swamp tupelo		D
Oldenlandia uniflora	clustered mille graine	*Hedyotis uniflora*	T
Oplismenus hirtellus	woodsgrass; basketgrass	*Oplismenus setarius*	T
Osmunda cinnamomea	cinnamon fern		T
Paederia foetida	skunkvine		AD
Panicum anceps	beaked panicum		AD
Panicum rigidulum	redtop panicum		OD
Panicum verrucosum	warty panicgrass		T
Paspalum conjugatum	sour paspalum; hilograss		AD
Paspalum laeve	field paspalum		T

Appendix A (continued). Plant list used for WAP methodology.

Botanical Name	Common Name	Synonymy	Wetland Zone
Paspalum notatum	bahiagrass		U
Paspalum setaceum	thin paspalum		AD
Persea palustris	swamp bay		OD
Phyla nodiflora	turkey tangle fogfruit; capeweed	*Lippia nodiflora*	AD
Phytolacca americana	American pokeweed		U
Pinus clausa	sand pine		U
Pinus elliottii	slash pine		AD
Pinus palustris	Longleaf pine		U
Pinus taeda	loblolly pine		AD
Pluchea rosea	rosy camphorweed		OD
Polygonum hydropiperoides	mild waterpepper; swamp smartweed		OD
Psidium cattleianum	strawberry guava		AD
Ptilimnium capillaceum	mock bishopsweed; herbwilliam		T
Quercus laurifolia	laurel oak; diamond oak		T
Quercus nigra	water oak		T
Quercus virginiana	live oak		U
Rubus argutus	sawtooth blackberry	*Rubus betulifolius*	AD
Saccharum giganteum	sugarcane plumegrass	*Erianthus giganteus*	OD
Salix caroliniana	Carolina willow; coastalplain willow		OD
Sambucus nigra subsp. *canadensis*	American elder; elderberry	*Sambucus canadensis*	AD
Sapium sebiferum	popcorntree; Chinese tallowtree		AD
Schinus terebinthifolius	Brazilian pepper		AD
Scoparia dulcis	sweetbroom; licoriceweed		AD
Setaria parviflora	yellow bristlegrass; knotroot foxtail	*Setaria geniculata*	AD
Smilax bona-nox	saw greenbrier		AD
Solanum viarum	Tropical soda apple		U
Stenotaphrum secundatum	St. Augustinegrass		AD
Stillingia aquatica	water toothleaf; corkwood		D
Symphyotrichum elliottii	Elliott's aster	*Aster elliottii*	T
Taxodium spp.	Cypress		D
Toxicodendron radicans	eastern poison ivy		AD
Ulmus americana	American elm		T
Urena lobata	caesarweed		U
Vaccinium corymbosum	highbush blueberry		T
Vaccinium myrsinites/darrowii	shiny blueberry		U
Vitis rotundifolia	muscadine	*Vitis munsoniana*	AD

APPENDIX B

Definition of Wetland Assessment Procedure (WAP) Terms

Adaptive (AD) species
Plants species designated as FAC or Upland by DEP, but commonly seen in the **transition zone** in limited numbers. When **adaptive** plants are found in the **outer deep** or **deep zones**, they should be treated the same as **transition zone** plants.

Appropriate Species
Term used to describe plant species that are found in a **wetland zone** in which they would normally be expected. See the definition of **Inappropriate Species**.

Assessment Area
The area to be assessed from the **WAP Transect**. Whenever possible, the width of the Assessment Area will be approximately ten meters in width (including ten meters beyond the **wetland interior**). If the evaluator determines that critical information concerning the **zonation** condition of the wetland exists beyond the standard ten meter-wide Assessment Area, a wider Assessment Area may be used (up to the entire area of the wetland). However, when an Assessment Area greater than ten meters is used, the evaluator must 1) justify the larger transect size on the field sheet and in the database, 2) approach all critical areas at a distance from which elevations and species identification can be readily determined, and 3) accurately describe the size of the Assessment Area on the field sheet and in the database. Future evaluators should use the Assessment Area established by previous evaluators unless there is strong evidence to do otherwise. Evaluators should stay on the **WAP Transect** as much as possible to avoid unnecessary trampling of vegetation, but can walk throughout the wetland if critical for an accurate evaluation.

Augmentation
The procedure or practice of artificially adding freshwater to a surface-water body. Augmentation can be done as part of a mitigation measure or can be part of an overall aesthetic or functional hydrologic plan to increase the amount of water that a wetland or water body receives. Augmentation can be derived from various water sources, including ground water, storm water, or water diverted from surface flows.

Canopy
The top layer of the forest. The definition further qualifies canopy species as woody plants or palms with a main trunk at least ten centimeters in diameter at a point 1.4 meters (4.5 feet) above the base of the tree (**Diameter at Breast Height** (**DBH**)). If the **tree** is on a slope, the **DBH** is measured from the mid-point of the base of the tree on the slope. Cabbage palms are considered canopy only when greater than six meters in height. **Vines** are not considered as canopy species.

Composition
The **assemblage** of plant species that occur within a plant community or plant community **zone**. For the WAP, composition is defined as the species that make up the different **strata** in a **wetland zone**. The **strata** include **tree**, **shrub**, and **groundcover** species (if present).

Cover
The area of ground covered by the vertical projection of the aerial parts of plants of one or more species.

Deep (D) species
Plant species commonly found in the **deep zone**, and designated either FACW or OBL by DEP.

Deep Zone
The lower portion of the **WAP Transect** extending from the **NP-12** marker to the **wetland interior**. The deep zone has the longest hydroperiod and the greatest depth of the **zones** found in a wetland.

Diameter at Breast Height (DBH)
The diameter of a plant's trunk or main stem at a height of 1.4 meters (4.5 feet) above ground.

Exotic plant
A plant not indigenous to Florida.

Extensive
A description used to characterize the categories of Disturbance, Drainage or Fire that indicates that greater than 50% of the assessed portion of the wetland (as determined from the **WAP Transect**) has been influenced. (See definition of **localized**).

FAC plants (Facultative)
Species of plants that are so widespread in their distribution as to render them inappropriate for indicating inundation or soil saturation. Specifically included are **exotic plants** with a **weedy** distribution (F.A.C. Section 62-340.200).

FACW plants (Facultative Wet)
Species of plants that under natural conditions typically exhibit their maximum **cover** in areas subject to surface water inundation and/or soil saturation, but can also be found in uplands (F.A.C. Section 62-340.200).

Floating Vegetation
Any plant not rooted in the ground.

FLUCCS
The Florida Land Use, Cover and Forms Classification System. A standardized numeric code developed by the Florida Department of Transportation for the classification of land use and plant communities. The code is used to identify natural and manmade land features using number codes (levels). Typically three or four digit numbers are used. A manual with descriptions of each code is available to assist with classifications (Florida Department of Transportation, 1999).

For the WAP, Level III FLUCCS code is used to identify wetland types.

Groundcover
All woody species less than one meter in height, and all non-woody species (regardless of height), rooted in the ground. Groundcover is the lower most of the three **strata** of vegetation. For the

WAP, *Eupatorium* spp., *Typha* spp., and *Rubus* spp., and certain other species generally thought of as herbaceous even though greater than one meter will only be assessed as groundcover.

Historic (**Historical**)
Characteristics assumed to be indicators of non-impacted or pre-impacted conditions. Historical wetland characteristics occur because of decades of normal ecological conditions.

Historic Normal Pool
The **normal pool** elevation of a wetland that formed under non-impacted natural or unaltered conditions. Historic normal pool can be determined from those **normal pool** indicators that change only extremely slowly with the absence of surface water. See Appendix C for details on establishing historic normal pool.

Historic Wetland Edge
The boundary between wetland and upland vegetation and soils formed under non-impacted natural or unaltered conditions. The historic wetland edge is the landward edge of the **WAP Transect** and the landward edge of the **transition zone**. The assessment of the **transition zone** begins at the historic wetland edge. See Appendix C for details on establishing historic wetland edge.

Hummock
A raised substrate (at or above the **historic normal pool**) in a wetland generally comprised of congregated root masses associated with **trees**, **shrubs** or some species of **groundcover** such as ferns. Hummocks can also include old tree bases and stumps that have been subsequently colonized by vegetation other than or including the species comprising the majority of plant matter that constitutes the hummock. Hummocks are associated with plant growth in frequently inundated wetlands, and are not part of the wetland floor.

Hydrology
The properties that deal with the distribution and circulation of water within a wetland or upland/wetland system.

Inappropriate Species
Term used to describe plant species that are found in a **wetland zone** in which they would not normally be expected. See the definition of **Appropriate Species**.

Localized
A description used to characterize the categories of Disturbance, Drainage and Fire where less than 50% of the assessed portion of the wetland (as determined from the **WAP Transect**) has been influenced. (See definition of **extensive**).

Leaning Trees
Trees that are generally at a 30-degree angle (or greater) from vertical due to uprooting or loss of support. The reasons for leaning trees are many and varied, and include soil **subsidence** where the soil support for trees roots has been impacted to the point that a tree cannot stand, or wind throw due to severe storm events.

Normal Pool
A water level elevation based on consideration of certain biological indicators of sustained inundation, utilizing reasonable scientific judgment. See Appendix C for a discussion of these biological indicators.

NP-6
The elevation six inches below **historic normal pool**. The NP-6 represents the boundary between the **transition zone** and the **outer deep zone** of the wetland.

NP-12
The elevation twelve inches below **historic normal pool**. The NP-12 represents the boundary between the **outer deep zone** and the **deep zone** of the wetland.

OBL plants (Obligate)
Species of plants that under natural conditions are only found or achieve their greatest abundance in an area that is subject to frequent or continuous surface-water inundation and/or soil saturation. Included in this category are the littoral plants and emergent aquatics, such as *Nymphaea* spp. (water lilies), *Nelumbo* spp. (lotus), and *Nuphar luteum* (spatterdock). Some OBL plant species can be observed in uplands, especially under a controlled environment.

As defined by the USACE, OBL species are those plants that occur almost always (estimated probably > 99%) in wetlands under natural conditions (USACE, 1987).

Outer Deep Zone
The portion of the **WAP Transect** extending from the **NP-6** marker to the **NP-12** marker.

Outer Deep (OD) species
Plant species commonly found in the **outer deep zone**, and designated either FACW or OBL by DEP.

Oxidation
A condition in which organics in the soils react with free oxygen. The result of soil oxidation is loss of organic constituents and possible lowering of the soil surface. The lowering of the soil surface is also called **subsidence**.

Fire within a wetland causes rapid oxidation. Fire, under dry conditions, can burn organic soils causing soil oxidation and/or soil **subsidence**. When oxidation is recorded, special care to determine signs of fire and other environmental conditions should be noted.

Protected Species
Species that include both flora and fauna that have some degree of protection under the law by local, State, and Federal agencies. Official lists have been developed for these species.

> Federally Protected Flora and Fauna Species are listed by:
> U.S. Fish and Wildlife Service (Endangered or Threatened Species). 50 CFR 17 (animals) and 50 CFR 23 (plants)
> http://endangered.fws.gov/wildlife.htm#species
>
> State Protected Fauna Species are listed by:

Florida Game and Freshwater Fish Commission (Endangered, Threatened Species and Species of Special Concern) Rules 3927.003-.005, Florida Administrative Code (F.A.C.) http://fac.dos.state.fl.us/faconline/chapter68.pdf

Florida State Protected Flora Species are list by:
The Florida Department of Agriculture & Consumer Services (Endangered, Threatened Species and Commercially Exploited). Chapter 5B-40 F.A.C.
http://fac.dos.state.fl.us/faconline/chapter05.pdf

Saw Palmetto Fringe
The rooted base of saw palmetto (*Serenoa repens)* nearest the wetland. Care must be taken in assessing whether the saw palmetto fringe has been altered by land use practices when considering its use in setting the **historic normal pool** or **wetland edge**.

Shrubs and Small Trees
Woody plants greater than one meter in height and less than four centimeters **Diameter at Breast Height** (**DBH**). Shrubs usually have multiple permanent stems. When greater than one meter in height, *Hypericum* spp. and *Ilex glabra* are considered shrubs. *Myrica cerifera*, and *Lyonia* spp., and other woody plants with multiple stems that are greater than one meter tall are always assessed as **shrubs and small trees**. Cabbage palms with trunks greater than one meter tall but less than six meters are considered **shrubs**.

Staff Gage
A water level measuring device used to measure above-ground surface water levels in a wetland. The staff gage is normally placed in a **deep zone** of the wetland, preferably at the **wetland interior**.

Strata
The defined layers of the vegetation community found within an ecosystem **zone**. Each wetland system can contain any and all of the three following strata: **Groundcover**, **Shrubs and Small Trees**, and **Trees**.

Stress
A physiological condition of a plant, as a result of external or internal conditions, which inhibits the normal growth and functions of the plant. Stressful conditions can include too much water or too little water. Stress can occur over short or long periods of time. Severe stress to a plant can result in plant death.

Indications of physiologic stress manifested during the growing season (generally during March - September) include: reduced numbers of leaves on stems/branches (a sparsely vegetated appearance), chlorosis of leaf tissue (a pale green, yellow or red/brown hue), leaf wilting (curling at edges, drooping of normally erect leaf tissue), or abscission (leaf drop). In addition, late leaf-out at the onset of the growing season (delayed onset of growth) or premature senescence of leaves prior to the fall may be indicators of stress.

As guidance for the WAP, stress can be caused by a variety of reasons aside from water stress. The assessor should look for other factors that may be contributing to the observed stress indicators (i.e., excessive flooding of less tolerant species, insect damage, disease, fire stress, frost damage, mechanical injury/damage to bark or root systems). Suspicion of non-water related stress should be discussed in comments.

Subsidence
The lowering of the soil levels caused by a variety of mechanisms, including **oxidation**, compaction, and karst activity (sinkholes). Subsidence is evident when the lowering of soil can be measured as a decrease in the soil volume and soil structure. Soil subsidence in wetlands can occur in highly organic soils that have experienced long periods of depressed water levels. In forested wetlands, subsidence often results in tree root exposure. In non-forested wetlands, subsidence is often evident by the appearance of soil fissures. In various types of wetlands, cattle trampling and karst activity can cause subsidence, which is apparent as soil slumping between **trees** or abnormal lowering of the wetland soil surface levels.

Transition Zone
The upper portion of the **WAP Transect** extending from the **historic wetland edge** to the **NP-6** marker. The transitional zone contains one vegetation community, or an arbitrary grouping of more than one vegetation community, with a shorter hydroperiod than the **outer deep** or **deep zones**.

Transition (T) species
Plant species commonly found in the **transition zone**, and designated either FACW or OBL by DEP.

Trees
Woody plants that are greater than or equal to one meter in height and greater than or equal to four centimeters **DBH**. *Myrica cerifera*, *Lyonia* spp. and other woody plants with multiple stems that are greater than one meter tall are assessed as **shrub and small trees**. Cabbage palms with trunks greater than one meter tall but less than six meters are considered **shrubs**.
Note that trees that are greater than or equal to four centimeters **DBH** and less than ten centimeters **DBH** are considered the sub-canopy, and trees greater than or equal to ten centimeters **DBH** are considered the tree **canopy**.

Trees, Small
Woody tree species greater than one meter and less than four centimeters **DBH**. The size class is the same as **shrubs** and is intended to specify tree species at the sapling stage. Wax myrtle, *Lyonia* spp. and other woody plants with multiple stems that are greater than one meter tall are assessed as **shrub and small trees**. Cabbage palms with trunks greater than one meter tall but less than six meters are considered **shrubs**.

Upland (U) species
Plant species that are not expected to be seen in wetlands. It is possible that a few of these species may be found along wetland edges, but are not expected throughout the **transition zone**.

As defined by DEP, upland plants are those species that under natural conditions are only found or achieve their greatest abundance in an area that is considered upland.

Upland Well
A surficial aquifer monitor well installed outside of the **historic wetland edge**, as required by the EMP. Some monitored wetlands do not have upland wells due to practical considerations (such as land management conflicts, private land access problems, etc.), or have a surficial aquifer monitor well installed in the **transition zone**, which substitutes for the upland well. All monitor wells require a construction permit from the SWFWMD, must be drilled by a licensed well driller, and should be constructed using the standards set forth in Chapter 40D-3, FAC. All monitor wells

should fully penetrate the surficial aquifer underlying and in connection with the monitored wetland (as per the judgment of a professional geologist or engineer).

Vines
Vines are linear woody or non-woody vegetation that utilizes the **tree canopy**, sub-canopy, or **shrub strata**, where they exist, for physical support. Where these **strata** are not present, vines will utilize **groundcover** vegetation and the forest floor as the physical substrate for support. Only vines originating from the wetland floor (within the **Assessment Area**) should be assessed as **groundcover**, while all others should not be included in the wetland assessment.

WAP Transect
A straight line from the **historic wetland edge** to the **wetland interior**, from which vegetative assessments in the **transition zone**, **outer deep**, and **deep zone** sections are made.

Weedy
A description of indigenous and non-indigenous species that interfere with management goals and objectives and are therefore unwanted. This definition is also known by the term "natural-area weed." More generically, weed is defined by the Weed Science Society of America as "a plant growing where it is not desired." Moreover, the presence of natural-area weeds infers that conditions within that ecosystem are such that the ecosystem's typical or characteristic species are replaced with species that are not typical of the ecosystem under natural hydrological or ecological conditions.

For the WAP, only weeds growing on the ground (and not on **hummocks)** will be considered.

Wetland Delineation Line
A boundary delineating the landward extent of wetlands under the current conditions using Chapter 62-340 FAC criteria. If a wetland has experienced hydrologic or other impacts, the wetland delineation line may not correspond with the **historic wetland edge**.

Wetland Dependent Species
Wildlife species that are closely associated with wetlands. The existence of individuals of wetland dependent species is threatened if wetland function is absent or there is a significant degradation of a wetland function. Wetland water levels, the duration of water levels, and the existence of aquatic plant and animal species may affect individuals of wetland dependent species.

Wetland Interior
The deepest part(s) of a wetland.

Wetland Plant Species
Plant species that have demonstrated ability (presumably because of morphological and/or physiological adaptations and/or reproductive strategies) to achieve maturity and reproduce in an environment where all or portions of the soil within the root zone become, periodically or continuously, saturated or inundated during the growing season (Reed, 1988).

Wetland Status
Term used in the Vegetative Index of Chapter 62-340 F.A.C to describe a plant's affinity to various hydrologic conditions. See Chapter 62-340 F.A.C. for more details.

Wetland Well
A surficial aquifer monitor well installed within the **deep zone** of a wetland, preferably within the **wetland interior**, as required by the EMP. All monitor wells require a construction permit from the SWFWMD, must be drilled by a licensed well driller, and should be constructed using the standards set forth in Chapter 40D-3, FAC. All monitor wells should fully penetrate the surficial aquifer underlying and in connection with the monitored wetland (as per the judgment of a professional geologist or engineer).

Wetland Zone
One of three subdivisions of a wetland used in the application of the WAP methodology. The three **zones** include the **transition zone**, the **outer deep zone**, and the **deep zone**, and are based upon elevation below **historic normal pool**.

Zonation
The distribution of plant species within a stratum. Three vegetation **strata** are designated in the WAP (**groundcover**, **shrubs and small trees**, and **trees**). Environmental conditions that may influence zonation include but are not limited to variations in **hydrology**, direct physical disturbance, and fire.

Zone
Refers to a **wetland zone**.

APPENDIX C

Methodology for Establishing Historic Normal Pool and Historic Wetland Edge

The **normal pool** of a wetland is an elevation datum established to standardize measured water levels and facilitate comparison among wetlands. The **normal pool** elevation is commonly used in the design of wetland storm water treatment systems (SWFWMD, 1988). This level can be consistently identified in cypress swamps based on similar vertical locations of several indicators of inundation (Hull et al, 1989; Biological Research Associates, 1996). In wetlands where declining water levels have caused the downward migration of certain **normal pool** indicators, or if significant **subsidence** has occurred as to physically lower all or parts of the wetland, more persistent indicators of the unaltered **normal pool** elevation or other considerations must be used to establish the datum. The datum determined by the persistent, unaltered indicators, is herein referred to as **historic normal pool**.

The **historic wetland edge** is a concept developed specifically for the WAP, and refers to the boundary between wetland and upland vegetation and soils prior to any hydrologic impacts. In a wetland that has not experienced any negative hydrologic impacts, this boundary would be the **wetland delineation line**. However, in wetlands that may have experienced hydrologic impacts, other biologic indicators must be used to identify the **historic wetland edge**.

Historic normal pool and **historic wetland edge** elevations will be established at environmental monitoring sites within one year of the initiation of the monitoring program. As described below, the elevations of at least five replicate **normal pool** indicators will be established in the field based on biological or physical indicators of sustained inundation. The final **historic normal pool** elevations will be based on the median of these elevations, plus any appropriate offset constants (as described below). The **historic normal pool** and supporting indicators used to develop the elevation must be surveyed to NGVD 29 by a professional land surveyor. The **historic wetland edge** need not be surveyed, but a permanent marker or other means of locating the **historic wetland edge** must be established. Together with the other information included with the establishment of a monitored wetland (see Section 3.2 of the WAP Instruction Manual), the **historic normal pool** elevation, **historic wetland edge** location, and the information used to determine them must be fully documented (see Appendix F). If necessary, Tampa Bay Water and the SWFWMD will perform field evaluations to verify the various elevations.

Establishing Historic Wetland Edge

When present, the preferred indicator of **historic wetland edge** is the rooted base of saw palmetto (*Serenoa repens*) immediately surrounding the wetland (referred to as the **saw palmetto fringe**). Unless the **saw palmetto fringe** is used to determine **historic normal pool**, there is no need to survey its elevation, but the location should be marked or otherwise clearly recorded for use as the landward edge of the **WAP Transect** and the landward edge of the **transition zone**. This indicator may not be reliable for wetlands if there is clear evidence that the **saw palmetto fringe** has been significantly altered by land management practices. In cases where the **saw palmetto fringe** has been altered, or where no **saw palmetto fringe** exists, other indicators should be used for **historic wetland edge**. Alternatives include **historic normal pool** minus 0.25 feet (Carr and others, 2004, Shultz and others, 2004), the elevation of the base of the outermost cypress plus 0.30 feet (Carr and

others, 2004, Schultz and others, 2004), or hydric soil indicators. In these cases, the final choice will be by consensus of Tampa Bay Water and the SWFWMD. If the wetland edge has been partially filled, the edge of the fill within the wetland can be considered the **historic wetland edge** (see Section 3..2 of the WAP Manual for more discussion on dealing with filled edges).

<u>Establishing Historic Normal Pool</u>

Historic normal pool will be set by one of the following methods (in order of priority, if present). Note that the value used as **historic normal pool** should be based on the median of at least five samples (although more samples are desirable), plus the applicable offset constant (as described below):

a. The elevation of the root crown of mature specimens of fetterbush (*Lyonia lucida*) on cypress **trees** or **hummocks**.
b. The inflection point on the buttress of cypress **trees**.
c. The lower limit of epiphytic bryophytes (aka moss collars) growing on cypress **trees** (*Taxodium* spp.).
d. The elevation of the rooted base of saw palmetto (*Serenoa repens*) immediately surrounding the wetland (referred to as the **saw palmetto fringe**). An offset factor of 0.25 feet must be added to the median value (Schultz and others, 2004). This indicator may not be reliable for wetlands if there is clear evidence that the **saw palmetto fringe** has been significantly altered by land management practices.
e. The ground elevation of cypress **trees** growing at the outside edge of the dome. An offset factor of 0.55 feet must be added to the median value (Schultz and others, 2004).
f. Indicators of hydric soil surrounding the wetland, as determined by a qualified soils scientist. This indicator may not be reliable in wetlands with evidence of significant soil **oxidation**.
g. Evidence of **historic** escarpment. This method may not be reliable in wetlands with clear evidence of significant filling along the wetland edge.
h. If none of the above indicators exist, a **historic normal pool** elevation should be proposed based on any form of evidence thought to be reasonable, including other biologic indicators, aerial photographic interpretation, etc.

A combination of any of the first three indicators is acceptable, as long as a minimum of five surveyed samples are used. The remaining four indicators should not be used in combination with other indicators.

If there is evidence that declining water levels have caused the downward migration of certain **normal pool** indicators (moss collars are particularly susceptible to this), or if significant **subsidence** has occurred as to physically lower all or parts of the wetland, only the **saw palmetto fringe** indicators may be reliable. Several sources of information and field observation should be used to make this determination, which may include investigations of **historical** aerial photography; identification of signs of severe soil **oxidation** or compaction; obvious indications of sinkhole activity; long-term declines in **hydrology** (as observed in collected data); and changes in surveyed elevations. If the **normal pool** elevation determined by the above methods is found to be significantly below the **historic wetland edge**, it may not be representative of **historic normal pool** (Carr and Rochow, 2004).

APPENDIX D

Wetland Type Definitions

All monitored wetlands should be classified as one of the following wetland types. It is recognized that some wetlands may be difficult to classify, so the evaluator will need to use scientific judgment based on field experience. However, the classification system is for convenience and data management purposes only. In the future, the classification of wetlands or the definition of wetland types may change.

For purposes of this classification system, the term "isolated" refers to a wetland system that has no significant and regular channelized inflow. For example, some cypress wetlands may have channelized outflows to riverine systems, but since significant and regular channelized inflow is absent, they are considered isolated cypress wetlands. Systems that are not isolated by this definition will be referred to as "flow" systems. The current version of the WAP is not designed for flow systems.

The wetland types are:

Cypress Isolated --- Commonly known as "cypress domes", although their shape and size vary. Pond cypress is usually the dominant tree species.

Hardwood Isolated --- Commonly known as "bay swamps" or "gum swamps". Bays and gums are usually the dominant tree species.

Marsh Isolated --- Isolated wetlands with very few or no **trees**. Marshes are typically vegetated with broad-leaved herbaceous species such as pickerelweed, duck potato, water lily, and spatterdock in deeper areas, and grasses and sedges in shallower areas. Marshes are typically 1 to 3 feet in depth.

Cypress Marsh Isolated --- Isolated wetlands with well-developed cypress and marsh areas. Typically, cypress surrounds, or nearly surrounds, the deep-water marsh area. Cypress marshes should be composed of at least 20 percent cypress **trees** or 20 percent marsh vegetation.

Wet Prairie Isolated --- Isolated wetlands with very few or no **trees**. Typically, grasses and sedges dominate both shallow and deep-water areas of wet prairies. Wet Prairies differ from marshes in being shallower (usually <1 foot deep at the deepest point).

Cypress Continuous --- Flow systems dominated by cypress (typically bald cypress). The current version of the WAP is not designed for these types of wetland systems.

Hardwood Continuous --- Flow systems dominated by hardwoods (typically pop ash, elm, gum, red maple, water oak, and laurel oak). The current version of the WAP is not designed for these types of wetland systems.

Mixed Hardwood/Cypress Continuous --- Flow systems where a mixture of hardwoods and cypress occur and neither appears dominant. The current version of the WAP is not designed for these types of wetland systems.

Marsh Continuous --- Flow systems with very few or no **trees**. Marshes are typically vegetated with sawgrass and broad-leaved herbaceous species such as pickerelweed, duck potato, water lily, and spatterdock. The current version of the WAP is not designed for these types of wetland systems.

Lake Wetlands --- Wetlands similar to those described above but occurring contiguous to lakes.

APPENDIX E

Wetland History

The Wetland History is an ongoing narrative that describes what is known about the history of the wetland health during both the period of data collection, and prior to data collection. Its main use is to give the user of data collected as part of the WAP a better perspective on the activities surrounding the wetland, observations by evaluators, and other factors that may affect the interpretation of the data. The wetland history also provides a running set of notes for current and future evaluators that should assist in WAP assessments and interpretation of WAP data.

When monitoring begins on a wetland (or when establishing a wetland history for a currently monitored wetland for which there is no existing wetland history), some research should be done to gather existing information on the wetland, and to describe what is learned. Sources of information that should be reviewed include:

a. Aerial photography, available through the SWFWMD, Tampa Bay Water, or other sources (available back to 1938 at: http://www.uflib.ufl.edu/digital/collections/FLAP/)
b. Existing reports by SWFWMD, Tampa Bay Water, and others
c. Previous experience of others who have monitored the wetland in the past

Wetland histories included in many of the Tampa Bay Water Wellfield Annual Reports are a good start.

Once the initial wetland history has been established, the WAP methodology calls for updates on at least a 5-year basis, although more frequent updates as needed are recommended. Wetland history updates should include any significant changes to the transects, monitoring devices, surrounding land uses, physical impacts to the wetland (no matter the cause), and any significant changes to wetland health or **hydrology** (no matter the cause, and including **augmentation**).

APPENDIX F

Worksheet for Supporting Transect Information

The following is a checklist of information that should be collected and documented as part of the establishment of the transect to be used for the Wetland Assessment Procedure (WAP). Depending on the wetland being monitored, thorough documentation of the transect may preclude the need for a site evaluation by SWFWMD staff. While not required, including photographs may be helpful.

General Information

1. Wetland Name (and aliases)
2. Wetland Site Number(s)
3. Wetland type (See Appendix D)
4. Location information, including county, land owner, and Section, Township, and Range of wetland
5. Map of wetland location, showing approximate location of transect
6. Explanation of why the transect was chosen
7. Has a benchmark been established near the wetland by a professional surveyor?
8. If so,
   a. Has the benchmark been clearly marked?
   b. Has the benchmark been given an identification name or number?
   c. What is the NGVD 1929 elevation of the benchmark?
   d. Have all surveys for current installations requested below been made from this benchmark (i.e. **historic normal pool** indicators, current staff gage, current wells, NP-6, and NP-12)? If these have not been surveyed in this manner please explain.

Staff Gage(s)

1. What is the identification number of the current staff gage (or gages)?
2. Was the staff gage installed by Tampa Bay Water or the SWFWMD?
3. Who performed the surveying for this gage, and was this person a professional surveyor?
4. What benchmark was used to survey this gage?
5. What is the approximate period of record for this staff gage?
6. Is the staff gage direct reading?
7. If not, what is the adjustment to convert to NGVD 29?
8. What is the dry elevation of the staff gage?
9. Please provide the above information for any other previous staff gages.

Monitor Well(s)

1. Does the wetland have both a wetland well and upland well?
2. Are there any other wells?
3. What is the identification number of each existing well?
4. Which agency installed each well?
5. Who performed the surveying for each well, and was this person a professional surveyor?
6. What benchmark was used to survey each well?

7. What is the approximate period of record for each existing well?
8. What is the top of casing elevation for each well (NGVD 29), and is this the measuring point for each well?
9. What is the ground elevation (NGVD 29) at each well (or length of casing above ground)?
10. What is the dry elevation (NGVD 29) of each well (or total depth of each well)?
11. Please provide the general construction information for each well, including casing depth, total depth, well diameter, and general construction specifications.
12. Please provide the above information for any other previous wells used to monitor this wetland.

Establishment of Historic Normal Pool

1. What indicators of normal pool were used?
2. How many indicators were used?
3. How was the historic normal pool determined?
4. When was the historic normal pool established, and who set it?
5. What are the elevations of the indicators used and the elevation of the historic normal pool determined for this wetland? How were these determined?
6. Please describe the checks for subsidence that were performed.

Historic Wetland Edge

1. What indicators of historic wetland edge were used?
2. How was the historic wetland edge determined?
3. Has a marker been placed at the historic wetland edge? If no, please describe the location of the wetland edge.
4. What is latitude and longitude of historic wetland edge marker, or marked location along the transect, and how was this determined? Note: this can be estimated.

NP-6 and NP-12

1. What are the elevations (NGVD 29) of the NP-6 and NP-12 markers, and how were they determined?
2. Who performed the surveying for the markers, and was this person a professional surveyor?
3. What benchmark was used to survey the markers?
4. Describe the markers used to designate the NP-6 and NP-12.
5. What is the latitude and longitude of the NP-6 and NP-12 markers? Note: this can be estimated.

Wetland Interior

1. Has a marker been placed at the wetland interior (end of transect)? If no, please describe the location of the wetland interior.
2. What is latitude and longitude of wetland interior (end of transect), or marked location along the transect, and how was this determined? Note: this can be estimated.

APPENDIX G

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Form No.: 338884-FM-TM-001, Rev 0

Tech Memo Approval Form

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Revision: 0
Project: 338884
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Tech Memo Title: Levy Nuclear Plant Well Field Aquifer Performance Testing Plan

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Document Review and Approval

Originator:	Steve Eakin/Environmental Scientist Name/Position	05/29/2012 Date
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Reviewer:	Jeff Lehnen/Senior Hydrogeologist Name/Position	05/29/2012 Date
	Mark Bulingame for Jeff Lehnen Signature	
Technical Manager:	Lorin Young/Program Manager Name/Position	05/29/2012 Approval Date
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Levy Nuclear Plant Well Field Aquifer Performance Testing Plan

Prepared for

Progress Energy Florida

Prepared by

CH2MHILL

May 2012

Contents

Acronyms and Abbreviations

APT	aquifer performance testing
bgs	below ground surface
CLP	Contract Laboratory Program
COC	Conditions of Certification
CWA	Clean Water Act
DWRM2	District-Wide Regulatory Model, Version 2
EMP	Environmental Monitoring Plan
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FSAR	Final Safety Analysis Report
gpm	gallons per minute
mgd	million gallons per day
MLU	Multi-Layer Unsteady State
NAVD88	North American Vertical Datum of 1988
NELAP	National Environmental Laboratory Accreditation Program
NGVD29	National Geodetic Vertical Datum of 1929
LNP	Levy Nuclear Plant Units 1 and 2
PEF	Progress Energy Florida, Inc.
PPSA	Power Plant Siting Act
PVC	polyvinyl chloride
PW	production well
SAS	surficial aquifer system
SCA	Site Certification Application
SWFWMD	Southwest Florida Water Management District
TMR	Telescoping Mesh Refinement
USACE	U.S. Army Corps of Engineers
UFA	Upper Floridan aquifer
USGS	U.S. Geological Survey

1.0 Introduction

Progress Energy Florida, Inc. (PEF) proposes to build and operate a nuclear-powered electric generating facility in Levy County, Florida. The plant will be known as the Levy Nuclear Plant Units 1 and 2 (LNP). The Florida Electrical Power Plant Siting Act (PPSA) mandates a site certification process for obtaining a single site-related license that will include all state, regional, and local requirements for construction and operation of an energy facility of the type and magnitude being proposed by PEF.

The "Final Order on Certification for the Progress Energy Levy Nuclear Power Plant Units 1 and 2," dated August 26, 2009 (as modified on January 25, 2011), included Conditions of Certification (COCs) adopted by the Final Order. As part of the COCs, PEF is required to develop an Aquifer Performance Testing (APT) Plan for the proposed LNP well field to be installed and operated on the site.

PEF has also agreed to submit and seek U.S. Army Corps of Engineers (USACE) approval of groundwater testing and monitoring plans, relative to its groundwater withdrawal from four production wells, prior to issuance of the Section 404 permit for the project.

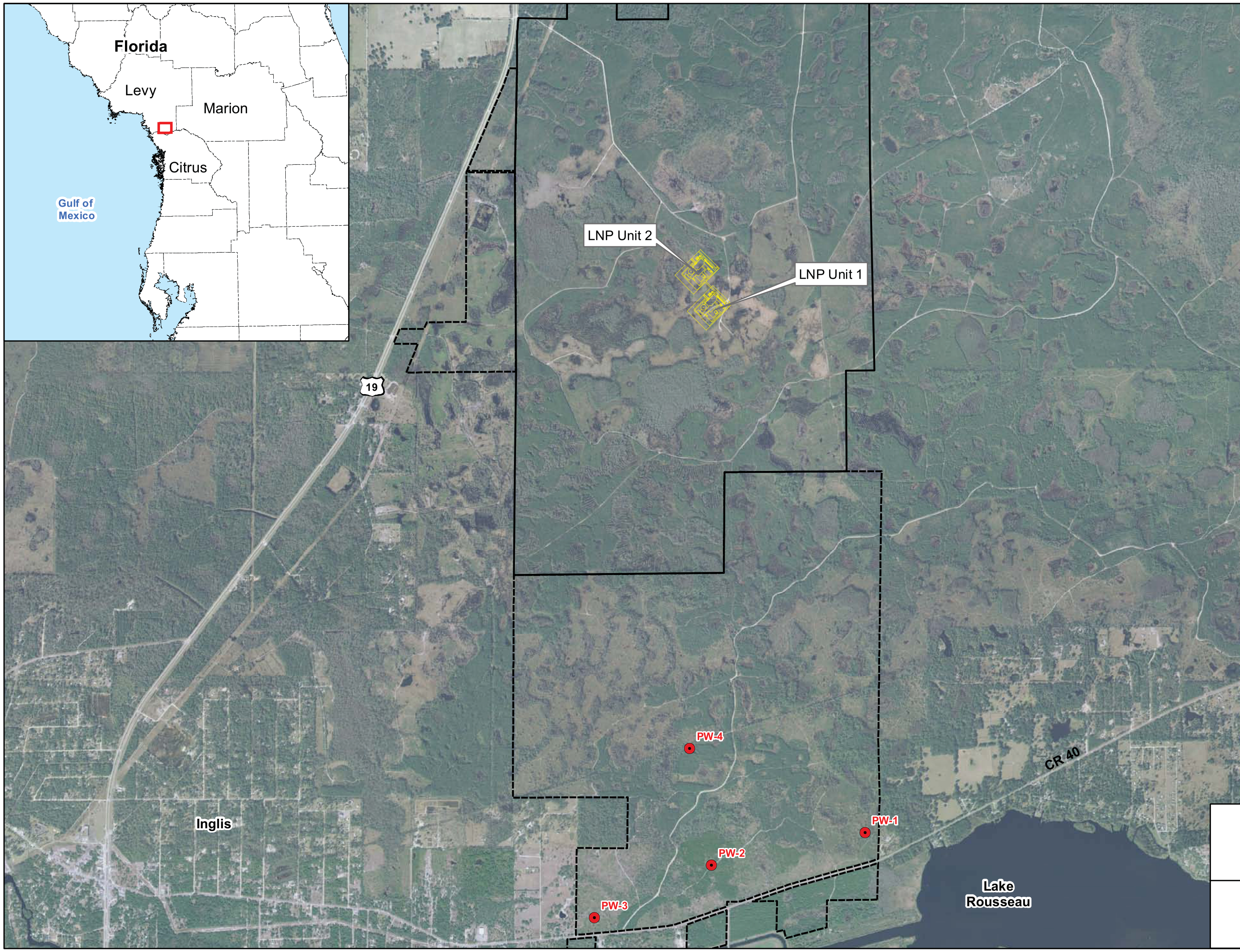
1.1 Purpose

This APT Plan is intended to address the specific requirements presented in COC Section C.II.A.4 to describe the field-testing for four production wells to be installed in the Floridan aquifer, and compare the field-testing results with previously submitted numerical modeling simulations of groundwater flow. Figure 1 shows the general project site location on the southern portion of the LNP property. Figure 2 shows the four proposed production wells, the aquifer test well layout, and the regional upper Floridan groundwater gradient.

The COCs specify that step-drawdown tests should initially be performed on each of the four production wells. Multi-well constant-rate (72-hour) pumping tests will be performed on two wells.

All four of the proposed LNP production wells will be installed in the same zone of the Upper Floridan aquifer (UFA) using the same methods, and are expected to perform similarly assuming the aquifer characteristics are similar at all of the wells.

The two production well test locations, PW-3 and PW-4 (along with proposed observation well locations), were selected for the 72-hour constant-rate aquifer testing. These two locations were selected based on aquifer characteristics used in the Southwest Florida Water Management District (SWFWMD) District-Wide Regulation Model, Version 2 (DWRM2). The approximate locations are shown on Figure 2, and the exact locations will be determined in the field.



N
W E
S

LEGEND

- Proposed LNP Supply Well
- LNP Site Boundary
- PEF Property Boundary

Sources
Base Data: Florida
Geographic Data Library
LNP Site: Sargent & Lundy, 2007

0 0.5 1
Kilometers
0 0.5 1
Miles

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Levy Nuclear Plant
Units 1 and 2
LNP Well Field APT Plan

Site Layout

FIGURE 1

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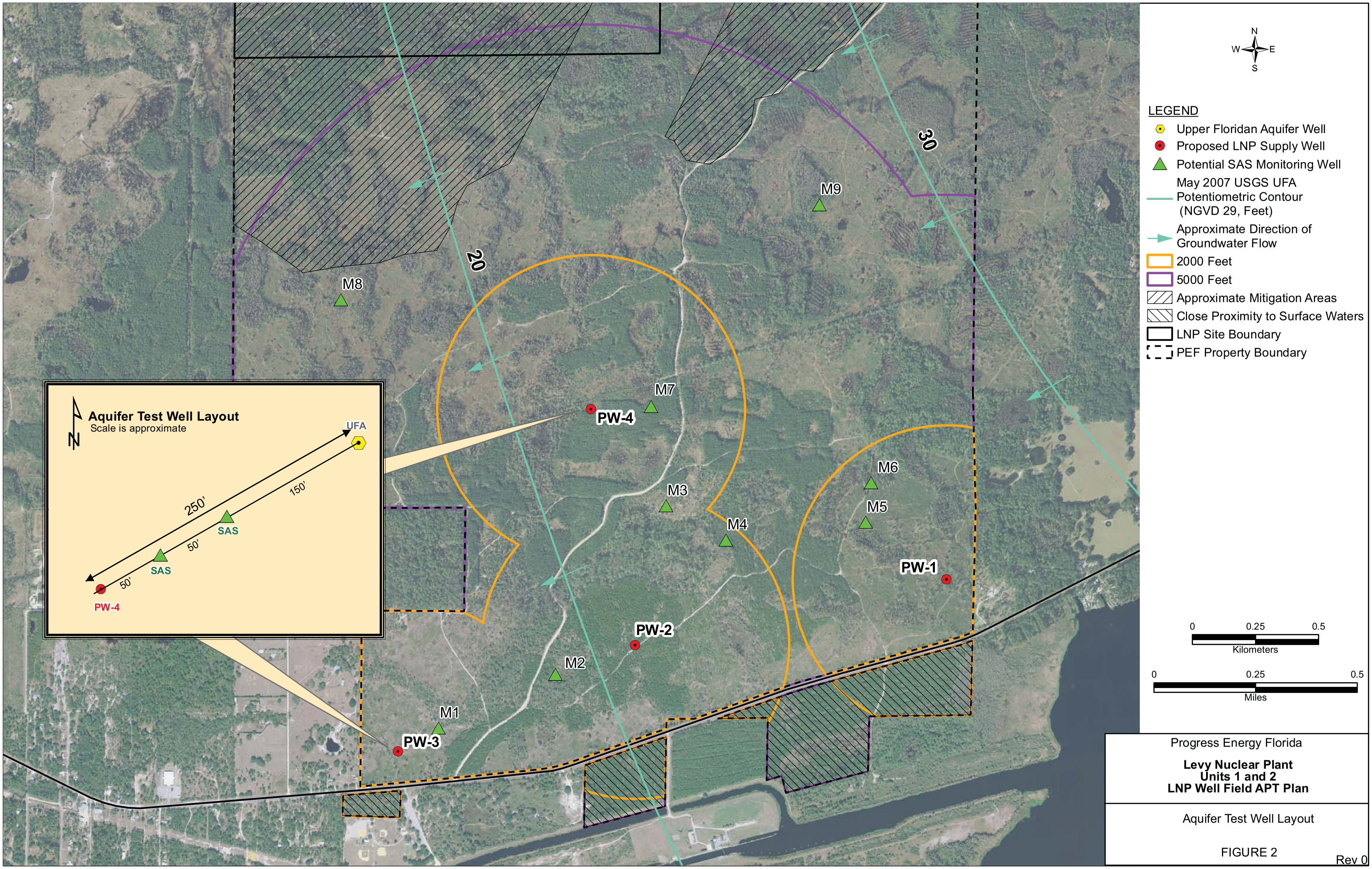

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Levy Nuclear Plant
Units 1 and 2
LNP Well Field APT Plan

Aquifer Test Well Layout

FIGURE 2

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Production well locations PW-3 and PW-4 are expected to be the most representative of the range of Floridan aquifer characteristics to be encountered onsite, and they are geographically separated north to south, with one well closer to the Withlacoochee River where SWFWMD has documented higher UFA permeability in the DWRM2 for the Floridan aquifer and the other well located at a more northerly location where the UFA permeability is estimated to be lower in the DWRM2 model. The final decision regarding the two production wells used for APT testing, however, will be determined in the field using the results from the step-drawdown tests.

One UFA monitoring well will be constructed about 250 feet from the pumping well in the upgradient direction. This well will provide distance drawdown data in the UFA necessary to evaluate transmissivity and leakance.

Two surficial aquifer system (SAS) observation wells are positioned based on predicted measurable drawdowns of 0.5 to 1.0 foot at these locations, and based on direction of regional groundwater flow gradients as suggested by the SWFWMD APT guidance document *Water Use Permit Information Manual – Part C – Water Use Design Aids* (SWFWMD, 2003).

In addition to these wells, SAS monitoring wells located in nearby wetlands will be monitored before, during, and after the pumping test to determine if any drawdown can be measured in the SAS related to the pumping test. The wetland SAS monitoring well locations are shown on Figure 2, labeled M1-M9, and the locations are described in TMEM-133 *Levy Nuclear Plant Well Field Environmental Monitoring Plan* (EMP).

1.2 Regulatory Requirements

Several regulations govern the design, execution, and analysis of the APT, including specific requirements included in the Florida Department of Environmental Protection's (FDEP's) COCs and general guidance provided by the SWFWMD for performing an APT. The following subsections describe each of these requirements.

1.2.1 State of Florida

The proposed LNP groundwater withdrawal was reviewed by the SWFWMD for consistency with applicable water use permitting rules. As part of the review process, PEF used the SWFWMD DWRM2 to evaluate site-specific impacts. Drawdown impacts were simulated using the DWRM2; however, the SWFWMD also required PEF to conduct field-testing on the water supply wells to evaluate hydraulic properties of the aquifer system in the area to confirm the parameter values used in the model.

Section C.II.A.4 of the COCs describes the conditions required by the SWFWMD for the well field and the testing, monitoring, and mitigation required to address potential environmental impacts from well field pumping. These requirements are addressed in this APT plan for the LNP well field in the sections identified.

- Section C.II.A.4 Aquifer Testing and Groundwater Impact Analysis:
    a. Described in Sections 3.0 and 6.0 of this APT Plan: *For the purpose of confirming Upper Floridan transmissivity and leakance values used in Licensee's groundwater flow*

model, a step-drawdown test shall be performed on the production wells. A multi-well constant-rate test shall be performed on two of the following production wells: District ID Nos. ***1, 2, 3, 4,*** *Licensee ID Nos.* ***PW-1, PW-2, PW-3, PW-4****, after the wells have been fully developed. Constant-rate multi-well test locations will be based on step-drawdown tests, water quality, and other data submitted to the District prior to the multi-well constant-rate site selections. The constant-rate tests shall be performed in accordance with the specifications in an Aquifer Performance Testing (APT) Plan submitted to and approved by the District. The APT Plan shall be submitted to the District at least 6 months prior to the start of construction of the first production well to support plant operations. The step-drawdown and constant-rate tests shall be conducted by the Licensee within 6 months of completion of construction of the wells included in the APT Plan, or within 6 months of the final approval of the APT Plan, whichever occurs later. In addition, these tests must be completed at least 5 years prior to initial use of the first production wells in excess of 100,000 gallons per day (annual) average) for production purposes. All recorded raw data and a full report analyzing the data shall be submitted to the District within ninety (90) days of completion of all the tests.*

b. Described in Sections 5.0 and 6.0 of this APT Plan*: If any of the transmissivity or leakance values derived from either the step-drawdown or the multi-well constant-rate tests referenced in Section C. Plant Specific Conditions, Condition II. Southwest Florida Water Management District, A.4.A. above, differ significantly from the values used in the groundwater flow model submitted as part of Licensee's application, the Licensee will revise its submitted Focused Telescoping Mesh Refinement groundwater model of the wellfield area based on the results of the aquifer tests described in Section C. Plant Specific Conditions, Condition II. Southwest Florida Water Management District, A.4.a. above. Significantly different transmissivity or leakance values shall mean any well having either a leakance or transmissivity value twenty (20) percent higher or lower than those included in the Licensee's submitted groundwater flow model. The revised model will include wellfield-specific Upper Floridan aquifer transmissivity and leakance values, and properties derived from well drilling and aquifer tests as described in Section C. Plant Specific Conditions, Condition II. Southwest Florida Water Management District, A.4.a. The model parameters including but not limited to the following: surficial aquifer transmissivity/hydraulic conductivity and thickness, Upper Floridan aquifer thickness and transmissivity/hydraulic conductivity, measured groundwater levels (NGVD) and gradients, aquifer leakage, and aquifer boundary conditions may require revisions to reasonably represent aquifer conditions. The revised model must also reflect a groundwater impact analysis including cumulative and incremental analysis to evaluate the pumping effects on other water users, and other analysis to confirm that the withdrawal meets the District's conditions of issuance for water-use permits. If required, all groundwater modeling and a full report, meeting District modeling guidelines, shall be submitted to the District within one-hundred eighty (180) days of completion of the aquifer tests described in Section C. Plant Specific Conditions, Condition II. Southwest Florida Water Management District, A.4.a above. Upon acceptance of the report by the District, the Licensee will complete any required Alternative Water Supply Implementation Plans as specified above.*

1.2.2 SWFWMD APT Guidance

The SWFWMD's guidance for conducting and evaluating APT plans is captured in its publication *Water Use Permit Information Manual – Part C – Water Use Design Aids* (SWFWMD, 2003). The proposed methods presented in this document for collection of background data, the layout and implementation of the APT, and well construction details follow the SWFWMD guidance.

1.2.3 Federal

The USACE Regulatory Program maintains jurisdiction over waters of the United States, including wetlands. Impacts to jurisdictional wetlands and waterways require permits under Section 404 of the CWA, which regulates the discharge of fill material in waters of the United States.

PEF has agreed to submit and seek USACE approval of groundwater hydrogeologic testing and monitoring plans, relative to its groundwater withdrawal from four production wells at the LNP site prior to issuance of the Section 404 permit.

2.0 Construction of Wells

Production wells (PW-1, PW-2, PW-3, and PW-4) and Floridan aquifer observation wells will be constructed, as described in this section, in accordance with well construction standards set forth in Rule 40D-3 of the Florida Administrative Code (F.A.C.) and other applicable regulatory requirements. SAS observation wells will be constructed as described in the following paragraphs. Well construction information will be submitted to SWFWMD after installation is completed.

The conceptual locations and layout of the proposed production wells and observation wells for the APT and the locations of wetland monitoring wells are depicted on Figure 2. Final locations will be determined during the field effort. All four production wells will be subjected to step-drawdown testing when constructed. Wells PW-4 (north central) and PW-3 (southwest corner) will be used for the multi-well constant-rate tests (see Figure 2). Observation wells will be positioned hydraulically upgradient of each pumped well, as shown in the inset on Figure 2. There are no known anthropogenic sources of contamination in the well field; therefore, the water produced from the pumping tests is not expected to be contaminated.

All production and observation wells will be surveyed after completion for both horizontal location and vertical elevations by a land surveyor licensed in Florida, using both the National Geodetic Vertical Datum of 1929 (NGVD29) and North American Vertical Datum of 1988 (NAVD88) reference systems, as well as the state plane coordinate system.

2.1 Production Wells

Each of the production wells will be installed by first completing a 24-inch-diameter mud rotary pilot boring into competent limestone to a typical depth of 100 feet below ground surface (bgs). No coring will be performed while drilling these wells, as sufficient site coring data are already available from the site investigations performed for the Final Safety Analysis Report (FSAR). An 18-inch outside-diameter final steel surface casing will then be installed into the rock and grouted to the land surface to isolate the SAS from the UFA. A nominal 16-inch borehole will then be drilled inside the casing to the total well depth of approximately 300 feet. Each well will be completed as an open (uncased) borehole well in the Avon Park Formation, and no screen or inner well casing will be used in the production zone.

New production wells will be constructed according to the following procedure:

1. Obtain SWFWMD well drilling construction permits for production and monitoring wells.
2. Determine surface casing length and well depth. Actual surface casing lengths and final well depth will depend on site-specific hydrogeologic conditions and will be determined by the onsite hydrogeologist.

3. Drill a 24-inch pilot hole to the competent limestone of the UFA, which is estimated to occur at approximately 100 feet bgs, using mud rotary techniques.
4. Record lithologic descriptions of the drill cuttings, and drilling and construction logs during borehole drilling and well construction.
5. Install and grout an 18-inch steel isolation casing to approximately 100 feet bgs to effectively seal off the SAS.
6. Drill a nominal 16-inch open borehole using reverse air rotary methods to the total well depth of approximately 300 feet bgs.
7. During drilling, collect borehole groundwater samples every 30 feet and analyze for specific conductance, pH, temperature, sulfate, and chloride.
8. Collect a suite of borehole geophysical logs to evaluate the hydrogeology below 100 feet bgs. Geophysical logging will include fluid resistivity, temperature, electric, gamma, caliper, and groundwater flow logs. A video log of the completed well will also be completed.
9. Conduct a single well step-drawdown specific capacity test on the well, as described in Section 3.1. Collect a water sample at the end of each pumping step and analyze for the list of parameters described in Section 3.1.
10. Submit a well completion report documenting the well construction details, geophysical logs, and APT pumping tests to FDEP, SWFWMD, and USACE within 90 days of completion of the wells.

2.2 Observation/Monitoring Wells

The proposed constant-rate pumping test observation wells will be installed after the production wells are completed. Observation wells will be constructed of flush-threaded polyvinyl chloride (PVC), and the screen lengths will be a minimum of 10 feet. SAS observation wells will be constructed of 2-inch inside-diameter PVC casing and screen, and a sand filter pack will be installed to a depth of not more than 1 foot above the top of the screen. The UFA observation wells will be constructed of 4- or 6-inch inside-diameter PVC surface casing set into rock at approximately 100-foot depths to isolate the SAS from the UFA. The UFA observation wells will then be completed as open boreholes drilled into the rock below the surface casings to the same depth as the production wells. The SAS monitoring wells will be drilled using a hollow-stem auger, and formation samples will be collected every 2 feet using a split-spoon sampler. Floridan aquifer monitoring wells will be drilled using a mud-rotary drill rig. Formation samples will be collected from the circulating fluid system.

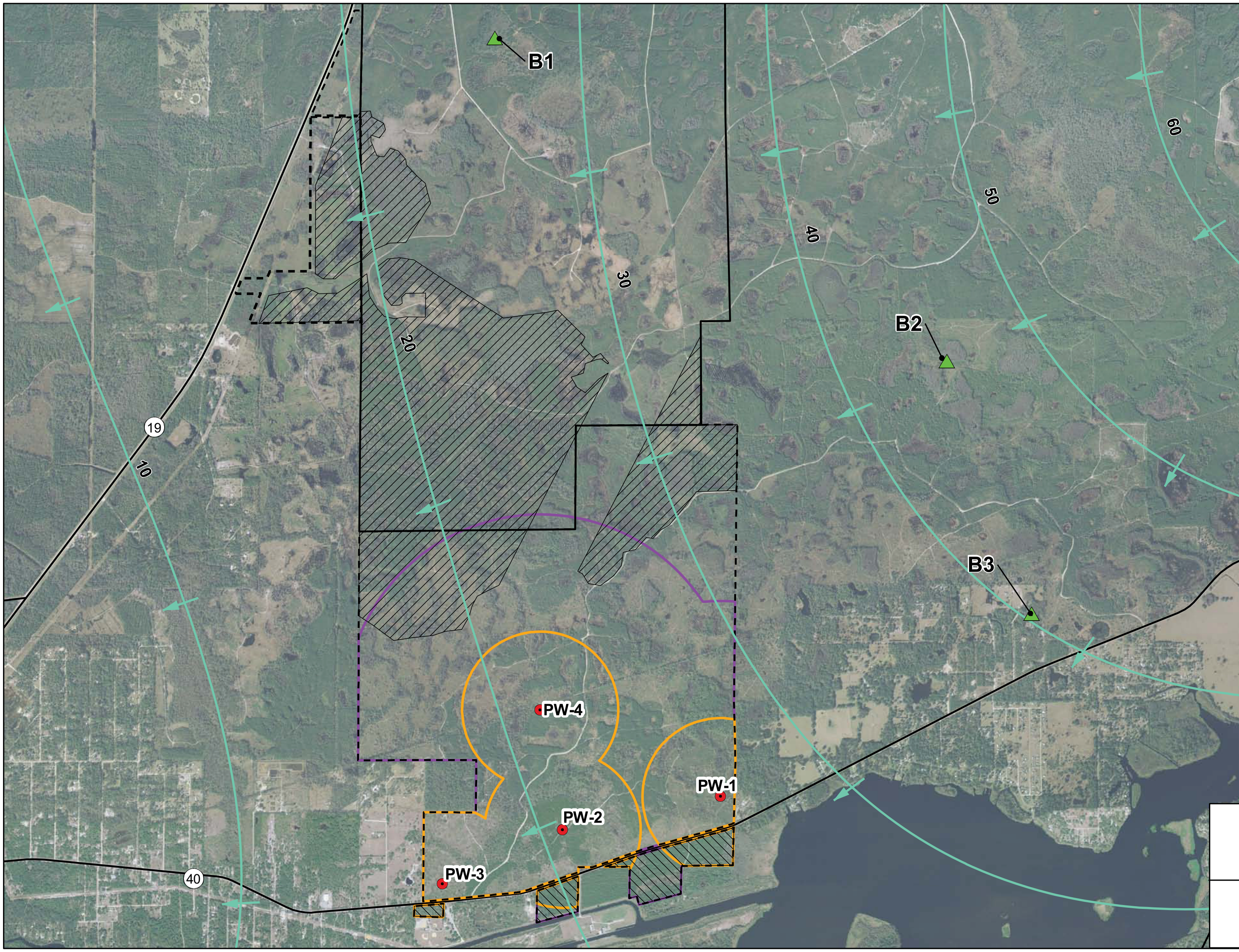
The SAS observation wells will be screened below the water table present at the time of installation to a depth estimated to be 20 to 30 feet bgs based on boring logs from the site. To the extent possible, the well screen will be positioned such that seasonal variations in water level will not result in a well screen positioned above the water table. The purpose of the observation wells is to provide information on vertical gradients and water level changes

between the SAS and UFA during the APT. Two SAS observation wells will be installed near each of the two production wells to be tested, with a layout, as shown on Figure 2.

Additional wetland monitoring SAS wells will be installed in accordance with the approved LNP EMP as required by COC Section C.II.A.2 (as modified on January 25, 2011). One SAS monitoring well will be installed at each of the twelve monitoring transects. The SAS well will be located outside of the wetland in the adjacent upland, as close as possible to the monitoring transect to facilitate access. The preliminary wetland monitoring well locations are shown in Figure 2 and the proposed background wetland monitoring wells are shown in Figure 3. These SAS monitoring wells will be screened below the water table present at the time of installation to a depth estimated to be 20 to 30 feet bgs based on boring logs from the site. To the extent possible, the well screen will be positioned such that seasonal variations in water level will not result in a well screen positioned above the water table. Each SAS monitoring well will be completed with 10–foot-long screens.

The location and number of wetland monitoring SAS wells will be in accordance with the approved EMP. These wells will be installed a minimum of 2 years prior to the construction and testing of the LNP well field.

A UFA observation well will be installed 250 feet upgradient of each of the two production wells (PW-3 and PW-4), as shown on Figure 2. Each observation well will be completed as an open borehole at elevations approximately equivalent to the production interval of the associated production well.



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Potential Background SAS Monitoring Well Locations

FIGURE 3

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3.0 Aquifer Testing Procedures

The proposed testing procedures for collection of background data, the layout and implementation of the APT, and well construction details follow the SWFWMD's guidance for conducting and evaluating APT plans is captured in its publication *Water Use Permit Information Manual – Part C – Water Use Design Aids* (SWFWMD, 2003).

Based on a preliminary evaluation of existing site hydrogeologic information from the FSAR, a 72-hour APT should be sufficient for determining the aquifer parameters and well performance information required to meet the COC requirements. The test may be conducted for a longer period of time, if necessary, to approach water level stabilization. Test duration will be a minimum of 72 hours and will be determined by the field geologist.

After installation and development, each production well will be equipped with a vertical turbine test pump or electric submersible test pump capable of a pumping rate of approximately 1,200 gallons per minute (gpm). The discharge piping at the surface will be fitted with throttle valves and an inline flow meter. Test procedures for both step-drawdown and constant-rate tests are described in more detail below. There are no known Floridan aquifer production wells near the well field. The nearest Floridan aquifer well is located about 1 mile west of the site. The background data collection will reflect any drawdown effects from this well or other nearby users.

3.1 Single-Well Step-Drawdown Test

A single-well step-drawdown test (also known as a specific capacity test) will be conducted on all four production wells when each is constructed to determine the optimum relationship between drawdown and pumping rate (specific capacity) for each well. The step-drawdown tests will be conducted following completion of each production well as follows:

- The well will be pumped at four discharge rates representing approximately 50 percent, 70 percent, 90 percent, and 100 percent of the maximum capacity that can be achieved from pumping through the 16-inch open borehole or up to a maximum of 1,200 gpm. The 1,200-gpm test rate is based upon a rate of approximately 110 percent of the maximum reported design pump capacity of 1,100 gpm. Pumping rates will be controlled by a throttling valve on the discharge side of the pump and reading the inline flow meter. Pumping rates will be increased step-wise.

- The duration of each pumping step will be approximately 90 minutes (total test duration estimated to be 360 minutes). Actual step durations will be determined by monitoring pumping drawdown levels and ascertaining when the level has stabilized for at least two consecutive readings 10 minutes apart, at which point that step will be concluded. Step durations will be a minimum of 60 minutes and will not exceed 90 minutes each.

Water level measurements from the pumped well will be recorded during pumping and recovery at frequencies meeting or exceeding recommendations in the SWFWMD guidance

document (SWFWMD, 2003). Water samples will be collected from the well at the end of each step of the test for field analysis of the following parameters:

- Chloride
- Sulfate
- Specific conductance
- pH
- Temperature

Both a primary and duplicate water quality sample will be collected near the end of the step-drawdown test. The duplicate sample will be held until needed, and the primary sample will be submitted to a laboratory for analysis of the following background water quality parameters:

- Bicarbonate – total alkalinity if pH is 6.9 or lower
- Calcium
- Carbonate
- Chloride
- Magnesium
- Nitrate and nitrite
- Potassium
- Sodium
- Specific conductance
- Sulfate
- Total dissolved solids
- Total hardness
- Total iron

The laboratory results will be checked for charge balance within 5 percent. In the event that the charge balance exceeds 5 percent, the previously collected duplicate sample will then be analyzed and the results submitted to the FDEP, SWFWMD, and USACE.

All water quality analyses will be performed by a laboratory having Florida Department of Health National Environmental Laboratory Accreditation Program (NELAP) certification.

A report that includes all sample analysis results, chain-of-custody forms, U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) Level 3 validation package or equivalent, and an evaluation of the data will be submitted electronically.

3.1.1 Drawdown and Recovery Measurements

A downhole pressure transducer and digital data logger will be used in each pumped well to record changes in water levels from the static baseline during the test. The transducer will be installed 48 hours before the test begins, and the data logger will be started to establish static water level in the well prior to pumping. A second transducer will also be installed in the well as a backup in the event of primary equipment failure. Pressure transducers will be installed in drop pipes for protection.

During the test, manual measurements will be collected with a water level tape at selected times and recorded in the field book as a quality control check. The time, duration, and pumping rate for each step interval will also be recorded in the field book by the field team.

At the end of the pumping test, recovery data will be collected for 48 hours. The raw data will be downloaded from the data logger to a portable computer. All equipment will be removed from wells and the wells secured.

3.1.2 Discharge Water Handling

Water discharged during testing will be directed to an area at least 1,000 feet away from the test well and hydraulically downgradient from the well. The discharge point will avoid wetlands that are being monitored under the EMP. Water will be transported via a temporary constructed pipeline to the designated discharge point. The discharge will be managed by use of diffusers, hay bales, and other similar materials as necessary to prevent erosion or sediment transport. The discharge point will be visually inspected every hour during the step-drawdown testing.

3.2 Multiple-Well Constant-Rate Pumping Test

As required by COC C.II.A.4.a, constant-rate aquifer tests will be performed on production wells PW-3 and PW-4 for the LNP. The number of observation wells and their locations are described in Section 2. The exact well locations and construction details may vary based on the lithology encountered during drilling. The constant rate tests will be performed consecutively with similar background, test, and recovery periods.

3.2.1 Pumping Rate

The turbine or submersible test pump will be used to establish a constant discharge rate, expected to be approximately 1,200 gpm, which is slightly in excess of the design capacity for long-term use. The flow rate will be measured by an inline flow meter. A calibration certificate will be required to demonstrate that the flow meter was calibrated within 6 months prior to the test. The flow rate will be checked every 30 minutes during the APT pumping period and adjusted as necessary via a throttle valve to maintain a constant rate.

3.2.2 Drawdown and Recovery Measurements

A downhole pressure transducer and digital data logger will be used in each of the pumped production wells (PW-3 and PW-4) and the observation wells to record water levels logarithmically during the pumping test, and at 1-minute intervals or other appropriate interval during the background period, pumping, and recovery test phases. Water levels will also be recorded in the other production wells during their respective tests, using both pressure transducers/data loggers and periodic manual measurements. Background data will be collected from these wells and nearby select wetland wells for at least 5 days prior to pumping (further described in Section 4). All manual water level measurements and pressure transducer positions will be referenced to an elevation reference point established on each observation and production well casing during the land survey.

Manual measurements will be made periodically in the pumped well and select observation wells during the background, pumping, and recovery phases as a check on the electronic measurements. Data loggers and pressure transducers will be calibrated to manufacturer's specifications prior to the test.

At the end of the 72-hour pumping period, the data loggers will be paused before the pumps are turned off, downloaded if necessary, reset, and restarted to capture the rapid water level changes that occur shortly after the pump is turned off. The data loggers will continue recording at 1-minute intervals or other appropriate intervals until the observation well water levels have recovered to at least 95 percent of their original static level. This is anticipated to occur in less than 72 hours after the pump has been turned off.

At the end of the 95 percent recovery period, the raw data will be downloaded to a computer, reviewed, and backed up prior to leaving the field to ensure that usable data were recovered. All equipment will be removed from wells and the wells secured.

3.2.3 Discharge Water Handling

Water discharged during testing will be directed to an onsite discharge point at least 1,000 feet away from the test well and positioned hydraulically downgradient from the well. Water will be transported via a temporary constructed pipeline to the designated discharge point. The discharge point will avoid wetlands that are being monitored under the EMP. The discharge will be managed by use of diffusers, hay bales, and other similar materials as necessary to prevent erosion or sediment transport. The discharge point will be visually inspected at least every 4 hours during the APT.

3.2.4 Rainfall and Barometric Pressure

The barometric pressure will be monitored and recorded by the digital data loggers for the APT background and testing periods to allow correction of test data. Rainfall data will be obtained from the Levy Meteorological Tower onsite for the period of background data collection, the APT test, and the recovery period after the test. If prolonged severe weather such as a tropical system moves into the area during the test, or is forecast for the test period, the test will be rescheduled.

4.0 Background Data Collection

4.1 Groundwater Levels

At least 5 days prior to initiating the constant rate APT, water level measurements will be collected from the production wells and observation wells, with downhole pressure transducers and data loggers in linear mode with 1-minute increments to document static groundwater conditions. In addition, SAS monitoring wells will be installed in nearby wetlands identified on Figure 2 in radial zones around the well, in accordance with the approved EMP as required by COC Section C.II.A.2 (as modified on January 25, 2011). The water level will be checked a minimum of every 8 hours using manual measurements. Linear distances from each pumped well to all other water level monitoring points will be obtained from the land survey.

A list of wells to be outfitted with continuous water level data loggers for the multi-well tests is presented in Table 1. Field water quality measurements or samples for laboratory water quality analyses may also be taken at this time if necessary.

4.2 Surface Water Levels

To assess potential impacts from aquifer pumping on adjacent wetland levels, water levels will be obtained from staff gauges and shallow wetland piezometers, in select wetlands near the APT well sites. The number and location of staff gauges and wetland piezometers will be in accordance with the approved EMP as required by COC Section C.II.A.2 (as modified on January 25, 2011).

The data will be collected for the 5-day background period, the 72-hour pumping period, and the recovery period of each APT by installing pressure transducers in the wetland wells and by reading the staff gauge levels every 4 hours during the tests.

4.3 Rainfall and Barometric Pressure Data

Barometric pressure data will be obtained from the digital data loggers to determine background and test conditions for the APT. Rainfall data will be obtained from the Levy Meteorological Tower onsite for the period of background data collection, the APT test, and the recovery period after the test.

TABLE 1
Aquifer Testing Well Network

Test Well ID	Observation Well ID	Well Use	Aquifer Zone
PW-3	SAS-1	Aquifer testing	SAS
	SAS-2	Aquifer testing	SAS
	UFA-1	Aquifer testing	UFA
	PW-1	Aquifer testing	UFA
	PW-2	Aquifer testing	UFA
	PW-4	Aquifer testing	UFA
	SAS-3	Aquifer Testing	SAS
	SAS-4	Aquifer Testing	SAS
	M-1	Wetland Monitoring*	SAS
	M-2	Wetland Monitoring*	SAS
	M-3	Wetland Monitoring*	SAS
	M-5	Wetland Monitoring*	SAS
PW-4	SAS-5	Aquifer testing	SAS
	SAS-6	Aquifer testing	SAS
	UFA-2	Aquifer testing	UFA
	PW-1	Aquifer testing	UFA
	PW-2	Aquifer testing	UFA
	PW-3	Aquifer testing	UFA
	SAS-7	Aquifer Testing	SAS
	SAS-8	Aquifer Testing	SAS
	M-7	Wetland Monitoring*	SAS
	M-3	Wetland Monitoring*	SAS
	M-4	Wetland Monitoring*	SAS
	M-8	Wetland Monitoring*	SAS
	M-9	Wetland Monitoring*	SAS

* Included in EMP wetland monitoring well array and on Figure 2. Final EMP monitoring well locations will be revised following the selection of wetland transects and installation of wetland monitoring wells.

Notes:
Well locations are shown on Figure 2.
PW = production well
SAS = surficial aquifer system
UFA = Upper Floridan aquifer

5.0 Analysis of Test Data

5.1 Single-Well Step-DrawdownTest

Results of the step-drawdown tests will be evaluated using the aquifer performance equations developed by Hantush and Jacob to determine optimal pumping rates versus drawdown levels for each of the four production wells. This information will then be used to finalize the pumping rates to be used for the constant-rate multi-well tests.

5.2 Multiple-Well Constant-Rate Test

The time-versus-drawdown water level information recovered during the constant rate tests will be evaluated using typical U.S. Geological Survey (USGS) curve matching techniques and numerically, to develop site-specific values for aquifer performance parameters, including transmissivity and leakance. The resulting aquifer parameters will then be compared with the values used in the DWRM2 Telescoping Mesh Refinement (TMR) groundwater model for LNP, which was submitted as part of the water use permit application.

The aquifer system at the LNP site includes three aquifers (SAS, UFA, and Lower Floridan aquifer) and two semi-confining units. The most commonly used analytical aquifer test analysis techniques are limited to two aquifers and aquitards. While analytical techniques should provide accurate estimations of transimissivity and leakance, a numerical method will also be employed to provide additional perspective on the aquifer conditions.

The Multi-Layer Unsteady State (MLU) model will be used for drawdown calculations and inverse modeling (aquifer test analysis) of transient well flow in layered aquifer systems and stratified aquifers. MLU can estimate select aquifer parameters based on a best fit semi-analytical solution to measured time-distance-drawdown data. The automatic curve-fitting algorithm computes final optimized aquifer parameter data.

MLU is based on a single hybrid analytical-numerical solution technique for well flow that addresses a number of the aquifer conditions expected at the site. The MLU model is accepted by SWFWMD for aquifer test analysis. Background information on the analytical solution techniques used by MLU has been published in the *Journal of Hydrology* (Hemker and Maas, 1987; Hemker, 1999a; Hemker, 1999b). The non-linear regression technique used by MLU is described in *Ground Water* (Hemker, 1985).

6.0 Aquifer Performance Testing Report

An APT report will be prepared in accordance with the requirements of the COC Section C.II.A.4 (as modified on January 25, 2011), and will be submitted to the FDEP, SWFWMD, and USACE within 90 days of testing completion. The report will include the following elements:

- Hydrogeologic conditions, including cross-sections and geophysical logs.
- Well construction details.
- Data analysis, including a discussion of any corrections made to the data.
- Tabulation of all water levels, rainfall, pumping rates, and water quality data (graphs of the data will also be included as appropriate).
- Discussion and comparison of field testing results and modeled assumptions with a focus on transmissivity and leakance.
- Survey results for elevation and location of all wells used.

If any of the transmissivity or leakance values derived from either the step-drawdown or the multi-well constant-rate tests differ significantly from the values used in the groundwater flow model submitted as part of the PEF Licensing application, PEF will revise the Focused Telescoping Mesh Refinement groundwater model of the well field area based on the aquifer test results. Significantly different transmissivity or leakance values shall mean any well having either a leakance or transmissivity value twenty (20) percent higher or lower than those included in PEF's unrecalibrated model for the Environmental Report (ER) and Site Certification Application (SCA).

If the model is recalibrated based on the conditions described previously, groundwater modeling and a modeling report meeting SWFWMD modeling guidelines, shall be submitted to the SWFWMD within one-hundred eighty (180) days of completion of the aquifer tests.

7.0 References

CH2M HILL. 2012. *Levy Nuclear Plant Well Field Environmental Monitoring Plan*. 338884-TMEM-133, Rev 0. April.

Hantush, M.S. and C.E. Jacob, 1955. Steady three-dimensional flow to a well in a two-layered aquifer, Trans. Am. Geophys. Union, vol. 36, no. 2, pp. 286-292.

Hemker, C.J. 1985. A General Purpose Microcomputer Aquifer Test Evaluation Technique. *Ground Water*, pages 247- 253.

Hemker, C.J. and Mass, C. 1987. Unsteady Flow to Wells in Layered and Fissured Aquifer Systems. *Journal of Hydrology*, Volume 90, pages 231-249.

Hemker, C. J. 1999a. Transient Well Flow in Vertically Heterogeneous Aquifers. *Journal of Hydrology*, Volume 225, pages 1-18.

Hemker, C.J. 1999b. Transient Well Flow in Layered Aquifer Systems: the Uniform Well-face Drawdown Solution. *Journal of Hydrology*, Volume 225, pages 19-44.

Southwest Florida Water Management District (SWFWMD). 2003. *Water Use Permit Information Manual. Part C. Water Use Design Aids*. Brooksville, FL.

State of Florida Conditions of Certification (COC). 2009. Adopted by the *Final Order on Certification for the Progress Energy Levy Nuclear Power Plant Units 1 and 2*. August 26. Modified on January 25, 2011.

Comment Resolution, USACE Review of Draft LNP Environmental Monitoring Plan and Draft Aquifer Performance Testing Plan, April 2012

Number	Location in Draft	Comment	Resolution
CH2M HILL TMEM 133: Levy Nuclear Plant Well Field Environmental Monitoring Plan			
Comments from RECOVER Review			
General			
A		Document should be further strengthened by adding specific references that support different elements of the monitoring and adaptive management plan. For example, the thresholds for hydrologic targets could be particularly helpful as early warning indicators of potential drawdown effects. However, the methodology needs to be supported by referencing comparative examples used in the state of Florida.	Additional references and clarification are provided in the EMP (Section 3.3.6) and in this support document (Appendices A, B in 3 volumes, and C).
B		A "real-world" example of how the data analysis and threshold determination will be performed would be helpful in explaining/clarifying the assessment methodology.	Additional references and clarification are provided in the EMP (Section 3.3.6) and in this support document (Appendices A, B in 3 volumes, and C).
C		There is a concern that no ecological indicators have been included in the monitoring plan for use in the adaptive management process. The USACE understands the difficulty in using an ecological indicator after visiting the site, but would still like to see some ecological indicator in addition to the hydrologic ones listed in the plan or better supporting documentation of how the hydrologic indicators chosen directly tie into the ecological conditions on the site. How will the hydrologic indicators determine ecological harm? How is that ecological harm expressed? Will it be expressed in the monitoring period recommended in the plan? Recommend including quantitative vegetation thresholds similar to those listed in the USACE Levy Nuclear Plant Monitoring Plan Recommendations dated 13 Jan 2012, Table 1. Several of the quantitative vegetation thresholds listed in Table 1 are directly referenced from the Wetland Assessment Procedure (WAP) PEF proposes utilizing for their ecological assessment methodology. While hydrology may be more precautionary if it works, uncertainty exists in setting those thresholds for these already altered wetlands. Vegetation monitoring thresholds will provide another indication of change to inform decisions about water supply well use or the need to pursue alternative water supply actions, as part of the adaptive management plan.	Additional quantitative vegetation monitoring has been added to the LNP EMP. Section 3.4 has been updated to describe the purpose and methodology for the quantitative vegetation data collection. The WAP methodology has been maintained (as required by the Conditions of Certification [COCs]) but expanded by adding fixed vegetation monitoring plots along the WAP transects and incorporating a Wetland Affinity Index (WAI) (See EMP Section 3.4). The new vegetation monitoring is more quantitative than the semi-quantitative WAP data collection and will provide a more measureable, repeatable, and statistically relevant data set. A description of this quantitative data set has further been added to the adaptive management of the LNP well field, and text was updated in Section 4.0 and Figure 5. The quantitative vegetation data set will be tested statistically for differences to baseline ranges on a semi-annual frequency. Statistically detectable differences that are not observed in the reference wetlands will trigger hydrologic data evaluations.

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Number	Location in Draft	Comment	Resolution
D		Recommend incorporating the aquifer performance test (APT) as part of this Environmental Monitoring and Adaptive Management Plan. The APT should be considered an actual field test of the monitoring wells before moving to full production. The threshold, as stated in the COC, would be if the APT reveals significantly different transmissivity or leakance values (20 percent higher or lower), then the model would need to be revised based on the new information. The revised model would then be accompanied with an updated groundwater impact analysis. The USACE recommends that if a revision of the model and subsequent groundwater impact analysis is required of PEF in light of the APT results as per the COC, a review/revision of this environmental monitoring plan is required. The review/revision of this environmental monitoring plan will take into account the updated modeling and groundwater impact analysis to refine the monitoring area of extent, monitoring components, and adaptive management measures. The revised monitoring plan must be approved by the USACE and will replace the current version.	Agreed. Section 3.6 was added to discuss the application of APT results in the EMP. EMP monitoring components and frequency will be reviewed and modified (elements added or reduced) based on APT results.
Specific Comments			
1	Page 5, Last Paragraph, add after Last Sentence	Add: “Monitoring effects will support regulatory decisions to adjust water withdrawal operations as part of the adaptive management plan sanctioned by the permit.”	Sentence added as recommended with “effects” changed to “results.”
2	Page 8, Paragraph 1, 2nd and 3rd to last sentences: “Normal operations…rotated routinely"	Initially we did not understand these sentences and how operations would work. After the presentation, the impression was that this scenario would not be “normal operations”, but this is included as one of the adaptive management measures to decrease the overall withdrawal rate. Is it normal operations or is it a management measure? Rotating well operations can’t be both, as currently explained.	Normal operations will be to run each well sequentially for about 24 hours until all four wells are run, then repeat the rotation. Rotation can be used as a management measure by changing the pattern if a particular wetland shows more drawdown than desired; for example, rotation could be reduced to only three wells to reduce or eliminate pumping on the production well nearest the affected wetland.
3	Page 9, Map	Map should show transmission lines and water pipeline tracks from wells to LNP site 1 and 2 in order to not bisect the site transects in these areas.	The transect locations shown are provisional. Final locations will be selected based on criteria described in Section 3.2, which include avoidance of site facilities such as transmission lines and water pipelines. No changes to map are proposed at this time.

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Number	Location in Draft	Comment	Resolution
4	Page 10, List of Questions	Why is a question related to faunal species effects not included? More specifically, state reasons why faunal species are not the focus of the monitoring plan for this project.	Faunal species are not the focus of the monitoring plan for several reasons; 1) Changes in wetland faunal communities, like changes in the vegetative community, are a deferred resolution to hydrologic change. The goal of this EMP is to be preemptive and avoid additional impact to the already impacted wetlands on the LNP well field site; 2) In our experience, faunal species such as amphibians (which are the faunal group most typically monitored in association with wetland health) can be an unreliable indicator of wetland hydrology. Amphibian populations are affected by factors external to hydrologic conditions such as predation by fishes, hogs, or Cuban tree frogs that interfere with assessment of natural population changes. CH2M HILL conducted a 10-year study for the St. Johns River Water Management District (SJRWMD) at four wetlands using various rehydration strategies to offset impacts from well field drawdown. Part of the study included assessing amphibian populations in the test and control wetlands. No differences in amphibian populations were detected between test and control wetlands where water levels differed. Amphibian monitoring was not a viable monitoring parameter for detecting change in wetlands for that study. The document titled *Summary results: Wetland Augmentation Demonstration Program* can be found at: http://floridaswater.com/technicalreports/spubs1.html 3) Typical wetland faunal communities are not present in wetlands in the vicinity of the proposed well field, most likely the result of historic hydrological degradation. Species occurrence observations are part of the WAP methodology and will be documented during routine wetland monitoring.

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Number	Location in Draft	Comment	Resolution
5	Page 10, Paragraph 3, last sentence	“Monitoring of these assessment…and pumping begins.” Does the 2-year baseline begin prior to the installation of the construction wells or the production wells? Clearly specify exactly when the 2-year baseline would begin and reference it to a specific construction action. For example, include a schedule of monitoring well and pipeline construction, well operation and testing phase, monitoring well full production phase, and when baseline vs. well operation monitoring periods. The power to detect change using monitoring will improve with a longer baseline and should be considered. Justification needs to be provided to support when the baseline period will begin. The USACE is concerned that any groundwater withdrawal activities on the site, no matter how small could impact the baseline information if not taken into consideration when designing the monitoring timeline. Clarification is needed on exactly what period of record (POR) would be considered the “baseline” for assessment purposes. During the presentation, several different PORs were mentioned (baseline, running average). The USACE recommends defining and initiating the baseline data set as the POR 2-years prior to all (construction and production) well installation. Baseline conditions will be generated from this specific data set and will be used to determine ecologic/hydrologic changes as a function of LNP groundwater withdrawal activities. The baseline condition should not be determined from a running average of all the data collected from the initiation of the monitoring program.	Text revised to clarify baseline period as follows: "Baseline monitoring of these assessment areas will begin a minimum of 2 years before operational production wells are installed." If appropriate long-term monitoring records are available, PE may employ "hindcasting" to synthesize hydrologic data records (see also comment resolution 8).
6	Page 11, Table 1	This Section/Table would be better located after the text description of the monitoring in Sections 3.4 and 3.5. Some of the parameters as listed in the table are unclear and only became clear after reading Sections 3.4 and 3.5.	Agreed, Section and Table relocated as recommended.

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Number	Location in Draft	Comment	Resolution
7	Page 11-12, Transects	Need to reference or state logic why only 12 monitoring transects are needed, as well as methodology for citing transect locations. Background transects would ideally be located in wetlands with similar health conditions as the project site. For example, can one be sited Southwest of the LNP boundary (South of U.S. 40). In addition, please clarify the length of the transects. They should cover the full elevation gradient from historic wetland edge historic normal pool to wetland interior's deepest point, as stated in the WAP.	Text was added to Section 3.2 to clarify or expand upon the provided comments. The number of proposed wetland transects within the LNP well field (9) and the frequency of data collection will provide a reasonable statistical sample size to allow comparisons of the monitored parameters. The number of study area and background transects proposed for the LNP EMP exceeds that of other well field monitoring plans (ratio of number of transects to permitted produced capacity), such as Pasco County Utilities and Tampa Bay Water's Central System well fields that also use the WAP monitoring methodology. Text has been added to further clarify the methodology for siting transects. Text has also been added to further describe the selection of background transects and the potential addition of background transects to accommodate the range of wetland conditions found within the LNP well field. Text was also added to further clarify transect length and placement along the wetland topographical gradient.
8	Page 16, Management Thresholds, section 3.4.6, 1st and 2nd Paragraphs	Need to identify references for management thresholds. The SWFWMD, 1999 citation states on page 7 that a palustrine cypress swamp is predicted to show signs of significant alteration if the median stage (p50) based on six year stage record is lowered to a level between 1.8 to 1.9 ft below unaltered normal pool elevation. If the mean p50 value for cypress swamps is 1.0 ft below NP elevation, then under steady state conditions the maximum allowable median value would be 0.8 ft below the p50 for a typical cypress swamp. If we are deviating from this threshold recommendation because the wetland is altered, please indicate what evidence or logic is being used to support a different threshold? Because this p50 has been referenced from state law supported by technical analysis, reviewing state law 40D-8.624(8(b) (F.A.C. [62-330 DEP]) indicates that for altered lake-fringing cypress swamps that remain viable and perform functions beneficial to the lake in spite of alterations, the threshold needs to be set based on historic minimum lake level. This legal definition based on science may not fit this specific case, but is an example of a reference document to develop the working threshold. Additional literature review reveals SJRWMD preferred a different threshold of 0.56 ft below median wet season water level (p50)	The plan to monitor the hydrology of the LNP site and to analyze the data for well field impact requires that water level data be collected at each wetland monitoring location, and that these data become a management baseline. If future water levels decline from this baseline, it will lead to a series of management resolutions, which could culminate in a decision to begin transitioning to an alternative source of water if water levels show a consistent and downward trend. To establish a basis of comparison, consistent with general practice in wetland hydrologic analysis, a cumulative frequency distribution of water elevations will be prepared from these data. The basic unit of assessment proposed for inferring a hydrologic change is the running median water elevation, or p50 (indicating the 50th percentile of water elevations). The existing isolated cypress wetland Minimum Flow and Level (MFL) promulgated in Chapter 40D-4, Florida Administrative Code (FAC), employs the p50 for this purpose, and assigns a

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		relative to unaffected wetlands or 0.55 ft for steady state conditions (SJRWMD 2005). In addition, USACE recommends considering a hydrologic regime to capture some of the variability by using the p25 to p75. Please see the draft RECOVER Southern Coastal Systems Performance Measure, Salinity in Florida Bay, regime metric for reference. Recommend adding graphical example to monitoring plan to indicate how p50 threshold is established.	critical elevation of 1.8 feet below the normal pool as an elevation indicative of stress if a 6-year running mean p50 drops below this value. This threshold was defined from data developed from long-term studies of isolated cypress wetlands monitored in the northern Tampa Bay Area by the Southwest Florida Water Management District (SWFWMD) and Tampa Bay Water. This existing level and basis of understanding were subject to and validated by a peer review process led by SWFWMD in the late 1990s. Supporting documentation for this threshold is provided in Appendix A. However, the specific isolated cypress wetland criterion does not appear to be applicable for the assessment of wetland on the LNP site, based on current conditions. CH2M HILL site reviews conducted during project planning and permitting indicate that many of the wetlands present on the LNP site and component properties already exhibit evidence of vegetative change in resolution to long-term hydrologic alteration. Based upon the increasing prevalence of altered wetlands toward the southern boundary of the project area, and evident length of time that wetland alteration has occurred, the causal factor is hypothesized to be a long-term, gradual drainage dewatering effect of the Cross Florida Barge Canal (CFBC). The actual departure from normal for a wetland hydroperiod on the LNP site is not known, given the lack of available site data. But it is reasonable to presume that a cumulative frequency distribution of hydrologic data would depict lower minimum water elevation levels for greater periods of time than expected for an unaffected isolated cypress wetland. As a provisional threshold to address the 1) insufficient site data to currently characterize water levels, and 2) inadequacy of the isolated cypress wetland criterion as a triggering threshold for the wetlands in their current condition, CH2MHILL proposed a provisional p50, based upon ongoing work in the Central Florida Water

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			Initiative (CFWI), a scientific working group comprised of hydrologists and ecologists from the SJRWMD, SWFWMD, South Florida Water Management District (SFWMD), and a number of utility stakeholders from seven central Florida counties. Appendix C summarizes the method and basis for a detailed quantitative analysis of the long-term water elevation data in a set comprised of 34 lakes and wetlands in central and west-central Florida. This analysis is composed of a data set consisting of wetlands located in the Osceola Plain and a range of mesic soil habitats, as well as wetlands and lakes located in the central Florida ridge and associated xeric habitats. Approximately half of the wetlands and lakes studied exhibited vegetative evidence of hydrologic stress, as determined through a modified WAP process. In the analysis, cumulative frequency distributions were established for the stressed and unstressed systems, and values were derived for the median + interquartile range, and average + 95 percent confidence interval, for all percentile values, including the p20, p50, and p80, among others. Previous work by consultants for Tampa Bay Water had established that surface water to surficial aquifer water level relationships were not uniform, and that wetlands and water bodies in or adjacent to xeric soil types and physiographies exhibited different relationships relative to mesic soil types and upland communities (Appendix B in 3 volumes). Given the hydrologically-altered condition of site wetlands, the p-values calculated for the “stressed, ridge system” waters were proposed as provisional thresholds. It is expected that baseline water level monitoring will establish a range of water elevations that may be different than the thresholds proposed in the EMP, but this is acceptable, given that the purpose of the baseline data is to identify the intrinsic range of fluctuation for specific wetlands or assemblages of wetlands on the LNP site. Given the importance of site baseline

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			data for establishing long-term performance, a sequential process may be implemented whereby water level data is collected and used to synthesize a long-term baseline ("hindcasting"), which provides a probabilistic estimate of median water values for a specific wetland site, and is used as a basis for estimating hydrologic resolution. Use of this approach will depend on the availability of appropriate long-term hydrologic data records.
9	Page 17, 2nd Paragraph, 1st Sentence	"Three management thresholds will be developed for each monitored wetland…" Are you referring to each of the 12 monitoring sites or for each of the three "zones"; near field, far field, background?	We are referring to each one of the 12 monitoring sites. The management thresholds may be similar for some groups of wetlands, but the thresholds will be individually determined for each monitored wetland.
10	Page 17, 2nd Paragraph, 3rd sentence	"If water levels fall…initiate a data review, and implement intervention measures, such as well field optimization or pumping rotation." Please describe in detail what is a "data review", "well field optimization or pumping rotation", see comment number 2. Is pumping rotation normal operations or an intervention measure?	Text in referenced section was re-worded for clarification. Section 3.3.6 describes the data analysis. This is the step beyond monthly water level data downloads, in which an assessment of the p50 value for each wetland piezometer is made.
11	Page 17, Section 3.5	"Wetland monitoring will be based on the WAP." The USACE is concerned about the use of the WAP. The WAP states "this WAP methodology is appropriate for isolated wetlands only". The wetlands of concern on the site are not as a whole classified as "isolated" using federal regulatory definitions of "isolated". Please clarify definition of "isolated wetlands" with respect to the WAP and why it is appropriate to use this procedure at this site.	For purposes of the WAP, the SWFWMD defines "isolated" as a system having "no significant and regular channelized inflow" (see Appendix D, WAP Instruction Manual, 2005). This definition is different from the definition of "isolated wetland" used by the USACE in jurisdictional determinations. Most wetlands on the LNP site lack significant and regular channelized inflow and are therefore appropriate for WAP application.
12	Page 18, Section 3.5.1.1, 1st sentence	"A history will be established for each wetland selected…" See comment number 9. What is meant by "each"?	"Each" refers to each one of the 12 monitoring sites.

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Number	Location in Draft	Comment	Resolution
13	Page 23, Thresholds	Need to state more clearly how these thresholds are initially established. Discussion at site visit indicated that baseline monitoring data at wetland transects would be used to establish thresholds to measure change. Will the near site transects being used? Will a P50 be established for each separate wetland? Will they be grouped by treatment group (near, far, background)? If water levels are already far below the p50 based on historic normal pool (NP), then how are the thresholds defined to indicate the wetland's current condition? For example, near site wetlands are more degraded and potentially would have a smaller threshold of change before the cypress wetlands would be impacted.	Thresholds will be individually determined for each monitored wetland based on stage exceedance frequency distributions calculated for each monitored wetland during baseline. Treatment groups (near-field, far-field, wetland type, etc.) may be analyzed to evaluate overall well field conditions, but thresholds will be developed and adaptive management strategies implemented on an individual wetland basis, with the goal of maintaining existing hydroperiods and conditions.
14	Page 23, Number 1, 2nd sentence:	"Decreases in the p50 stage…will initiate an increase in the frequency of data investigations." How long will you maintain the increased frequency of data investigations?	Increased frequency of data investigations will continue for 1 month (wet season) or 2 months (dry season), after which a management strategy will be implemented. Please refer to Section 4.0 and Figure 5.
15	Page 23, Number 2, 1st sentence	"The initial management threshold…at a level designed to provide an indication of hydrologic changes before ecological harm takes place." What is level and how are you determining this?	The threshold levels will be determined based on the ranges of water levels established during the baseline monitoring period for each monitored wetland. The initial and secondary threshold levels are within the measured range of water levels for the wetlands, but may suggest a trend that, if allowed to continue, may ultimately be harmful. The third (lowest) of the three threshold levels is a water level below which further harm is likely to occur, based on baseline data and on stage exceedance curves for similar systems.
16	Page 23, Number 3, 1st sentence	"The secondary…a water level at which harm is not expected to occur." What is the level at which harm is not expected and how are you determining this?	See resolution to Comment 15
17	Page 23, Number 3, 2nd sentence:	"If this level…a management strategy is immediately implemented." What is that management strategy?	Specific management strategies will be determined at the time of threshold exceedance. In general, the initial management strategy is expected to be reduction or cessation in pumpage of the well associated with the monitoring transect.
18	Page 23, Number 4, 1st sentence	"The third…at a water level below with harm is expected to occur to wetlands…." What is the water level below which harm is expected to occur and how are you determining this?	See resolution to Comment 15

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Number	Location in Draft	Comment	Resolution
19	Page 24, Diagram	Increase font size for the note about the listed thresholds being provisional. Provide documentation on how or why the thresholds (shown in the squared rectangles) were selected to be the provisional thresholds. Provide documentation supporting the provisional thresholds as ecologically significant.	Figure 5 updated. Font size increased. See resolution to Comment 8 for clarification on the development of provisional thresholds.
20	Page 25, 2nd Paragraph, number 1	Describe in further detail what is meant by “rotate pumpage between production wells.”	As described in resolution to Comment 2, pumpage rotation will be used in normal operations as well as a targeted management strategy. Statement revised to read, "Reduce groundwater withdrawals or modify the well rotation schedule to reduce or eliminate the use of a particular supply well nearest the wetland area of concern."

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Number	Location in Draft	Comment	Resolution
Comments from Engineering Division			
21	p. 8, Section 2.0, paragraph 1	The statement "Each well will average 0.4 mgd if the wells are rotated routinely". We believe this statement is somewhat misleading and could be reworded or removed. When a single production well is pumping under normal operations, it will be pumping at a rate of 1.58 mgd, which is equivalent to the pumping capacity of 1,100 gpm. During normal operations, each well would continue to average 1.58 mgd when it is being pumped. We do not know with certainty that the combined drawdowns experienced with one well being pumped at 1.58 mgd or with all four wells being pumped at 0.4 mgd are necessarily equivalent or that the delivery capacity of each production well will be equal to the other. Recommend striking the sentence.	The statement is correct, since the drawdown cone of depression takes time to develop around a pumping well. By rotating the wells, the cone of depression that results will be the same distance and drawdown as would result from pumping all four wells at 0.4 million gallon per day (mgd) each. The point of the statement is to clarify that while each well pumps at a rate of 1,100 gallons per minute (gpm), the resulting cone of depression will reflect the well rotation schedule and the spacing (over 2,500 feet between wells). To clarify, sentences were revised as follows: Each well will average 0.4 mgd on an annual average basis as a result of well rotation and an assumed total average day withdrawal from the wellfield of 1.58 mgd.
Comments from Meeting Minutes (numbering maintained from Final Meeting Minutes preceded by "MM")			
MM 1		USACE asked for better reference to the definition of "isolated" wetlands with respect to Wetland Assessment Procedure (WAP). USACE recommended referencing definition from WAP manual or background minimum flow and level (MFL) documentation. The procedures manual states that the WAP procedure is only applicable to isolated cypress wetlands. This needs further clarification and documentation to demonstrate that its use is clearly appropriate for the LNP wetland systems. CH2M HILL provided discussion of definition of "palustrine" wetland systems and the relationship to the term "isolated" as it applies to WAP and USACE jurisdictional determination. Citation will be provided in revision to EMP.	See resolution to Comment 11.
MM 2		USACE asked about historical assessments and aerial photography required by WAP. CH2M HILL responded that the collection of information and aerial photography of the assessment wetlands has already begun and will continue through implementation of the EMP.	No resolution required
MM 3		USACE questioned why the EMP did not include the construction well. CH2M HILL responded that the construction well was on the north property and was too small and would only be used temporarily so an EMP was not required for it.	No resolution required.

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Number	Location in Draft	Comment	Resolution
MM 4		USACE raised concern about only evaluating hydrologic data for detecting trends towards harm versus the use of additional ecological data. Concern that high trophic level species were not be included in the wetland monitoring described in the EMP. CH2M HILL responded by reiterating that through the WAP methodology, ecological parameters such as the transition of vegetation communities and the occurrence of wetland dependent species are monitored. We will make sure this is emphasized in the EMP. However, since these ecological parameters are expressions of a wetland's hydrology, and the ecological parameters responses lag behind changes in hydrology, hydrology is a more appropriate parameter to measure trends towards harm since it is a leading indicator.	See resolution to general Comment C.
MM 5		USEPA asked if the terms "trend" or "harm" could be better defined in the EMP. The discussion trended towards the application of the Southwest Florida Water Management District (SWFWMD) MFL levels to wetlands that are already impacted. USACE stated that the margin for management thresholds may be too narrow for application in impacted wetlands. CH2M HILL responded by further describing the establishment of management thresholds and how they were set prior to harm occurring and that the final threshold is the level below which harm occurs. The discussion expanded to the SWFWMD and Tampa Bay Water (TBW) MFL establishment and where/when it has been implemented. CH2M HILL and PEF agreed to provide background resources for MFL establishment.	Trend is used to describe potential changes in hydroperiod over time. PE will monitor water levels and implement management strategies if it appears wetland hydroperiods are reduced as a result of well field pumpage, thereby preventing harm to these systems. The goal is maintenance of existing hydroperiods. Section 3.3.6 and Appendices A, B, and C of this resolution document provide additional background resources.

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Number	Location in Draft	Comment	Resolution
MM 6		Group expressed concern two years might not be adequate as a baseline. USACE asked about the availability of any additional (nearby) background wetland monitoring or long term hydrologic monitoring. Also need a better definition of when baseline begins and ends (construction of production wells/and when production wells are installed or when the plant starts production). CH2M HILL clarified that EMP referred to a minimum of two years for baseline and suggested an approach to investigate whether nearest regional rain gage, or well, lake or wetland water elevation long-term data set can be monitored concurrently during the baseline and thereby be used to extrapolate (hind-cast) historic records to create a synthetic baseline. Use of this approach is contingent upon availability of data. a. This approach has been used by SWFWMD to develop long-term records for setting MFLs. b. This approach could be used to estimate a long-term "confidence interval" around the p50 value.	See resolution to Comment 5.
MM 7		USEPA asked that the decision flow chart diagram clarify that the thresholds on the figure are for healthy wetland systems. USACE requests clarification on application of the thresholds presented on the decision flow chart diagram. CH2M HILL agreed that text could be added to the figure to clarify.	See resolution to Comment 8 for clarification on threshold values. Diagram and text (Section 3.4) revised to clarify application of thresholds, including vegetation component.
MM 8		USACE asked about using a range of frequency exceedance (p25, p75) for comparisons of baseline and operation period data. They further expressed that the p50 value may be too limiting of seasonal fluctuations. CH2M HILL provided a discussion of the usage of the p50 value through the MFL establishment. CH2M HILL agreed to consider other frequency exceedance values for comparisons.	The p50 value incorporates the range of p-values, including p25 and p75. As a single value it is a useful metric for evaluating overall trends and for use as a management threshold. In addition, use of the p50 helps to "buffer" the effects of using a relatively short baseline period.
MM 9a		USEPA asked for clarification about how and when the comparisons of the p50 values will be made between baseline and operation periods, and asked if each year's p50 value becomes fixed for comparison. CH2M HILL provided clarification that the threshold comparisons between the operational and baseline periods are made on a quarterly basis. Actions then follow the decision flow chart.	No resolution required.

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Number	Location in Draft	Comment	Resolution
MM 9b		USACE requested that potential wetland monitoring transect locations be randomized as much as possible to capture a range of conditions within the study area. CH2M HILL responded by agreeing that transect locations could be randomized to the extent possible prior to final field verification.	See resolution to Comment 7 and associated EMP text updates (Section 3.2).
MM 10	p. 15, Section 3.4.2	USACE requested that the term “startup” (page 15, Section 3.4.2) in regards to the baseline period be better defined. CH2MHILL agreed to provide clarification in the text as to when the baseline period ends and the operational period begins.	Text was added to EMP defining baseline period as a minimum of 2 years prior to installation of production wells.
MM 11		USACE asked what specific statistical analyses will be used to investigate trends and correlative relationships in onsite observed hydrological data (i.e., rainfall, wetland stages). CH2M HILL agreed to update text to propose specific analyses.	See resolution to Comment 5 and associated EMP text updates (Section 3.4.4).

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Number	Location in Draft	Comment	Resolution
MM 12		Group indicated the need to separate the ongoing ecological resolution to existing (long-term) hydrologic alteration from potential well field effects. CH2M HILL suggested a preliminary approach that another reference and control wetland could be located outside of well field drawdown but in same zone of property of barge-canal effect for comparison. This might be in the area south of County Road 40 or otherwise located within the southern edge of the property.	See resolution to Comment 7. In general, the possible incremental effect of water table drawdown on wetlands within the LNP site in addition to existing drying trends will be assessed through monitoring of successional patterns at sites within and external to the modeled drawdown areas. By comparison of trends, it will be possible to assign impacts, if any occur. The addition of a monitoring well south of County Road 40 will be investigated prior to the baseline period, and will depend upon availability of suitable wetland sites (See EMP Section 3.2). The additional well would be located between the southernmost well, and the CFBC, with the expectation that the condition of the site is responding only to the regional low water trend. This site would be located outside the projected 0.5-foot drawdown contour around each well. Changes in the WAI, WAP, and vegetative cover composition would be measured as part of the routine ecological monitoring, and the average change in these values would be statistically compared to the average changes determined at the near-field wetland monitoring sites, as well as the far-field and background wetlands. Comparisons will be structured as tests of hypotheses governing the expected changes. For example, the null hypothesis is assumed to be that there is no statistically significant change in WAI, WAP score, or indicative plant species composition between locations. The difference in monitoring parameter values (WAI, WAP score, percent species composition) from baseline for the CFBC and far-field stations will characterize the regional background trend. These differences can then be compared to the near-field stations. If not significantly different, the impact of the water level drawdown can be inferred to be less than that attributed to the existing drawdown effect. If the difference is statistically significant, the relative difference and direction of change will be indicative of the ecological response in the wetland.

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Number	Location in Draft	Comment	Resolution
MM 13		Group asked that examples of how the p50 method and WAP monitoring has been used for well field monitoring elsewhere be provided. CH2MHILL and PEF agreed to provide background resources on this topic.	Background resources and examples are provided in the EMP (Section 3.3.6) and in Appendices A-C in this supporting document.
MM 14		Group asked for the background resources on basis of selection for the preliminary p50 threshold values for the EMP. CH2MHILL and PEF agreed to provide background resources on this topic.	Background resources and examples are provided in the EMP (Section 3.3.6) and in Appendices A-C in this supporting document.
MM 15		On "adaptive management" the USEPA asked to better describe the "transition" process and steps for implementing the alternative water supply, should the threshold be triggered. CH2M HILL agreed to update the EMP to provide additional text describing this topic.	Section 4.0 has been updated to describe the transition process should the threshold be triggered.
MM 16	p. 25	USEPA requested that PEF "tier" the proposed management strategies on EMP page 25 to show more clearly which would be implemented first. For example: Tier 1 – Strategies 1-3; Tier 2 – Strategies 4 & 5; and Tier 3 -Strategy 6. The USACE also want an idea of how long some of these strategies may take to implement. For example, if we determine that a well needs to be abandoned and a new one drilled, how long would it take to modify the Water Use Permit (WUP) and bring the well into production? CH2M HILL agreed to update the EMP to provide additional clarity.	The general sequence of proposed management strategies is provided in Section 4.0. The specific management strategies will be determined when/if a threshold is reached, and considering water use at that time and pumpage patterns for the well associated with that monitoring transect.
MM 17		USACE recommended that the EMP be made as defensible as possible by fortifying it with references to research (ex. Water Management Districts and USGS) as to wetland drawdown effects and thresholds and citations to sources be readily provided. CH2M HILL agreed to provide additional references, citations, and examples.	Background resources and examples are provided in the EMP (Section 3.3.6) and in Appendices A-C in this supporting document.

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Number	Location in Draft	Comment	Resolution
CH2M HILL TMEM 135: Levy Nuclear Plant Well Field Aquifer Performance Testing Plan			
Comments from Engineering Division			
a	Page 8, Section 1.2.1, Paragraph b	Statement is made, "If required, all groundwater modeling and a full report, meeting District modeling guidelines, shall be submitted….." Can it be assumed that the groundwater modeling and a full report will be required if any of the transmissivity or leakance values derived from either the step-drawdown or multi-well constant-rate tests differ significantly (more than 20 percent higher or lower) from the values used in the groundwater flow model submitted as part of Licensee's application? Attempting to clarify if the phrase "If required" is a hard and fast requirement of the COC based on the outcome of the APT's, or does "If required" imply based on the discretion of the SWFWMD?	As stated in the COC's, If any of the transmissivity or leakance values derived from either the step-drawdown or the multi-well constant-rate tests referenced in Section C…differ significantly from the value use in the model….the Licensee will revise the model. Therefore, any test results from the production wells could trigger the re-modeling effort. Our understanding is that the "if required" statement becomes a requirement if the field data vary significantly requiring re-modeling, then the modeling and report shall meet District guidelines, etc.
b	Page 16, Section 3.2	Multiple-Well Constant-Rate Pumping Test. Statement is made, "As required by COC C.II.A.4a, constant-rate aquifer tests will be performed on production wells PW-3 and PW-4 for the LNP." Is the protocol to conduct APT on both PW-3 and PW-4 (pumping at approximately 1,200 gpm) concurrently, or will the two production wells be APT'd consecutively with the necessary background, pumping and recovery phases between each? If the wells are to be APT'd consecutively, and since there is the operational intent to eventually utilize each of the four production wells (assuming they have adequate capacity), we recommend that the APT protocol for the constant-rate pumping test likewise be conducted on all four production wells. We believe that in order to assess the potential impacts from aquifer pumping on adjacent wetland levels, the water levels obtained from staff gauges and shallow wetland piezometers in the select monitored wetlands near the APT sites should be collected and evaluated for the background, pumping and recovery periods of each APT.	Each of the two constant rate APT tests will be run consecutively (one after the other) with the same duration of background and recovery data collected for each test. The monitoring data from the adjacent wetlands to each tested well will be obtained for the same duration of background and recovery. We do not believe it is necessary to run four constant rate tests for the following reasons: • The two test locations (PW-3 and PW-4) were selected to best represent the expected range of aquifer conditions since the groundwater model transmissivity increases from north to south. • Water Use Permits typically don't require multiple long term constant rate test on all wells in a well field, only representative wells as is planned for LNP • Step drawdown tests will be run on all of the production wells which will provide adequate aquifer characteristics. If the two constant rate APT tests confirm the model assumptions, this will demonstrate that the unrecalibrated model can be relied upon as a good predictor of drawdown and that the monitoring described in the EMP is a reasonable approach to confirming operating conditions.