



## Tech Memo Approval Form

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# Levy Nuclear Plant Well Field Aquifer Performance Testing Plan

Prepared for

**Progress Energy Florida**

Prepared by



May 2012

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# Acronyms and Abbreviations

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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

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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.

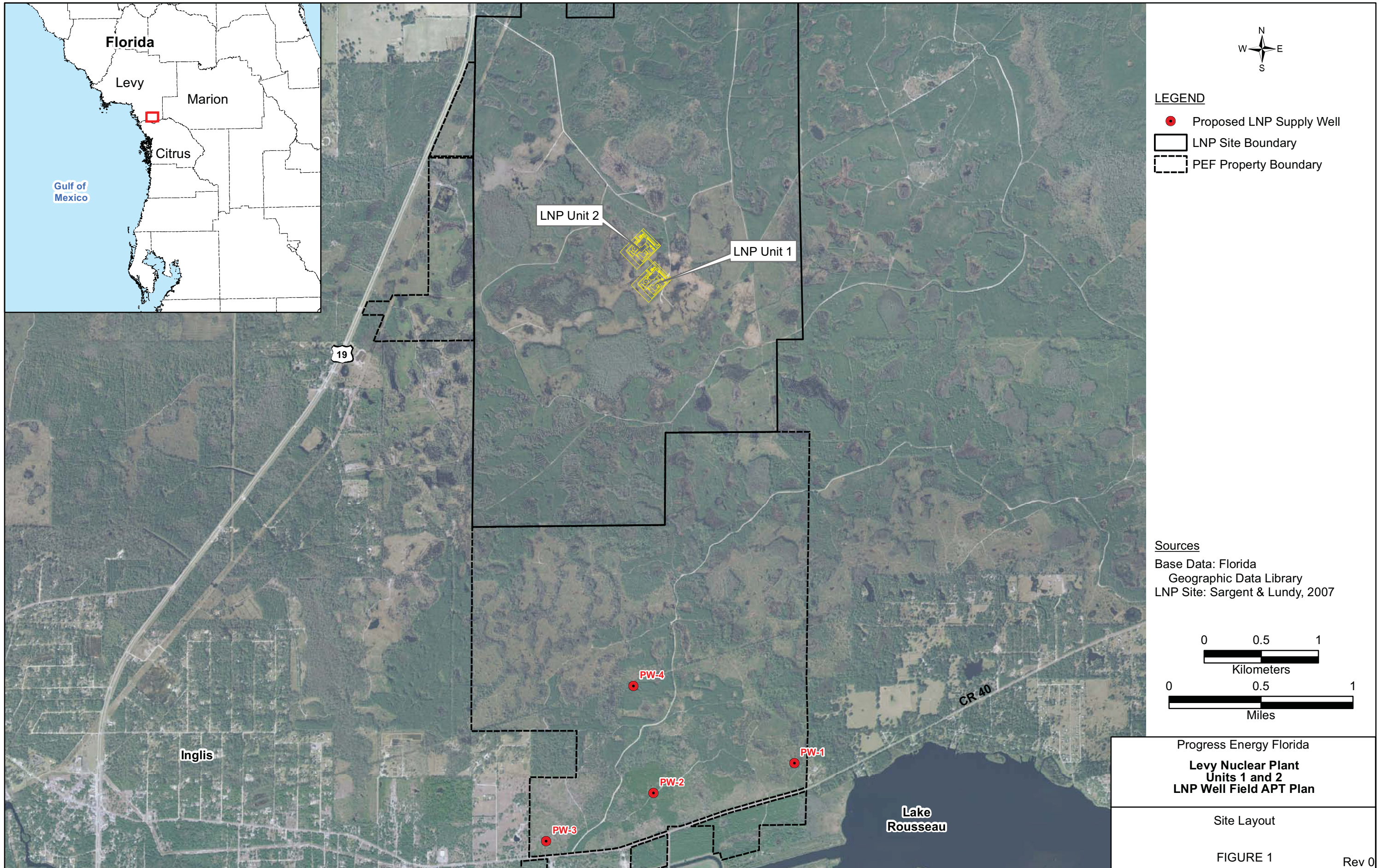
## 1.1 Purpose

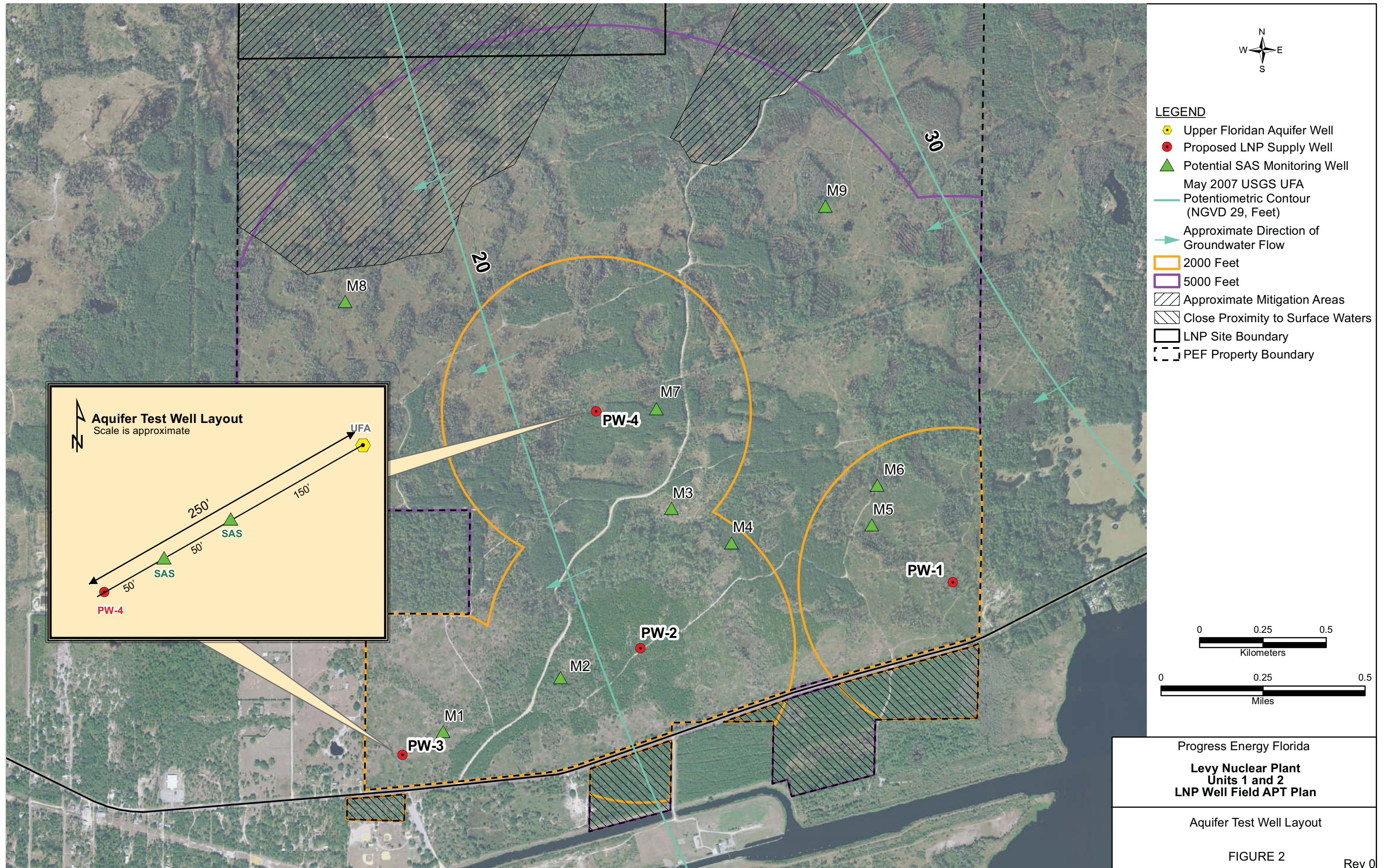
This APT Plan is intended to address the specific requirements presented in COC Section C.II.A.4 to describe the field-testing for four production wells to be installed in the Floridan aquifer, and compare the field-testing results with previously submitted numerical modeling simulations of groundwater 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.





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

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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.

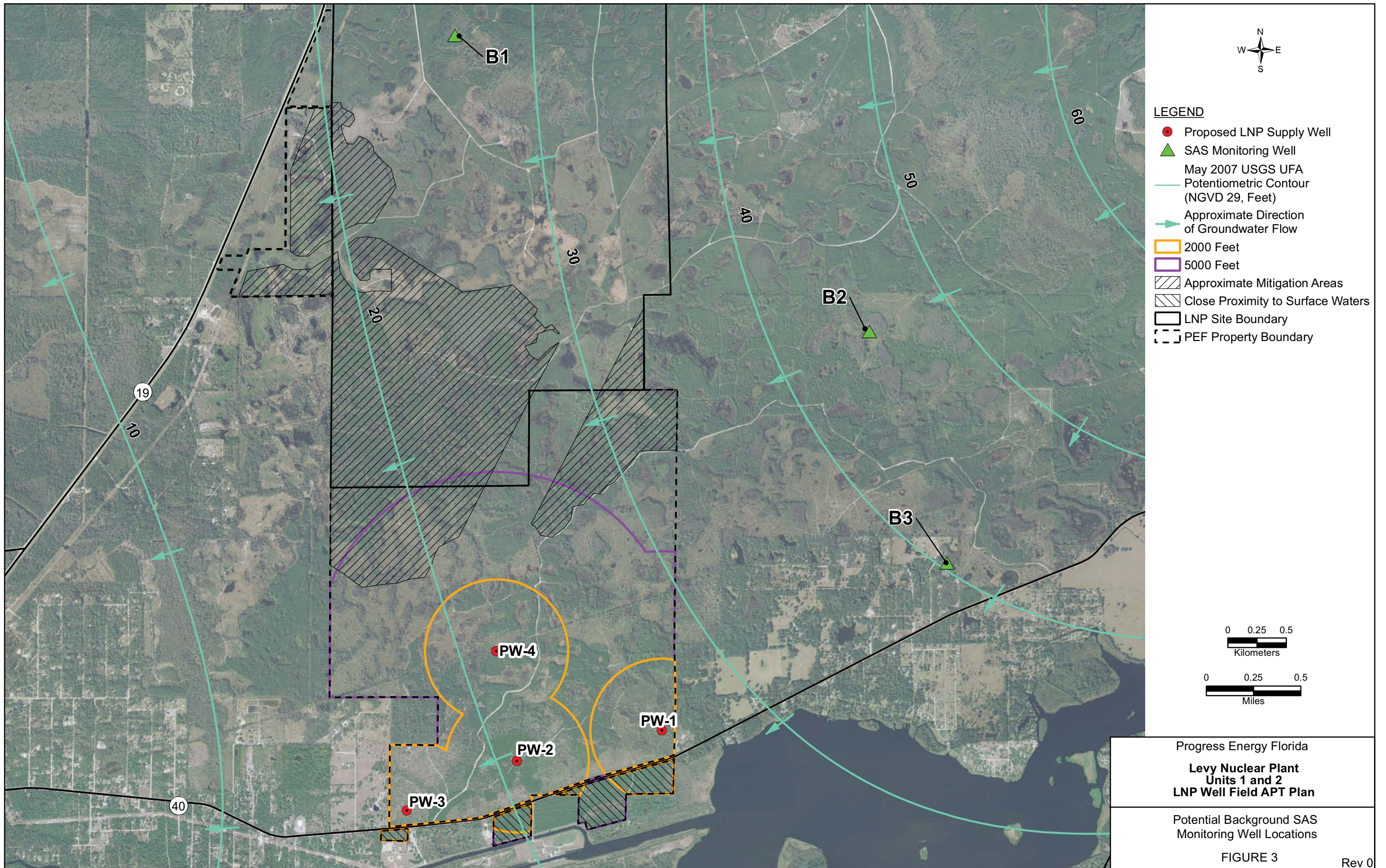
The SAS observation wells will be screened below the water table present at the time of installation to a depth estimated to be 20 to 30 feet bgs based on boring logs from the site. To the extent possible, the well screen will be positioned such that seasonal variations in water level will not result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

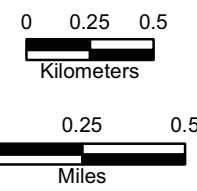
Additional wetland monitoring SAS wells will be installed in accordance with the approved LNP EMP as required by COC Section C.II.A.2 (as modified on January 25, 2011). One SAS monitoring well will be installed at each of the twelve monitoring transects. The SAS well will be located outside of the wetland 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.



- LEGEND**
- Proposed LNP Supply Well
  - ▲ SAS Monitoring Well
  - May 2007 USGS UFA Potentiometric Contour (NGVD 29, Feet)
  - Approximate Direction of Groundwater Flow
  - 2000 Feet
  - 5000 Feet
  - ▨ Approximate Mitigation Areas
  - ▩ Close Proximity to Surface Waters
  - ▭ LNP Site Boundary
  - - - PEF Property Boundary



Progress Energy Florida  
**Levy Nuclear Plant  
 Units 1 and 2  
 LNP Well Field APT Plan**

Potential Background SAS  
 Monitoring Well Locations

FIGURE 3

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## 3.0 Aquifer Testing Procedures

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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

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## 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**

<b>Test Well ID</b>	<b>Observation Well ID</b>	<b>Well Use</b>	<b>Aquifer Zone</b>
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-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

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## 5.1 Single-Well Step-Drawdown Test

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 transmissivity 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

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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

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