**June 26, 2012**

**UNITED STATES OF AMERICA**
**NUCLEAR REGULATORY COMMISSION**

Before the Atomic Safety and Licensing Board

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| In the Matter of | ) | |
| | ) | Docket Nos. 52-029-COL |
| Progress Energy Florida, Inc. | ) | 52-030-COL |
| | ) | |
| (Combined License Application for | ) | |
| Levy County Nuclear Plant, Units 1 and 2) | ) | ASLBP No. 09-879-04-COL |

PRE-FILED DIRECT TESTIMONY OF
JEFFREY D. LEHNEN, P.G.
ON COMPUTER MODELING OF THE EFFECTS ON LOCAL AND REGIONAL WATER RESOURCES FROM ACTIVE GROUNDWATER WITHDRAWALS DURING CONSTRUCTION AND OPERATION OF THE LEVY NUCLEAR PLANT, UNITS 1 & 2

## I. BACKGROUND –WITNESS

Q1: Please state your name and business address.

A1. My name is Jeffrey D. Lehnen. My business address is 3011 S.W. Williston Road, Gainesville, Florida 32608.

Q2: Please state your employer and position.

A2: I am a Senior Hydrogeologist with CH2M HILL, Inc., an engineering consulting company, engaged by Progress Energy Florida, Inc. (Progress) in support of the permitting, site certification, and licensing of Progress's Levy Nuclear Plant, Units 1 and 2 (LNP).[1] CH2M HILL provides environmental, engineering, design, construction, management, and infrastructure services to government, industry, and municipal clients throughout the United States and around the world. As a Senior Hydrogeologist, I provide technical expertise on a variety of water resource evaluation and planning issues associated with existing and proposed water use development projects throughout

[1] PEF201 defines select acronyms used in my testimony as a convenient reference.

Florida, including project water use calculation and estimation; water resource (including groundwater and wetland) management and protection; wellfield development, operation, and rehabilitation; water quality evaluation; water resource (including groundwater) modeling and interpretation; and wastewater treatment and disposal.

Q3: Please describe your professional qualifications and experience.

A3: My professional and educational experience is summarized in the curriculum vitae provided in PEF202. I hold a Bachelor of Science in Geology from the University of Florida, Gainesville. I am licensed by the State of Florida as a Professional Geologist, P.G. 447.

I have over 34 years of research and practical experience in hydrogeology and water resource evaluation and planning in Florida, during which time I have developed considerable experience in the design, permitting, site certification, and construction of water use development projects throughout Florida, including the counties surrounding the LNP site. I have performed a variety of tasks in support of the water use permitting and site certification of water use development projects in the State of Florida, including compiling historical water-level and use data, conducting water quality evaluations, and performing future use and trend analysis. I am experienced in the methodology generally employed by hydrogeologists in identifying and evaluating the direct, indirect, and cumulative effects on local and regional water resources (including groundwater, wetlands, springs, lakes, and surface waters) from water use associated with development projects in Florida. In particular, I am experienced in the design, application, refinement/calibration, and interpretation of computer models simulating the effects on water resources from proposed groundwater withdrawals (groundwater modeling) associated with development projects.

I am knowledgeable of the hydrogeology and characteristics of the Upper Floridan Aquifer and groundwater resources in the vicinity of the LNP site from my work in connection with Upper Floridan Aquifer supply and monitoring wells (similar to those planned for the LNP wellfield) in the counties surrounding the LNP site. I have also been involved in the development and management of aquifer storage and recovery projects on behalf of water management districts (specifically, the South Florida Water Management and Saint John's River Water Management Districts) adjacent to the Southwest Florida Water Management District (SWFWMD) in which the LNP site is located.

Q4: What is the purpose of your testimony?

A4: The purpose of my testimony is to address those elements of Contention 4A, as admitted by the Nuclear Regulatory Commission's (NRC) Atomic Safety and Licensing Board in the combined licensing proceeding for the LNP, pertaining to the computer modeling of the effects on local and regional water resources from active groundwater withdrawals during construction and operation of the LNP. These elements include Contention 4A, Part A, Items 1-3.

Q5: Are you knowledgeable of the matters related to Contention 4A, Part A, Items 1-3?

A5: Yes. I am knowledgeable of the technical issues raised by Contention 4A, Part A, Items 1-3 relating to the hydrogeology of the LNP site and the surrounding area, as well as those related to the computer modeling of the effects on water resources from active groundwater withdrawal during construction and operation of the LNP. As noted earlier, I have the benefit of over three decades of research and practical experience in hydrogeology and water resource evaluation and planning in the vicinity of the LNP site and other parts of Florida, in which time I have acquired considerable expertise in the design, application, refinement/calibration, and interpretation of groundwater models.

My responsibilities in connection with earlier projects in counties neighboring Levy County (where the LNP site is located) required me to be knowledgeable of the representative hydrogeological characteristics of the area in the vicinity of the LNP site. In Marion County (adjacent to Levy County to the east), I was involved in wellfield capacity evaluations, as well as production well drilling and testing, of Upper Floridan Aquifer wells in both the City of Ocala and The Villages wellfields. In Pasco County (roughly 40 miles to the south of the LNP site), I performed numerous geophysical logs on Upper Floridan Aquifer public water supply wellfields evaluating producing zones, confining beds and well completion details. In Alachua County (adjacent to Levy County to the north), I led the development of a groundwater flow model designed to address the impacts of groundwater drawdown (a reduction in water-level) within the Upper Floridan Aquifer on the surficial aquifer and wetlands in the vicinity of the wellfield for the Gainesville Regional Utilities' Murphree Water Treatment Plant.

I have also acquired knowledge relating to the hydrogeological characteristics of the LNP site and the surrounding area in connection with my work on the LNP project. I have studied relevant peer-reviewed literature on the hydrogeological characteristics of the Upper Floridan Aquifer generally, as well as in the vicinity of the LNP site. I have also reviewed the results of groundwater modeling used in simulating the effects on local and regional water resources from proposed groundwater withdrawals in the area surrounding the LNP site. I have studied site-specific field data on the hydrogeological characteristics of the LNP site, including data obtained from 118 boreholes drilled at the site in 2006-2007. I have consulted with officials from the Florida agency responsible for water use permitting (the SWFWMD) in the vicinity of the LNP site, as well as officials of the Florida Geological Survey (FGS) and U.S. Geological Survey (USGS) regarding the hydrogeology of the LNP site and surrounding area. I have examined the parameters and assumptions employed in the groundwater models used in connection with Florida water use permitting and site certification for the LNP, as well as the NRC combined license application for the LNP. Lastly, I have studied the pertinent sections of Progress's Environmental Report (ER) and Final Safety Analysis Report (FSAR) for the

LNP, and the NRC's Draft Environmental Impact Statement (DEIS), and Final Environmental Impact Statement (FEIS) for the LNP.

Q6: What is your understanding of the technical issues raised by Contention 4A, Part A, Items 1-3?

A6: I understand that Contention 4A, Part A, Items 1-3 raise the following issues with respect to active groundwater withdrawals during construction and operation of the LNP: (i) whether groundwater modeling performed in connection with the ER prepared by Progress supports that document's conclusion that the direct, indirect, and cumulative environmental impacts associated with constructing and operating the LNP will be SMALL, and (ii) whether the recalibrated groundwater model prepared at the request of the NRC Staff supports the conclusion within the FEIS prepared by the NRC Staff that the direct, indirect, and cumulative environmental impacts associated with constructing and operating the LNP will be SMALL, and in one case SMALL-MODERATE.[2] The Intervenors claim in Contention 4A that LARGE environmental impacts will result from active groundwater withdrawals during construction and operation of the LNP.[3]

Q7: Has your work on the LNP project been relevant to Contention 4A?

A7: Yes. I was initially retained by Progress in 2006 to serve as the Task Leader for Freshwater Supply for the Site Certification Application (SCA) that Progress submitted to the State of Florida. I have also assisted Progress in preparing responses to Requests for Additional Information (RAI) issued by the NRC in connection with the LNP project, and I have worked with Progress in responding to the allegations in Contention 4A.

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[2] "SMALL" is defined by the NRC as meaning "Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource." "MODERATE" is defined by the NRC as meaning "Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource." FEIS, NRC001 at p. 1-3.

[3] "LARGE" is defined by the NRC as meaning "Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource." NRC001 at p. 1-4.

In my capacity as Task Leader for Freshwater Supply for the SCA, I was responsible for identifying, evaluating, and documenting the direct, indirect, and cumulative effects on local and regional water resources arising from the LNP's groundwater withdrawals in connection with State (SWFWMD and Florida Department of Environmental Protection) and Federal (U.S. Army Corps of Engineers (USACE) and NRC) permitting, site certification, and licensing processes. In connection with these responsibilities, I reviewed and interpreted site-specific field data on the hydrogeological characteristics of the LNP site and communicated with State and Federal authorities (in particular, the SWFWMD) to obtain information regarding the hydrogeological characteristics of the LNP site and the surrounding area. I supervised groundwater modeling simulating the effect on local and regional water resources from the LNP's withdrawal of groundwater at annual average daily and maximum week pumping rates (the ER Model). I was responsible for overseeing and interpreting the results of the ER Model used in connection with Progress's SWFWMD Water Use Permit (WUP) and State site certification, USACE permit application, and the ER.

I helped prepare Progress's written responses to the NRC's RAIs regarding the effects on local and regional water resources from active groundwater withdrawals by the LNP, including communicating with the NRC Staff during its evaluation of the results of groundwater modeling conducted in connection with Progress's ER. Lastly, I supervised CH2M HILL's recalibration of the ER Model performed at the request of the NRC Staff (the Recalibrated Model).

## II. OVERVIEW

Q8: What will your testimony address specifically?

A8: I will describe the characteristic hydrogeology of the LNP site and the surrounding area, to include how these features affect the hydrological characteristics of the area. I will compare the anticipated active groundwater withdrawal rates associated with construction and operation of the LNP against the (modeled) regional flow through the Upper Floridan Aquifer. I will describe how hydrogeologists use groundwater modeling — in particular, the District Wide Regulation Model Version 2 (DWRM2) — in their evaluation of the effects of proposed groundwater withdrawals on local and regional water resources within the SWFWMD. I will describe how CH2M HILL extracted the ER Model from the DWRM2 regional model and obtained realistic predictions of drawdown and regional flowrates through the Upper Floridan Aquifer as a result of active groundwater withdrawals during construction and operation of the LNP. I will also discuss how the subsequent recalibration of the ER Model performed by CH2M HILL at the request of the NRC Staff resulted in less realistic predictions than the ER Model for drawdown and regional aquifer flowrates from construction and operation of the LNP. Lastly, despite these differences in the drawdown and regional aquifer flowrate values obtained from the ER Model and the Recalibrated Model, my testimony will demonstrate that the groundwater modeling efforts performed by CH2M HILL for Progress and the NRC Staff support the conclusions in the ER and FEIS regarding the direct, indirect, and cumulative environmental impacts resulting from active groundwater withdrawals during construction and operation of the LNP.

## III. HYDROGEOLOGY OF THE LNP SITE AND THE SURROUNDING AREA

Q9: Please define the term hydrogeology.

A9: Hydrogeology is the study of the occurrence and movement of groundwater, both within the complex subsurface environment as well as to and from hydrologically-connected surface waters. Hydrogeology is an interdisciplinary subject integrating geology, hydrology (the science encompassing the behavior of water as it occurs in the atmosphere, on the land surface, and underground), hydrostratigraphy (the delineation of a body of rock into more or less permeable units to aid in the understanding of a flow system), chemistry, physics, mathematics, and engineering.

Q10: Please describe the basis of your knowledge of the geology of the LNP site and the surrounding area.

A10: As explained in greater detail earlier, I am knowledgeable of the geology of the LNP site and the surrounding area as a result of my work in water resource evaluation and planning in connection with a variety of projects in adjacent counties, as well as my activities in support of the permitting, site certification, and licensing of the LNP.

Q11: Please describe the geology of the LNP site and the surrounding area.

A11: The LNP site is located within the Limestone Shelf and Hammocks subzone in the Gulf Coastal Lowlands province, a limestone plain overlain by silty, fine-sand dunes, ridges, and coast-parallel sand belts and clay. NRC001, Fig. 2-30 at p. 2-178. Geological data obtained from the Robinson No. 1 Well (an old oil well 1,650 feet north of the LNP site property line) and a series of 118 bore holes drilled at the LNP site identified an average 30 feet-deep layer of sand and clay deposits overlying what is known as the Avon Park Formation, a rock formation whose top 100 feet consist of limestone before grading into harder dolomite (rock composed of calcium and magnesium carbonate that is less susceptible to dissolution than ordinary limestone) at greater depths. General Hydrogeology of LNP Site, Levy County, PEF203. Unlike some of the counties in the region, the area in the vicinity of the LNP site does not overlie the clay and silt of the Hawthorn Group or the relatively easily-dissolved limestone and phosphate deposits within the Suwannee and Ocala Formations. FSAR Fig. 2.5.1-217, PEF204; FSAR Fig. 2.4.12-202, PEF205.

Q12: Please define the term karst.

A12: The term karst refers to terrain in which the topography is chiefly formed by the dissolution of soluble rock (particularly limestone). Karstic terrain is highly permeable as a result of the network of interconnected fissures, fractures and conduits formed in a relatively low-permeability rock formation. These features facilitate groundwater flow and transport, resulting in highly permeable aquifers. Because permeability is a measure of a geologic formation's ability to transmit water throughout an aquifer, high permeability results in high capacity aquifers capable of yielding large quantities of water with very little drawdown.

Q13: Please describe karst (and the potential for development of karst) at the LNP site and in the surrounding area.

A13: As described in greater detail in the FSAR prepared by Progress, the LNP site and surrounding area represent a mature karst terrain overlain by a thin (30 feet to 40 feet) mantle of permeable sand and silt deposits. FSAR, PEF 206 at p. 2.5-4; FSAR Fig. 2.5.1-237, PEF207. The LNP site and the surrounding area exhibit characteristics — including circular and irregularly-shaped, shallow depressions of varying size, as well as relatively high hydraulic conductivity (a measure of the ease with which water can move through the pore spaces or fractures within a geologic formation) — consistent with ancient karst phenomena resulting from the coalescing of smaller, shallow depressions. PEF207. This mature, mantled (by sand and silt) karst terrain tends to inhibit the development of new karst phenomena as the mantle of sand and silt fills in any voids that develop below. FSAR Fig. 2.5.1-239, PEF208. Additionally, the geological characteristics of the LNP site and the surrounding area — specifically, the presence of the highly-dolomitized Avon Park Formation, and the absence of the relatively soluble limestone and phosphate stone of the Hawthorn Group and the Suwannee and Ocala Formations — make the LNP site and the surrounding area particularly resistant to the future development of karst phenomena. PEF205. Neither Progress's review of public and proprietary sinkhole databases, nor its LNP site characterization activities revealed active sinkholes at the LNP site. PEF206 at p. 2.5-4.

Q14: Please describe the basis of your knowledge of the hydrogeology of the LNP site and the surrounding area.

A14: I am knowledgeable of the hydrogeology of Levy County and the surrounding area as a result of my work in water resource evaluation and planning in connection with a variety of projects in adjacent counties, as well as my activities in support of the permitting, site certification, and licensing of the LNP, as described in greater detail above.

Q15: Please describe the hydrostratigraphy of the LNP site and the surrounding area.

A15: The hydrostratigraphy of the area surrounding the LNP is characterized by two aquifers: the surficial aquifer (the shallow water table) and the Upper Floridan Aquifer. The surficial aquifer is composed of unconsolidated sandy sediments with an average thickness of 30 feet to 40 feet. The underlying Upper Floridan Aquifer is composed of limestone and dolomite of the Avon Park Formation. Although the surficial aquifer in other parts of west-central Florida is separated from the Upper Floridan Aquifer by semi-confining beds, the surficial aquifer lies directly over the Upper Floridan Aquifer in the vicinity of the LNP site. PEF203. With no semi-confining beds, there is a good hydraulic connection between the surficial aquifer and Upper Floridan Aquifer resulting in similar water-levels and similar drawdown between the two aquifers when pumping from the Upper Floridan Aquifer. The surficial aquifer in the vicinity of the LNP site contains freshwater and occurs from 1 foot to 5 feet below land surface to a depth of approximately 30 feet to 40 feet below land surface. The Upper Floridan Aquifer is directly underneath the surficial aquifer, is reported to be approximately 500 feet to 800 feet-thick in the vicinity of the LNP site, and contains a number of cavities, fractures, and solution channels allowing the flow of groundwater within the limestone and dolomite of the Avon Park Formation. The Upper Floridan Aquifer is hydraulically separated from the more saline Lower Floridan Aquifer by low-permeability rock.

Q16: How does the hydrostratigraphy at the LNP site and the surrounding area affect the hydrological characteristics of these locations?

A16: As I explain below, the characteristic hydrostratigraphy of the LNP site and the surrounding area contributes to (i) the high hydraulic conductivity and transmissivity (the product of hydraulic conductivity and the thickness of the aquifer) of the Upper Floridan Aquifer; (ii) a high rate of recharge (replenishment of drawn groundwater) over a wide area; and (iii) abundant groundwater resources in the area.

Q17: Please explain how the characteristic hydrostratigraphy at the LNP site and the surrounding area results in high hydraulic conductivity and transmissivity.

A17: The Upper Floridan Aquifer in the vicinity of the LNP site is characterized by the occurrence of ancient cavities, fractures, and solution channels within the limestone and dolomite of the Avon Park Formation. The ability of groundwater to flow easily through these permeable features results in high hydraulic conductivity of the Upper Floridan Aquifer in the vicinity of the LNP site. The characteristically high hydraulic conductivity of the area surrounding the LNP site in turn results in the high transmissivity of the Upper Floridan Aquifer in the vicinity of the LNP site.

Q18: Please explain the significance of the high transmissivity in the vicinity of the LNP site.

A18: Aquifer transmissivity is important in the identification and evaluation of the impacts on water resources because it affects the amount of drawdown in water-levels at a given pumping rate. High transmissivity means that water moves relatively freely through an aquifer; consequently, there is very little change in water-levels around an operating well during pumping. As water is withdrawn from a well, there is a minimal amount of change to water-levels in the groundwater system and hydrologically-connected systems such as wetlands, rivers, springs, and lakes. If the area of the water resources affected by the active withdrawal is small, the direct, indirect, and cumulative effects on local and regional water resources are also small.

Q19: Please explain how the characteristic hydrostratigraphy at the LNP site and the surrounding area results in a high rate of recharge over a wide area.

A19: As noted earlier, the Upper Floridan Aquifer is largely unconfined in the vicinity of the LNP site because it is hydraulically connected to the surficial aquifer. Because recharge to the Upper Floridan Aquifer occurs in areas where the soil and rock separating the surface and Upper Floridan Aquifers are absent or thin, virtually the entire area in the vicinity of the LNP site — as well as portions of adjacent Alachua, Citrus, and Marion Counties exhibiting a similar hydrostratigraphy — serves as a recharge area for the Upper Floridan Aquifer. Moreover, because the LNP site and the surrounding area are characterized by a high degree of transmissivity arising from the ancient cavities, fractures, and solution channels within the Avon Park Formation, recharge in one portion of the area surrounding the LNP site effectively recharges the Upper Floridan Aquifer throughout a much larger area.

Q20: Please explain how the hydrostratigraphy at the LNP site and the surrounding area results in abundant groundwater resources in the area.

A20: The Upper Floridan Aquifer forms a vast reservoir of freshwater that allows the area in the vicinity of the LNP site to accommodate withdrawals without detrimental impacts to local and regional water resources. In the area in which the LNP site is located, the Upper Floridan Aquifer is characterized by high permeability and direct recharge from rainfall over a large area, resulting in abundant groundwater resources. The abundant resources of the Upper Floridan Aquifer in the vicinity of the LNP site are evinced by an average discharge of over 1 billion gallons per day (gpd) from three first-magnitude springs — 493 million gallons per day (mgd) from the Rainbow Springs (10.5 miles east of the site), 630 mgd from the Kings Bay Springs group (11 miles south of the site), and 68 mgd from the Homosassa Springs (17 miles south of the site) — in the area. FGS

Bulletin No.66: Springs of Florida, PEF209 at pp. 61-66, 232-36.[4] This magnitude of flow is consistent with an aquifer system characterized by high permeability and direct recharge from rainfall over a large area.

Existing groundwater withdrawals in the area are minor compared to the total volume of flow through the Upper Floridan Aquifer in the region. Permitted groundwater uses amount to roughly 6.1 mgd within the 20 mile x 20 mile domain of the ER Model, compared to the 450 mgd regional aquifer flowrate obtained from the ER Model through the same area. TMEM-074, PEF212 at pp.13-14; RAI 5.2.2-3I Fig. 8, PEF211.[5]

## IV. EXISTING AND PROPOSED GROUNDWATER WITHDRAWALS (LNP AND OTHERS)

Q21: Please describe the design of the wellfield to be used during operation of the LNP.

A21: The operational water supply source for the LNP will be four Upper Floridan Aquifer production wells located in the property owned by Progress to the south of the LNP site. TMEM-123, PEF210 at p. 17. This location was selected to take advantage of the high transmissivity of the Upper Floridan Aquifer and minimize environmental impacts to wetlands. PEF212 at pp. 2-4. The four production wells will be located a minimum of 2,500 feet from each other to minimize groundwater drawdown around each well. Although each production well will be capable of pumping 1,100 gallons per minute (gpm), in practice the production wells will be operated on a rotating, daily basis (one well per day) such that the annual average daily pumping rate for each well will be 275 gpm.

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4 Because of the length (more than 650 pages) of FGS Bulletin 66, PEF209 consists of only the relevant excerpts of this document, specifically its introduction and sections pertaining to the springs discussed in this testimony.

5 Compared to the modeled regional aquifer flowrate of 208 mgd obtained from the Recalibrated Model created at the request of the NRC Staff, the total permitted groundwater use in the model domain still represents only a small fraction of the modeled flow through the Upper Floridan Aquifer in the same area. PEF210 at p. 17.

Q22: Please describe the rate of groundwater withdrawal from the wellfield on an annual average day during operation of the LNP.

A22: Based upon calculations performed by Westinghouse (the manufacturer of the AP1000 reactor planned for use at LNP), on an annual average day, the wellfield will need to supply approximately 1.26 mgd of groundwater. NRC001, Fig. 3-8 at p. 3-27. This groundwater will be used for the potable water, demineralizer, service tower makeup, and fire protection systems associated with the simultaneous operation of the two reactors at the LNP. Although Westinghouse's figure of 1.26 mgd represents the actual freshwater demand of the LNP during operation, this figure was adjusted upwards to include a 25% contingency for the purposes of environmental impact assessment during the Florida and Federal permitting, site certification, and licensing of the LNP. As a result, the groundwater modeling assumes a conservatively high figure for the annual average pumping day of 1.58 mgd.

Q23: Please describe the rate of groundwater withdrawal from the wellfield in a maximum pumping week during operation of the LNP.

A23: Calculations performed by Westinghouse estimate that, during an annual week-long maintenance period during which both reactors at the site could be shutdown, the LNP's maximum groundwater demands could rise to an aggregate 5.8 mgd. NRC001, Fig. 3-8 at p. 3-27. This value, however, is inherently conservative. Although both units at the LNP could theoretically be shut down during an annual week-long maintenance period, this scenario is unlikely; Progress would generally stagger each reactor's maintenance period to ensure continuity of power generation, thus placing less demand on the facility's freshwater systems. Additionally, this figure assumes a number of other worst-case conditions — maximum cool down demand on the service cooling tower by each reactor, continued use of the demineralizer system by both reactors, and a fire that requires the maximum pumping flow of 1,250 gpm required to replenish the fire water storage tanks associated with each reactor — that are unlikely to occur simultaneously (if at all).

Q24: How does the rate of groundwater withdrawn from the wellfield on an annual average pumping day or a maximum pumping week compare to total groundwater flow through the Upper Floridan Aquifer in the vicinity of the LNP site?

A24: The rate of groundwater withdrawal from the wellfield on an annual average pumping day or a maximum pumping week is small compared to the regional flow within the Upper Floridan Aquifer. Based on the ER Model, flow through a small portion of the Upper Floridan Aquifer system — in particular, the 20 mile x 20 mile portion of the Upper Floridan Aquifer in the vicinity of the LNP site — is estimated to be 450 mgd. PEF211. Compared to this regional Upper Floridan Aquifer flowrate, the groundwater withdrawal rate from the wellfield on an annual average pumping day or a maximum pumping week is small — roughly 0.35% and 1.3%, respectively.[6] For that reason, the direct, indirect, and cumulative effects on local and regional water resources from active groundwater withdrawals during operation of the LNP are SMALL.

Q25: Please describe the quantity of water expected to be pumped in support of construction activities associated with the LNP.

A25: Progress anticipates that construction activities at the LNP site will require much less freshwater than that required for facility operation; construction activities at the site will require an annual average withdrawal rate of 0.275 mgd and a maximum withdrawal rate of 0.550 mgd. NRC001 at p. 3-21. These figures represent roughly 0.06% and 0.12%, respectively, of the 450 mgd regional flow through the Upper Floridan Aquifer obtained

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[6] Compared to the modeled regional aquifer flowrate of 208 mgd obtained from the Recalibrated Model created at the request of the NRC Staff, the withdrawal rates associated with an annual average pumping day and maximum pumping week for the LNP still represent only a small fraction — 0.76% and 2.8%, respectively — of the modeled flow through the Upper Floridan Aquifer. PEF210 at p. 33.

from the ER Model.[7] Additionally, individual construction-related groundwater withdrawals will be of limited duration and involve relatively small pumping rates; any drawdown from construction-related withdrawals would be limited in terms of its area and duration such that the normal fluctuation in the water-levels of nearby wetlands would not be affected. Lastly, as explained in the Pre-Filed Direct Testimony of Mitchell L. Griffin, Ph.D., much of the groundwater withdrawals associated with construction will be recharged to the aquifer. PEF001. For those reasons, the direct, indirect, and cumulative impacts on water resources from active groundwater withdrawals during construction of the LNP are SMALL.

Q26: Please quantify existing groundwater withdrawals in the vicinity of the LNP site.

A26: Review of WUP data incorporated by the SWFWMD into its DWRM2 regional groundwater model reveals abundant water resources in the region surrounding the LNP site. The 20 mile x 20 mile section of the DWRM2 used as the groundwater modeling domain in connection with the LNP contains 46 CUPs authorizing the withdrawal (based on reported withdrawals from 2001) of approximately 6.1 mgd from the Upper Floridan Aquifer. PEF212 at pp. 13-14. This figure represents roughly 1.4% of the 450 mgd regional flowrate through the Upper Floridan Aquifer obtained from the ER Model. PEF211.[8] Since the rate of existing groundwater withdrawals in the area surrounding the LNP site has not resulted in discernible detrimental impacts to local water resources, it is expected that the annual average day freshwater withdrawal rate associated with the LNP (representing 0.35% of the regional flowrate through the Upper Floridan Aquifer

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7 Compared to the modeled regional aquifer flowrate of 208 mgd obtained from the Recalibrated Model created at the request of the NRC Staff, the annual average and maximum withdrawal rates associated with construction of the LNP still represent only a small fraction — 0.13% and 0.26%, respectively — of the modeled flow through the Upper Floridan Aquifer. PEF210 at p. 33.

8 Compared to the modeled regional aquifer flowrate of 208 mgd obtained from the Recalibrated Model created at the request of the NRC Staff, the existing withdrawal rates still represent only a small fraction — 2.9% — of the modeled flow through the Upper Floridan Aquifer. PEF210 at p. 33.

obtained from the ER Model) will result in SMALL direct, indirect, and cumulative effects on local and regional water resources.

Q27: Please discuss the significance of anticipated groundwater withdrawals associated with the proposed Tarmac King Road Limestone Mine.

A27: The Tarmac King Road Limestone Mine (Tarmac Mine) is planned for a site approximately 2 miles west of the LNP site (4.5 miles from the nearest LNP production well). Although the Tarmac Mine is expected to use roughly 13 mgd of water during processing, the vast majority of this water is continually recirculated through the mine excavations, resulting in no net groundwater withdrawal except for evaporation and loss of water entrained in the produced rock product. To make up the water lost during processing, the SWFWMD has issued a WUP that allows the Tarmac Mine to withdraw freshwater from the Upper Floridan Aquifer at an average rate of 0.123 mgd and a maximal rate of 0.137 mgd. Tarmac Mine Water Use Permit, PEF213 at pp. 1-2. (This permitted water use figure is much lower than the estimated water use of approximately 1.0 mgd that appeared in the DEIS and was repeated (uncorrected) in the FEIS. DEIS, PEF214 at p. 7-15; NRC001 at p. 4-24.) The Tarmac Mine's permitted withdrawal rates correspond to roughly 0.03% of the 450 mgd regional flow through the Upper Floridan Aquifer obtained from the ER Model. PEF211.[9] Groundwater modeling conducted in support of the Tarmac Mine's SWFWMD WUP yields that these relatively small withdrawals will have a negligible effect on the Upper Floridan Aquifer water-levels in the vicinity of the LNP site. The predicted 0.1 foot drawdown curve associated with the Tarmac Mine withdrawal reaches only a portion of the LNP site. Upper Floridan Aquifer Drawdown from Tarmac Mine, PEF215. Given the relatively small magnitude of the

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[9] Compared to the modeled regional aquifer flowrate of 208 mgd obtained from the Recalibrated Model created at the request of the NRC Staff, the existing withdrawal rates still represent only a small fraction — 0.06% — of the modeled flow through the Upper Floridan Aquifer. PEF210 at p. 33.

additional groundwater withdrawals associated with the Tarmac Mine, operation of that mine should not disturb the conclusions of the ER and FEIS that the direct, indirect, and cumulative impacts on water resources from active dewatering during operation and construction of the LNP will be SMALL. NRC001, Tables 10-1 & 10-2 at pp. 10-5 to 10-12.

## V. GROUNDWATER MODELING

Q28: Please describe the basis of your knowledge in the design, application, refinement/calibration, and interpretation of groundwater models.

A28: As noted earlier, I have acquired considerable experience in the design, application, calibration/refinement, and interpretation of groundwater models over the course of my 34-year career in hydrogeology. I first began using groundwater models in the 1970s when they were relatively simple two-dimensional solutions. As the sophistication of available groundwater models and computing power has increased over time, I have seen groundwater modeling become such an important tool that almost all of my current work in water resource evaluation and planning requires the use of groundwater models.

In these projects, I am typically involved in every step of the modeling process. I am generally responsible for the design and conceptualization of the groundwater model to include the determination of the logical layering, aquifer parameter ranges, boundary conditions, domain, and objectives of the modeling effort. I have performed sensitivity analysis evaluations to determine the model parameters affecting the performance of the model. I have been responsible for identifying and reviewing field data to be used in the calibration of groundwater models, as well as for comparison of model output against the identified calibration targets. I have used models to simulate existing conditions and predict future conditions to evaluate fluid and contaminant migration as well as the relative impact on local and regional water resources from groundwater withdrawal. I have been responsible for refining groundwater models to account for the cumulative effects on local and regional water resources from both existing and proposed water use. In my capacity as the Task Leader for the SCA for the LNP, as well as in assisting Progress respond to NRC RAIs, I was responsible for overseeing CH2M HILL's groundwater modeling efforts.

Q29: Please describe how groundwater models are employed by hydrogeologists.

A29: Groundwater modeling is the accepted methodology among hydrogeologists and most water permitting authorities for simulating existing groundwater occurrence and flow and predicting the effects on groundwater systems and hydrologically-connected surface waters from changes such as withdrawals and recharge. Groundwater models are typically used in a project to estimate the nature and magnitude of the effects on local and regional water resources; subsequently, groundwater models may be refined or re-applied to account for new data, changes in the project, or to evaluate uncertainty regarding the effects on local and regional water resources. Within Florida, groundwater modeling is required by virtually every water permitting authority to help determine a proposed activity's impact on existing use (permitted or not) and local and regional water resources, and to help determine the need for, and form of, additional mitigation measures.

Q30: Is there a particular groundwater model generally used by hydrogeologists for simulating the effects on local and regional water resources from proposed groundwater withdrawals?

A30: The USGS has developed a three-dimensional, finite difference groundwater model code known as MODFLOW-2000, which is used by many hydrogeologists and water permitting authorities for simulating existing groundwater occurrence and flow, as well as predicting the effects on hydrologically-connected waters from groundwater withdrawals, and recharge. The model is comprised of three-dimensional cells arranged in layers corresponding to the hydrostratigraphic cross section (formations, confining beds, aquifers, or zones within an aquifer). Groundwater flow is calculated from node to node on the 6 faces of each cell. Each layer or group of cells within the model is assigned parameters relating to the hydraulic properties (conductivity, thickness, boundary conditions, storage capacity, initial conditions, recharge, discharge, etc.) that are characteristic of that part of the modeled hydrostratigraphic column or area. As parameters for particular cells or groups of cells are adjusted to simulate the hydraulic change introduced, the resulting changes to the model are monitored and evaluated over defined pumping time periods to determine the effects throughout the model.

Q31: Is there a particular groundwater flow model used by hydrogeologists and water permitting authorities in simulating the effects on local and regional water resources from proposed groundwater withdrawals in the vicinity of the LNP site?

A31: The SWFWMD, which is the responsible water permitting authority for Levy County and the 15 other counties in the vicinity of the LNP site, has developed a regional groundwater model — the DWRM2, adapted from the USGS MODFLOW-2000 groundwater model code — for use in evaluating the effect on local and regional water resources from proposed groundwater withdrawals within the SWFWMD, as well as to help determine the need for and the form of additional mitigation measures. The design and calibration of the DWRM2 is described in greater detail in the Pre-Filed Direct Testimony of James O. Rumbaugh, III. PEF100. I have also discussed the design and calibration of the DWRM2 with the SWFWMD Staff and Mr. Rumbaugh.

Q32: Can the MODFLOW-based DWRM2 be used to simulate the effects on local and regional water resources from proposed groundwater withdrawals in a portion of the DWRM2's 16-county model domain?

A32: Yes. A subregional model can be extracted from the DWRM2 using the Telescopic Mesh Refinement (TMR) process to provide improved precision in the prediction of a proposed groundwater withdrawal's effects on water resources within a portion of the area covered by the DWRM2. In the TMR process, a sub-domain of the larger DWRM2 is selected and extracted, resulting in a model with finer grid spacing (i.e., smaller cells), allowing it to better simulate the effect on relatively small, local features such as springs and wetlands resulting from hydraulic changes (e.g., groundwater withdrawals) elsewhere in the system.

Q33: Was the DWRM2 groundwater model used in evaluating the effects on local and regional water resources from active groundwater withdrawals during the construction and operation of the LNP?

A33: Yes. My team at CH2M HILL used a subregional model extracted from the DWRM2 by the TMR process (the ER Model) — in evaluating the effects on local and regional water resources from proposed active groundwater withdrawals during the construction and operation of the LNP in connection with the facility's SWFWMD water use permit and Florida site certification, USACE permit application, and the ER. Subsequently, at the request of the NRC Staff, my team at CH2M HILL recalibrated the ER Model for use in connection with the FEIS (the Recalibrated Model).

Q34: How did your team at CH2M HILL extract, develop, and use the ER Model?

A34: CH2M HILL's extraction, development, and use of the ER Model are described in detail in TMEM-074. PEF212. My team at CH2M HILL extracted the ER Model from the DWRM2 groundwater model by the TMR process. Centered on the LNP production wellfield, the ER Model encompassed the Withlacoochee River, Lake Rousseau, and the Cross Florida Barge Canal (CFBC) within its 400 square mile ($mile^2$) domain, and was comprised of cells arranged within three active layers (representing the surficial, Upper Floridan, and Lower Floridan Aquifer systems) and two inactive layers (representing the upper and lower intermediate aquifer systems that are not present in the vicinity of the LNP site) to mimic the characteristic hydrostratigraphy of the LNP site.

Although the ER Model for the most part assigned the same boundary conditions and parameters assigned in the parent DWRM2, on the recommendation of the

SWFWMD Staff, the boundary conditions of cells representing wetlands were changed to variable-head conditions to eliminate the possibility that the application of DWRM2 boundary conditions to these cells could artificially limit simulated drawdowns. The ER Model also extended the modeled pumping period for active operation from 1 year to 60 years to better reflect the expected lifetime of the facility, and incorporated two springs (Little King and Big King) that had been omitted from the parent DWRM2 within the model layer representing the Upper Floridan Aquifer.

CH2M HILL considered recalibrating the ER Model based on 2007 USGS data (including the water-level data obtained for the T&J Ranch Well), but rejected such recalibration of the ER Model on the recommendation of the SWFWMD Staff, who advised that the existing calibration of the DWRM2 would be better representative of local conditions. The layers of the DWRM2 incorporated USGS water level data, and the DWRM2 was calibrated in two stages, against data that had been collected over the course of 8 years from over 1,000 water-level targets throughout the SWFWMD. SWFWMD Refinement of the DWRM Model, PEF103 at pp. 9-22. The calibration of the DWRM2 is discussed in greater detail in the Pre-Filed Direct Testimony of Mr. Rumbaugh. PEF100.

Q35: Please describe the incremental and cumulative impacts predicted by the ER Model for the withdrawal rate associated with an annual average pumping day during operation of the LNP.

A35: The ER Model's simulation of incremental and cumulative impacts at withdrawal rates for an annual average pumping day of 1.58 mgd revealed negligible effects on local and regional water resources over both (1 year and 60 years) modeled pumping periods. With respect to incremental impacts within the LNP wellfield, the ER Model yielded no more than a 0.5 foot drawdown (relative to 2001 water-levels) in the surficial and Upper Floridan Aquifers over both (1 year and 60 years) modeled pumping periods throughout the vast majority of the wellfield. PEF212 at pp. 7, 16-17. (The cumulative drawdown in the immediate vicinity of a single production well registered a 0.6 foot drawdown in the Upper Floridan Aquifer after 60 years of pumping. PEF212 at pp. 5, 18-19.) No wetlands within the 400 mile$^2$ model domain would exhibit a cumulative or incremental impact of greater than a 0.5 foot drawdown within both (1 year and 60 years) modeled pumping periods. PEF212 at pp. 7, 22-23. The ER Model predicted that no permitted users would see greater than a cumulative 0.2 foot drawdown over the anticipated lifetime of the LNP. PEF212 at pp. 5, 18-19.

The predicted change in flow into surface waters and from springs within the model domain was negligible over both modeled pumping periods. Groundwater withdrawal at annual average pumping day rates resulted in reductions of modeled flow into Lake Rousseau and the Lower Withlacoochee River of 0.9%, and reductions in the discharges from Big King and Little King Springs of approximately 0.3%. PEF212 at pp. 5, 20. These small reductions in groundwater flow to surface waters would not be expected to affect surface water-levels in a meaningful way.

Q36: Please describe the incremental and cumulative impacts predicted by the ER Model for the withdrawal rate associated with a maximum pumping week during operation of the LNP.

A36: The ER Model's simulation of incremental and cumulative impacts from the withdrawal rate during a maximum pumping week for the LNP revealed negligible effects on local and regional water resources. The maximum pumping week withdrawal rate of 5.8 mgd is an inherently conservative figure. In the remote possibility that the LNP would withdraw groundwater at maximum pumping week rates, it would do so only during an annual weeklong maintenance period, under worst-case scenario conditions. As a result, the incremental and cumulative impacts associated with maximum pumping week withdrawals were modeled over a shorter pumping period (specifically, one week) than those used in connection with modeling the impacts associated with the annual average daily pumping rate. Although modeling of groundwater withdrawals during the maximum pumping week yielded an approximately 0.7 foot to 0.8 foot drawdown in the immediate vicinity of each production well, the magnitude of drawdown diminished rapidly with distance from the well, such that areas greater than 1 mile from the center of the wellfield would not be expected to experience more than a 0.1 foot drawdown. Additionally, the closest permitted users to the LNP wellfield would not be expected to experience more than a 0.2 foot drawdown during a maximum pumping week. PEF212 at pp. 6-7, 21. The CH2M HILL team did not perform modeling of the impacts to springs and surface waters during a maximum pumping week in light of the limited drawdown impacts predicted, and because the short duration of the modeled pumping period was not expected to affect these water resources.

Q37: What changes, if any, were subsequently made to the ER Model at the request of the NRC Staff?

A37: CH2M HILL's recalibration of the ER Model and use of the resulting Recalibrated Model are described in detail in TMEM-123. PEF 210. The NRC Staff requested that my CH2M HILL team recalibrate the ER Model against site-specific and 2007 USGS potentiometric data (water-levels and potentiometric heads). PEF210 at p. 2. Specific calibration targets used in the recalibration effort included the following:

- Measured water-levels from 10 monitoring wells within the surficial aquifer at the LNP site;
- Measured water-levels from 6 monitoring wells within the Upper Floridan Aquifer at the LNP site;
- Measured water-levels taken from the SWFWMD and USGS published water-level data for 2 wells within the Upper Floridan Aquifer;
- Water-levels extrapolated from the 2007 USGS potentiometric contour map for 4 wells within the Upper Floridan Aquifer (including the T&J Ranch Well); and

- 20 synthetic targets located throughout the Recalibrated Model providing water-level data extrapolated directly from the 2007 USGS potentiometric contour map.

PEF210 at p. 13; Recalibrated Model Calibration Targets, PEF216. The Recalibrated Model was calibrated under steady state conditions only.

The choice of these particular calibration targets required changes elsewhere within the Recalibrated Model. Replication of the 2007 USGS water potentiometric data — in particular the high water-level associated with the T&J Ranch Well located on the eastern boundary of the model — created a steep groundwater gradient (a change in the direction and quantity of groundwater flow) along the eastern boundary of the model. To create this steep groundwater gradient within the Recalibrated Model, my CH2M HILL team made a number of adjustments within the Recalibrated Model to effectively mound water in the area of the high point of the groundwater gradient. My team assigned high constant head (constant water-level) boundary conditions to cells near the high point of the groundwater gradient and set local water-levels just below the surface to maximize the amount of water introduced in the area by recharge. My team also reduced the values of a series of parameters throughout the Recalibrated Model — including Upper Floridan Aquifer transmissivity, surficial aquifer hydraulic conductivity, and leakance (the ability of water to move vertically from one aquifer to another) between the surficial aquifer and Upper Floridan Aquifer — to hold water at the high points of the groundwater gradient by inhibiting movement of water to lower points in the system. These greater impediments to flow through the groundwater system tended to exacerbate the predicted drawdown impacts associated with the withdrawals, as well as resulted in lower regional flowrates through the Upper Floridan Aquifer.

Furthermore, these changes introduced within the Recalibrated Model appear to be inconsistent with hydrogeological understanding of the groundwater system in the region. In reviewing the flowrates in the Water Budget for the Recalibrated Model, PEF210 at p. 33, three potential areas of difference with hydrogeological understanding of the groundwater systems in the region present themselves:

- Recalibrated Model results appear inconsistent with hydrogeologists' general understanding of the relationship between the Upper Floridan Aquifer and coastal marshes and wetlands. Hydrogeologists generally understand inland recharge of the Upper Floridan Aquifer to discharge to the marshes and wetlands near the coast via the surficial aquifer.[10] However, the Recalibrated Model exhibits a net discharge in the opposite direction — from the surficial aquifer to the Upper Floridan Aquifer.
- Recalibrated Model results appear inconsistent with hydrogeologists' general understanding of lateral flow within the Upper Floridan Aquifer. The large area of the Upper Floridan Aquifer and the high volume of discharge from springs fed by this aquifer are generally understood by hydrogeologists to indicate high lateral flowrates through the Upper Floridan Aquifer. However, the lateral flowrates within the Upper Floridan Aquifer are relatively low in the Recalibrated Model.[11]
- Recalibrated Model results appear inconsistent with hydrogeologists' general understanding of the relationship between the surficial aquifer and surface waters. Hydrogeologists generally understand the surficial aquifer to discharge to surface waters such as Lake Rousseau, the Withlacoochee River, and the

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[10] The Water Budget associated with the ER Model predicts a net discharge from the Upper Floridan Aquifer to the surficial aquifer. PEF211.

[11] Lateral flowrates within the Upper Floridan Aquifer predicted by the ER Model are much higher (213 and 187 mgd into and out of the Upper Floridan Aquifer, respectively) than those predicted by the Recalibrated Model (38 and 136 mgd into and out of the Upper Floridan Aquifer, respectively).

CFBC.[12] However, the Recalibrated Model seems to exhibit a net recharge of the surficial aquifer system by these surface waters.

Q38: Did the SWFWMD participate in the recalibration of the ER Model requested by the NRC Staff?

A38: No, the SWFWMD declined to participate in the recalibration of the ER Model.

Q39: In your professional opinion, was the recalibration of the ER Model requested by the NRC Staff necessary to provide more realistic drawdown and regional aquifer flowrate predictions?

Q39: No. The SWFWMD's own experience has confirmed that the DWRM2 provides realistic drawdown and regional aquifer flowrate predictions. As explained earlier in my testimony, as well as in the Pre-Filed Direct Testimony of Mr. Rumbaugh, PEF100, the DWRM2 has been calibrated in two stages against an exhaustive set of data collected over the course of 8 years, from over 1,000 targets. The SWFWMD itself has used the DWRM2 in its evaluation of WUP applications within its jurisdiction since the model's introduction in 2007, and recommends against the use of alternative calibrations by WUP applicants.

Furthermore, the rationale identified by the NRC Staff for the recalibration of the ER Model — a desire to match USGS potentiometric data — is irrelevant for the purpose of predicting the drawdown impacts associated with construction and operation of the LNP. A groundwater model's ability to accurately predict drawdown impacts from a proposed withdrawal is less a function of the precision of the model in replicating the water-level at a particular calibration target than it is the model calibration's overall fidelity to observed aquifer performance parameters (e.g., transmissivity and conductance) and the groundwater gradient across the site of a proposed withdrawal.

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[12] The Water Budget associated with the ER Model predicts a net discharge from the surficial aquifer to area surface waters. PEF211.

Q40: Please describe the incremental and cumulative impacts predicted by the Recalibrated Model prepared at the request of the NRC Staff based on the withdrawal rate for an annual average pumping day during operation of the LNP.

A40: The Recalibrated Model's simulation of incremental and cumulative impacts from withdrawal rates on an annual average pumping day of 1.58 mgd revealed small effects on local and regional water resources over both (1 year and 60 years) modeled pumping periods. With respect to incremental impacts, the Recalibrated Model yielded a 0.5 foot drawdown (relative to 2001 water-levels) in the surficial and Upper Floridan Aquifers over a roughly 1 mile radius from the center of the wellfield during the 1 year modeled pumping period. PEF210 at pp. 8, 37-38, 46. This 0.5 foot drawdown radius increased to roughly 3 miles after the 60 year modeled pumping period. PEF210 at pp. 9, 42-43, 47. With respect to cumulative impacts, the Recalibrated Model yielded a 0.5 foot drawdown in the surficial and Upper Floridan Aquifers over roughly 1.5 miles around each of the production wells during the 1 year modeled pumping period. PEF210 at pp. 38-39. These 0.5 foot drawdown radii increased to roughly 5.5 miles over the 60-year modeled pumping period. PEF210 at pp. 44-45. Although the Recalibrated Model indicates that the surficial aquifer beneath some wetlands could experience more than a 0.5 foot drawdown within both (1 year and 60 years) modeled pumping periods, these drawdown predictions are not as realistic as the drawdown predictions obtained from the ER Model for the reasons explained in this testimony.

The modeled change in flow into surface waters and springs within the Recalibrated Model domain was small over both modeled pumping periods. Groundwater withdrawal by the LNP at annual average pumping day rates resulted in maximal reductions of modeled flow into Lake Rousseau and the Lower Withlacoochee River of 8.6% and maximal reductions in the discharge from Big King and Little King Springs of approximately 1.0%. Recalibrated Model Impacts to Rivers, Lakes, and

Springs, PEF217. These reductions in groundwater flow to surface waters due to the LNP would not be expected to affect surface water-levels in a meaningful way.

Q41: Please describe the incremental and cumulative impacts predicted by the Recalibrated Model prepared at the request of NRC Staff during a maximum pumping week during operation of the LNP.

A41: The Recalibrated Model's simulation of the incremental and cumulative impacts from groundwater withdrawals during a maximum pumping week for the LNP revealed negligible effects on local and regional water resources. The maximum pumping week withdrawal rate of 5.8 mgd is an inherently conservative figure. In the remote possibility that the LNP would withdraw groundwater at maximum pumping week rates, it would do so only during an annual weeklong maintenance period, under worst-case scenario conditions. As a result, the incremental and cumulative impacts associated with maximum pumping week withdrawals were modeled over a shorter modeled pumping period (specifically, one week) than those used in connection with modeling the impacts associated with the annual average daily pumping rate. The Recalibrated Model's simulation of the maximum pumping week yielded a 0.5 foot drawdown in the surficial aquifer across a radius extending a maximum 0.2 miles from each of the LNP production wells, and a 0.5 foot drawdown within the Upper Floridan Aquifer across a radius extending 0.6 miles from each of the LNP production wells. PEF210 at pp. 48-49. The limited increase in drawdown resulting from maximum week pumping and the expected short duration of such conditions would not be expected to affect wetlands or surface water bodies in the area.

Q42: In your professional opinion, how do the results of the Recalibrated Model compare to the results of the ER Model?

A42: In my professional opinion, the Recalibrated Model's predictions relating to drawdown impacts and the regional flow through the Upper Floridan Aquifer are less realistic than (but still largely consistent with) those obtained from the ER Model.

The ER Model retained the proven calibration of its parent DWRM2 regional model. The DWRM2 had been calibrated in two stages, against data that had been collected over the course of 8 years from over 1,000 water-level targets throughout the SWFWMD. The SWFWMD itself has used the DWRM2 in its evaluation of WUP applications within its jurisdiction since the model's introduction in 2007, and its experience has confirmed the accuracy of the DWRM2's predictions. The SWFWMD recommends against the use of alternative calibrations of the DWRM2 model by WUP applicants. In my professional opinion, this exhaustive, proven calibration ensures that the ER Model's predictions relating to regional aquifer flowrates and drawdown impacts are realistic.

In contrast, the calibration against 2007 USGS data requested by the NRC Staff resulted in less realistic predictions of drawdown impacts and the regional aquifer flowrates. The calibration targets used in the recalibration effort — in particular the high water-level associated with the T&J Ranch Well — created a steep groundwater gradient along the eastern boundary of the Recalibrated Model that in turn required my CH2M HILL team to make a series of adjustments to boundary conditions and aquifer performance parameters inhibiting flow from the high points of the groundwater gradient to other areas. These adjustments not only resulted in the greater drawdown impacts and lower regional aquifer flowrates than those obtained from the ER Model, but they also gave rise to a handful of potential inconsistencies between the Recalibrated Model's predictions and hydrogeologists' general understanding of the hydrogeological characteristics of the area in the vicinity of the LNP site. Because the Recalibrated Model is not as representative of local conditions as the ER Model, in my professional opinion its predictions relating to drawdown impacts and regional aquifer flowrates are not as realistic as those obtained from the ER Model.

However, even though the Recalibrated Model's results are less realistic than those obtained from the ER Model, in my professional opinion they still have predictive value. Although hydrogeologists use groundwater modeling to help them understand the complex relationships between groundwater systems and hydrologically-connected surface waters, no groundwater model is a perfect representation of its subject. As a consequence, groundwater modelers will often approach the same problem from different perspectives — by employing different methodologies, assumptions, and calibrations, etc. — yet still arrive at roughly the same conclusions.

Here, the modeling efforts in connection with the ER Model and the Recalibrated Model employed different calibrations and different aquifer performance parameters, yet still yielded results that (after considering the 400 $mile^2$ model domain) are fairly similar. The two models' respective regional aquifer flowrates — of 450 mgd (ER Model) and 208 mgd (Recalibrated Model) — are well within an order of magnitude (roughly a factor of two) of one another. Moreover, both sets of predicted drawdowns will, in my professional opinion, be virtually undetectable in the field when one takes into consideration the natural seasonal variation in the water-levels within the surficial aquifer (up to 5 feet) and Upper Floridan Aquifer (up to 8 feet). NRC001 at p. 2-28.

## VI. CONCLUSION

Q43: In your professional opinion, does the groundwater modeling conducted in connection with the ER and the FEIS support the conclusions in those documents regarding the direct, indirect, and cumulative impacts resulting from active groundwater withdrawal during construction and operation of the LNP?

A43: In my professional opinion, the groundwater modeling performed in connection with the ER and FEIS supports those documents' consistent conclusions that the direct, indirect, and cumulative impacts resulting from active groundwater withdrawal during construction and operation of the LNP will be SMALL.

The groundwater models used in connection with those documents were extracted from the SWFWMD DWRM2 regional groundwater flow model which was derived from the USGS MODFLOW-2000 software developed and supported by the USGS. The layers within the DWRM2 incorporated USGS water level data, and this regional model was calibrated in two stages against data that had been collected over the course of 8 years from over 1,000 water-level targets throughout the SWFWMD. The SWFWMD itself has used the DWRM2 in its evaluation of WUP applications within its jurisdiction since the model's introduction in 2007, and its experience has confirmed the accuracy of the DWRM2's predictions.

In my professional opinion, the ER Model's reliance on this proven, exhaustive calibration makes its drawdown impacts and regional aquifer flowrates more realistic than those obtained from Recalibrated Model created at the request of the NRC Staff. The NRC Staff's choice of calibration targets for this model required adjustments throughout the model that resulted in higher drawdown values and lower regional aquifer flowrates, as well as a handful of potential inconsistencies between the Recalibrated Model's predictions and hydrogeologists' general understanding of the hydrogeological characteristics of the area in the vicinity of the LNP site. With these considerations in mind, it is my professional opinion that the Recalibrated Model — though not without value — does not provide drawdown and regional aquifer flowrate predictions as realistic as those provided by the ER Model.

I, Jeffrey D. Lehnen, swear under penalties of perjury that the foregoing testimony is true and correct to the best of my knowledge and belief.

Jeffrey D. Lehnen
Signature

June 26, 2012
Date