NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:
Alex S. Karlin, Chairman
Dr. Anthony J. Baratta
Dr. Randall J. Charbeneau

In the Matter of:	)	Docket Nos.
PROGRESS ENERGY FLORIDA, INC.	)	52-029-COL, 52-030-COL
(Levy County Nuclear Power Plant, Units 1 and 2)	)	December 5, 2012

INTERVENORS' PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW REGARDING CONTENTION 4

Pursuant to 10 C.F.R. § 2.1207(a)(2) and LBP-09-22, 70 NRC 640, 655 (2009), the Ecology Party of Florida and Nuclear Information and Resources Service ("Intervenors") submit their proposed findings of fact and conclusions of law regarding Contention 4.

I. INTRODUCTION

This case concerns the adequacy of the U.S. Nuclear Regulatory Commission's (NRC's) Final Environmental Impact Statement (2011) ("FEIS") (**Exhibit NRC001**) for the proposed Levy nuclear power plant Units 1 and 2 ("LNP") to address the environmental impacts of construction and operation of the proposed reactors on the environmentally sensitive aquatic (wetland) and terrestrial ecosystems in which Progress Energy Florida, Inc. ("PEF") proposes to construct and operate two new 1100-MW AP1000 nuclear reactors and extensive support facilities. Based in part on the results of groundwater modeling by PEF, the FEIS concedes that the environmental impacts of water withdrawals from the underlying aquifer on surrounding wetlands could be significant, but asserts they will be reduced to an insignificant level (*i.e.,* "SMALL to MODERATE)" by the requirement of future monitoring and mitigation measures in PEF's State water use permit. **Exhibit NRC001** at 5-47. According to the FEIS, under these conditions groundwater withdrawals "cannot cause unacceptable adverse impacts" because those impacts will be detected and prevented or mitigated before they can cause significant harm. *Id.* at 5-30. In light of this conclusion, the Staff decided that it was not necessary to evaluate any other measures for avoiding or mitigating impacts to wetlands. **Exhibit NRC001** at 4-17. Intervenors argue the FEIS must be rejected because its finding of no significant impact does not comply with the National Environmental Policy Act's ("NEPA's") procedural requirements.

The question at the heart of this case is whether the NRC Staff lawfully may rely on a promise to reduce potentially significant environmental impacts to an insignificant level by monitoring their occurrence and attempting to swiftly prevent or mitigate them before those impacts become irreversible, when the NRC concededly has very little information about how, when or where those impacts will occur. As is clear from the hearing record, neither PEF nor the NRC Staff conducted any technical investigation whatsoever into the geology of the southern portion of the LNP site, where PEF proposes to locate its groundwater withdrawal wells. And little study was made of the geology of the north parcel beyond the immediate surface footprint of the proposed reactors. The FEIS simply assumes that the limestone rock beneath the site is uniformly porous, that water will draw down uniformly, and therefore it will be adequate for PEF to look for adverse effects in a wide radius around the service-water wellfield. In contrast, the Intervenors point to evidence that the karstic limestone under the site is laced with preferential flow pathways, such as dissolution conduits along the bedding planes and vertical fractures extending for many miles into surrounding counties, that can laterally conduct a large volume of water rapidly and to distant locations such as offsite springs. By the same token, if water is drawn from these features they can also serve to rapidly and drastically dewater springs and wetlands, both in the immediate vicinity and for considerable distances offsite.

Because PEF has made no effort to identify or monitor along these preferential flow pathways, prevention or mitigation of adverse impacts will fail. In addition, the large structures that PEF plans to build may block overland flow of fresh water through the wetlands as well as groundwater flow to nearby springs. Although PEF has promised to investigate the geology of the site more fully *after* the LNP license has been issued, NEPA requires the NRC to understand the effects of its licensing action now, before the action is taken. *Robertson v. Methow Valley Citizens Council,* 490 U.S. 332, 349 (1989). The NRC Staff argues that it is not necessary to know more now about the environmental impacts of water withdrawal on wetlands, because any such impacts will be detected and mitigated under PEF's monitoring plan. But NEPA's "rule of reason" requires us to reject this circular reasoning. *San Luis Obispo Mothers for Peace v. NRC,* 751 F.2d 1287, 1301 (D.C. Circuit 1984), vacated in part and rehearing en banc on other grounds, 760 F.2d 1320 (D.C. Circuit 1985). If the Staff does not know now how or where the environmental impacts of water withdrawal will occur, then it does not know enough to judge the effectiveness of proposed mitigation measures to reduce those impacts to an acceptable level. Indeed, the evidence affirmatively shows that PEF's proposed wetland monitoring and mitigation plans are based on the very groundwater model that NRC Staff judged inadequate to predict impacts to the wetlands. The last-resort mitigation measure is supposedly to install an alternative water supply five years after operation commences if impacts prove too great, but PEF's own witness said that this is not feasible, calling into question whether this is merely an empty promise. Furthermore, an alternative water supply would not resolve the other widespread environmental harm from the proposed LNP, such as the myriad excavations and their impacts on ground and surface water flow.

We agree with the NRC Staff that that the groundwater model is an inappropriate basis for designing the mitigation plan for three important reasons. First, the model is conceptually wrong. It is not sufficiently realistic, it failed to model the measured water levels accurately, and it is designed for water resource allocation, not to predict wetland impacts. Second, the model is not designed to take account of the preferential flow pathways that form the bulk of the groundwater flow at the LNP site and in the vicinity. If groundwater withdrawal wells draw from conduits and fractures in the underlying limestone, water withdrawals could severely affect localized springs and wetlands, even at a significant distance from the LNP site. In addition, if the nuclear islands cut off flow to Big and Little King Springs, those will be significantly affected. Finally, the recalibrated groundwater model underestimates environmental impacts by: a) using annual average rainfall data in prediction mode and therefore fails to take into account periods of drought; and b) adding in 5 mgd of artificial recharge that does not really exist.

Given the NRC's lack of information about the geology of the LNP site and environs, or how that geology affects the LNP's environmental impacts on wetlands, we find that the NRC Staff has no factual basis for concluding that PEF will know where or when to monitor for adverse environmental impacts, let alone how to prevent or mitigate them. Therefore, we conclude that the existence of a State-approved monitoring and mitigation plan does not support the FEIS' conclusions regarding the insignificance of LNP's environmental impacts. We also conclude that the Staff erred by placing unquestioning reliance on the State's imposition of conditions, without independently evaluating their adequacy. *Calvert Cliffs Coordinating Comm. v. U.S. AEC,* 449 F.2d 1109, 1123 (D.C. Cir. 1971). Without further investigation into the hydrogeological and hydroecological characteristics and features of the LNP site and independent analysis by the NRC Staff, the FEIS lacks an adequate factual basis for its finding that the direct environmental impacts of groundwater withdrawals at the LNP site will be insignificant. Moreover, during the hearing even PEF conceded that the monitoring plan designed to satisfy the state conditions does not include any monitoring for Big and Little King springs. In addition, the baseline data for the small number of wetlands that will be monitored is scheduled to be taken after construction commences, when impact could already have occurred.

Finally, because the NRC lacks the most basic information about the direct environmental impacts of water withdrawals for construction and operation of the LNP reactors, it has no basis for making an adequate evaluation of indirect and cumulative impacts, including but not limited to the combined impacts of water withdrawals with salt drift from LNP cooling towers, LNP construction impacts such as onsite and offsite excavations, subterranean plugging of the aquifer by the nuclear islands, impacts from nearby mining operations, climate change, salt drift, passive dewatering during times of drought, increased fire frequency and other contributors to lowering of freshwaters levels and increasing salt inputs to the sub-surface.

Therefore, we conclude the FEIS is insufficient to satisfy NEPA and remand it to the NRC Staff. In the meantime, given the lack of an adequate supporting environmental analysis, PEF's application for a COL is denied. 10 C.F.R. § 51.20(a)(2).

Our decision below is organized as follows: Section II describes the applicable legal requirements, Section III sets forth the factual background and procedural history of the case, Section IV presents our findings of fact, and Section VI contains our conclusions of law.

II. APPLICABLE LEGAL REQUIREMENTS

A. National Environmental Policy Act

1. General requirements of NEPA

In Contention 4, Intervenors seek compliance with the procedural requirements of NEPA, 42 U.S.C. § 4321-4370f, which are intended to implement a "broad national commitment to protecting and promoting environmental quality." *Louisiana Energy Services, L.P.* (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 87 (1998) (quoting *Robertson,* 490 U.S. at 348 and citing 42 U.S.C. § 4331). The preparation of an environmental impact statement ("EIS") is "[c]hief among [the] procedures" established by NEPA for protection of the environment. *Id.* In an EIS, an agency must take a "hard look" at the environmental consequences of a proposed project. *Id.* (citing *Robertson,* 490 U.S. at 349-50; *Hughes River Watershed Conservancy,* 81 F.3d 437, 443 (4th Cir. 1996). The results of this "hard look" must be published for public comment "to permit the public a role in the agency's decision-making process." *Id.*

In order to enable an agency to conduct the "hard look" required by NEPA, an EIS must contain a sufficient discussion of the relevant issues and opposing viewpoints." *Louisiana Energy Services,* 47 NRC at 88 (citing *Tongass Conservation Society v. Cheney,* 924 F.2d 1137, 1140 (D.C. Cir. 1991) (quoting *Natural Resources Defense Council v. Hodel,* 865 F.2d 288, 294 (D.C. Cir. 1988)). In *Louisiana Energy Services,* for example, the Commission affirmed an ASLB decision that an EIS for a proposed uranium enrichment plant had not sufficiently analyzed the disparate environmental impacts of a proposed road closure on the neighboring environmental justice communities, including transportation-related impacts, impacts on property values, and mitigation impacts. 47 NRC at 106-110. The FEIS was remanded for revision. *Id.* at 110.

2. Requirements for discussion of environmental impacts in EIS

An EIS must discuss environmental impacts that are "reasonably foreseeable or have some likelihood of occurring." *Southern Nuclear Operating Co.* (Early Site Permit for Vogtle ESP Site), LBP-09-7, 69 NRC 613, 631 (2009) (citing *Long Island Lighting Co.* (Shoreham Nuclear Power Station), ALAB-156, 6 AEC 831, 836 (1973)). Impacts that must be considered include both direct impacts (*i.e.,* impacts that occur at the same time and place as the action) and indirect impacts (*i.e.*, impacts that are caused by the action at a later time or more distant place yet are still reasonably foreseeable). *Id.* at 632 (citing 40 C.F.R. § 1502.16, 1508.8).

In addition, an FEIS must discuss the cumulative or "synergistic" impacts of a proposed action. *Hydro Resources, Inc.* (P.O. Box 15910), Rio Rancho, NM 87174), CLI-01-4, 53 NRC 31, 57-58 (2001) (citing *Kleppe v. Sierra Club,* 427 U.S. 390, 410 (1976)). The cumulative impacts analysis "looks at the possibility that . . . impacts may combine in such a fashion that will enhance the significance of their individual effects." *Id.* *See also* 40 C.F.R. § 1508.7; Council on Environmental Quality, *Considering Cumulative Effects Under the National Environmental Policy Act* (1997) (Evidence is increasing that the most devastating environmental effects may result not from the direct effects of a particular action, but from the combination of individually minor effects of multiple actions over time.")NEPA fundamentally requires agencies to consider the environmental impacts of their actions *before* they approve the actions, rather than waiting until "after the die is cast." *Robertson,* 490 U.S. at 349. Moreover, the agency must reach its own independent conclusions and may not delegate its NEPA responsibility to other federal agencies or state agencies. *Calvert Cliffs,* 449 F.3d at 1123. *See also* LBP-09-10, 70 NRC 51, 100 (rejecting "the proposition that the ER [Environmental Report] and EIS [for the Levy LNP] can properly exclude any environmental impact that is regulated by another federal or state entity or that, because NRC has no jurisdiction to *regulate* an environmental impact, it can be excluded, *per se,* from the ER or EIS").

3. Significance of environmental impacts

Where a proposed action will have environmental impacts that are significant, NEPA requires that an agency must consider alternatives for avoiding or mitigating those impacts. *Van Eye v. EPA,* 202 F.3d 296, 309 (D.C. Cir. 2000). Therefore the designation of impacts as "significant" or "insignificant" is important. The NRC characterizes the significance of environmental impacts as "SMALL," "MODERATE," or "LARGE," with "LARGE" impacts being the only impacts having significance. 10 C.F.R. Part 51, Appendix B, Table B-1 n.3. *See also* FEIS Vol. 2 at xxxii. According to the NRC, impacts of "LARGE" significance "are clearly noticeable and are sufficient to destabilize important attributes of the resource." *Id.*[1] As the ASLB observed in LBP-09-10, the term "resource" is not defined:

For example, in determining whether the LNP project will have noticeable impacts on

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[1] The definitions of "SMALL" and "MODERATE" significance are as follows:

> SMALL--For the issue, environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small as the term is used in this table.
> MODERATE--For the issue, environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

Id.

> water resources, should we define the resource as the onsite wetlands? The regional wetlands and waters? The Gulf of Mexico? The oceans? More specifically, at one point PEF suggests that mining for aggregate for concrete can be summarily dismissed because the 25,000 cubic yards of concrete (and aggregate) needed for the LNP project is negligible compared to the "global or national" availability of concrete. If the "resource" is the globe, then the mining necessitated by any individual project will almost never have a noticeable impact on the resource.

Id., 70 NRC at 101. Intervenors respectfully submit that where there are no specific standards or definitions, NEPA must be applied under a "rule of reason" to evaluate whether the agency has examined a geographic region where significant impacts may occur. *Grazing Field Farms v. Goldschmidt,* 626 F.2d 1068, 1072 (1st Cir. 1980). Only if the impacts in a potentially affected region are "remote and speculative" may they be disregarded. *City of New York v. Dept. of Transp.,* 715 F.2d 732, 738 (2d Cir. 1983).

4. Public participation

NRC regulation 10 C.F.R. §§ 51.74 and 51.75(c) require that an EIS for a COL application must be circulated in draft form before it can be finalized. The regulation serves one of NEPA's key purposes: to give the public "a springboard for public comment." *Robertson,* 490 U.S. at 349 (quoting *Baltimore Gas & Electric Co.,* 462 U.S. 87, 97 (1983). The Final EIS must respond to "relevant responsible opposing views." 10 C.F.R. § 51.91(b).

B. Burden of Proof

Generally, in NRC licensing proceedings the applicant carries the burden of proof. 10 C.F.R. § 2.325 (2011) ("Unless the presiding officer otherwise orders, the applicant or the proponent of an order has the burden of proof."). In a hearing on NEPA issues, the NRC Staff bears the ultimate burden of proof. *Louisiana Energy Services,* 47 NRC at 89.

The Intervenors also carry a "burden of going forward." *Amergen Energy Co., L.L.C.* (Oyster

Creek Nuclear Generating Station)*,* CLI-09-07, 69 NRC 235, 269 (2009). The NRC has compared the burden of proof with intervenors' burden of going forward as follows:

> The ultimate burden of proof on the question of whether the permit or the license should be issued is … upon the applicant. But where … one of the other parties contends that, for a specific reason … the permit or license should be denied, that party has the *burden of going forward* with evidence to buttress that contention. Once he has introduced sufficient evidence to establish a *prima facie* case, the burden then shifts to the applicant who, as part of his overall burden of proof, must provide sufficient rebuttal to satisfy the Board that it should reject the contention as a basis for denial of the permit or license.

Id.

III. FACTUAL BACKGROUND AND PROCEDURAL HISTORY

A. Factual Background

1. PEF's COL application and LNP site

On July 8, 2008, PEF submitted a combined license ("COL") application to the NRC for two new reactors in Levy County, Florida. The application included an Environmental Report ("ER") that discussed the environmental impacts of the proposed project on the environment, including aquatic and terrestrial impacts.

PEF plans to conduct its activities in an area of approximately 7,000 acres that is divided into a north parcel of approximately 3,000 acres and a south parcel of approximately 2,000 acres. Tr. 1129 (Vermeul). While the FEIS refers to the north parcel as "the site" (**Exhibit NRC001** at 1-2 1152), in fact PEF's activities will occur on both the north and south parcel; therefore we will refer to PEF's entire property as the "site." Tr. 1130 (Karlin).

PEF plans to build the two new reactors on the north parcel. For purposes of stability, PEF also plans to support the reactors with a "roller compacted concrete Bridging Mat" under the "nuclear island." **Exhibit PEF700,** A.5 (Rizzo).

If the reactors are built, PEF's State water use permit will allow it to withdraw an annual average of 1.58 million gallons of water per day from the underlying aquifer for service water. Tr. 1199 (Vermeul). PEF will be permitted to withdraw up to 5.8 MGD for short periods of time. *Id.* PEF originally proposed to install groundwater withdrawal wells on the north parcel, but moved the wells to the south parcel because the model predicted large drawdowns from the withdrawal in the northern part of the site. Tr. 1265 (Lehnen). Drawdowns appeared to decrease and transmissivity appeared to increase moving south from the reactors. *Id.*

The proposed location of the new reactors and water extraction wellfield is a "green field" site. Although portions of the site were logged and farmed in the past, it has no industrial development. **Exhibit NRC001** at 2-5. As described in the FEIS, the north parcel is composed of freshwater wetlands and forest. *Id.* at 2-42 – 2-49. This is also true of the south parcel. *Id.,* Figure 2-4.

2. Environment surrounding the LNP site

The LNP site is located in a much larger region of wetlands. *See* **Exhibit PEF001**, A.11 (Griffin) (wetlands lie offsite to the west and south). The wetlands located on and around the Levy site collectively provide multiple hydrological and ecological functions such as recharging groundwater and providing wildlife habitat for many wildlife species including seasonally migrating birds. **Exhibit NRC001 at 2-49.** Just on the site alone, sixteen species of Federally or State listed terrestrial animals are possible or have been observed on the site; and likewise 48 species of Federally or State listed plants are possible or observed. *Id.,* Table 2-8, 7-13. If the proposed corridors are included the numbers rise to 32 listed animals and 68 listed plants. *Id.* Among animals affected by the construction and operation of the LNP are the Federally Endangered Florida Panther, Woodstork, and Red-cockaded woodpecker; and the Threatened Eastern indigo snake, American alligator, Florida scrub jay and sand skink. *Id.* Bald Eagles, also Federally protected, have been observed in the site vicinity (*id.* at 2-85), and whooping cranes also could use the Levy site. *Id.* at 2-86.

Apart from the terrestrial species, there are aquatic species that could be adversely affected by the construction and operation of the LNP. *Id.* at 2-21. Manatees use the Old Withlacoochee River and the Withlacoochee Canal (erroneously referred to in the FEIS as the Florida Barge Canal) year–round and rely on freshwater from the springs around the LNP site and off shore. *Id.* at 2-116. Five Federally Endangered species of turtles as well as two species of fish inhabit the aquatic environment. *Id.* at 2-117. Twenty-four important species of fish designated of either commercial, recreational or essential importance or a combination thereof live in waters associated with the construction and operation of the LNP. *Id.* at 2-121. Essential Estuarine fish habitat for eighteen species of fish and three crustaceans in the area has been designated by the National Marine Fisheries Service in the CREC and Withlacoochee Canal areas. (There was no mention in the FEIS of the organisms living in the aquifer system itself or in the springs.)

The area of the LNP site also hosts a number of freshwater springs. For instance, Big King Spring lies approximately six miles northwest of the proposed wellfield. Tr. 1146 (Barnhurst). According to the USGS publication "Springs of Florida," the combined flow of Big King Spring and Little King Spring is 5 Mgd; but no measurements have been taken by PEF. Tr. 1415 (Lehnen). Although PEF has sought to characterize this flow as small, it is notable that PEF predicted that a withdrawal of 1.5 Mgd in the north part of the site would cause large drawdowns (Tr. at 1265(Lehnen)), illustrating that locally a flow of 5 Mgd is large relative to the water resources available.

Springs have also been observed along the side of the Withlacoochee Canal, which lies within 0.3 miles (1,637 feet) of the southern site boundary. **Exhibit INT335** (Bacchus) (Figure 1A). These springs provide fresh water to the Florida Barge Canal and serve as a drinking water supply for mammals such as Manatees.

3. Site characterization

PEF has done limited testing of the geology of the north parcel, and no testing of the geology of the south parcel. Tr.1215 (Rizzo). *See also* tr. 1239 (Lehnen). The focus of the investigation was the safety of the reactors, and therefore boreholes were concentrated in a 0.6 mile radius around the reactors and the nuclear islands. Tr. 1215 (Rizzo); Tr. 1151 (Barnhurst). The rest of the 3,000-acre north parcel was only investigated by a few wells. [###cite] The characterization addressed "composition, variability, fracturing and dolomitization." Tr. 1133 (Stirewalt).

On the southern site where PEF plans to build the wellfield, no geological or water measurements of any kind were taken. Instead of measuring the aquifer properties below the southern part of the LNP site, PEF relied on extrapolations derived from regional groundwater modeling. PEF used the Southwest Florida Water Management District's ("SWFWMD's") regional groundwater model to simulate groundwater usage impacts. **Exhibit NRC001** at 5-7. We will refer to this iteration of the model as "Model 1." PEF applied a set of codes to reduce the size of the study area from the entire region to a 20 by 20-mile area. Tr. 1382. (Vermeul).

See also tr. 1404 (Rumbaugh). No measurements of water levels on the site or other additional information for the smaller area was inserted into the Model 1. *Id.* Based upon the results of Model 1, SWFWMD recommended the issuance of a water use permit to PEF and formulated to Conditions of Certification. *Id.*

The water level predictions of Model 1 were 8 to 9 feet lower than on-site measurements on and around the LNP site, and therefore the NRC Staff requested PEF to recalibrate the model "using site-specific and regional hydraulic head data to improve the model's goodness of fit." *Id.* PEF recalibrated the model by incorporating water level data collected from 23 wells on the south end of the north property. Tr. 1243 (Lehnen); tr. 1388 (Vermeul); **Exhibit NRC001** at 2-26. PEF also included regional water level data from the USGS. Tr. 1387 (Vermeul). PEF re-submitted the recalibrated model, which we will refer to as "Model 2." However, Model 2 predicted even larger drawdowns than Model 1 by up to a factor of 4. Tr. 1375, 1390 (Vermeul)

4. Environmental Impact Statement

In August of 2010, the NRC Staff published a Draft Environmental Impact Statement ("DEIS") for LNP, concluding that the environmental impacts to wetlands would be insignificant, *i.e.,* "SMALL to MODERATE." The NRC repeated the same conclusion when it issued the FEIS in April 2011, despite receiving extensive and detailed critical comments on the DEIS from Dr. Sydney Bacchus, an expert for Intervenors.

In evaluating the LNP's environmental impacts on wetlands, the NRC Staff relied on PEF's groundwater models and published groundwater data for the region. **NRC Exhibit 001** at 5-7. With respect to the model, the NRC Staff testified that it "did not perform a rigorous evaluation of the relative contributions of various components of the water balance calculation or confirm that all model implementation assumptions were valid." **Exhibit NRC090,** A.46 (Vermeul, Barnhurst, Vail, Prasad).

The NRC found that the drawdowns predicted by Model 2 – of as much as 2.5 ft in areas near the wellheads, with a drawdown of 0.5 ft extending up to 3 mi from the wellheads -- could adversely affect many acres of wetlands in the LNP site vicinity:

> [The] groundwater drawdown zone would encompass about half of the LNP site and substantial offsite areas, including many acres of wetlands. See Sections 2.3.1.2 and 5.2.1 for further detail about the groundwater models and projected impacts on groundwater resources. The recalibrated groundwater model for the LNP project predicts increased drawdown to the surficial aquifer from groundwater pumping over 60 years of operation. A review of the effects of groundwater drawdown on isolated wetlands in Florida suggests that extended drawdowns from 0.6 ft to 1 ft can result in substantial changes to vegetation composition and structure, and that a 1-ft or greater decline can adversely affect seasonally and semi-permanently flooded wetlands (Mortellaro et al. 1995).
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> Using the recalibrated groundwater model, up to 2092.9 ac of wetlands could be adversely affected over 60 years of groundwater pumping to support the LNP project, with 563.4 ac occurring within groundwater drawdown zones that exceed 1 ft. No wetlands would lie within groundwater drawdown zones exceeding 0.5 ft under the original DWRM2 model prepared by PEF.

Exhibit NRC001 at 5-27. The FEIS noted that the groundwater modeling results "should be viewed with a degree of uncertainty" because "groundwater models are subject to many limitations." *Id.* The fact that the results of Model 1 and Model 2 differed by a significant margin – 400% -- caused the Staff to conclude that while the model was appropriate for a water use assessment, it does not provide an accurate enough estimate of drawdowns to be used in wetlands assessment. Tr. 1390. This conclusion is reflected in the FEIS, which states that the uncertainty in hydraulic property values at the proposed LNP wellfield "demonstrates how differences in model values can substantially influence the assessment of wetlands impacts (i.e., the original Levy DWRM2 groundwater model compared to the recalibrated groundwater model." **Exhibit NRC001** at 5-27.

Based on the groundwater model results, the FEIS determined that "[c]onsidering the uncertainty associated with existing groundwater modeling for the LNP site, operational impacts from groundwater withdrawal to wetlands on and around the LNP site could affect the hydrological and hence ecological properties of wetlands within a localized area . . ." *Id.* at 5-30. Nevertheless because the terms of PEF's SWFWMD water use permit forbid PEF from causing "unacceptable adverse impacts on wetlands," the FEIS concluded that the environmental impacts of PEF's water withdrawals on the wetlands would be only "SMALL to MODERATE." *Id.* at 5-47.

B. Procedural History

1. Contention 4

On February 6, 2009, Intervenors submitted a set of contentions challenging PEF's COL application. The ASLB partially admitted Contention 4, which challenged the adequacy of the ER to address onsite and offsite dewatering impacts, impacts of salt drift from the saltwater cooling towers into the freshwater aquatic environment, and the underestimation of the zone of environmental impact and the areal extent of impact on listed species, irreversible and irretrievable impacts, and mitigation measures. LBP-09-10, 70 NRC 51, 101-06, 149-50 (2009). In November 2010, Intervenors amended Contention 4 to address the DEIS, and their contention was admitted in significant part on February 22, 2011.

2. Discovery and motion for summary disposition

Following the DEIS' disclosure that the Staff had relied upon the results of Model 2 for its conclusions about the environmental impacts of LNP on wetlands, Intevenors requested a copy of the model files from the Staff. Staff, however had not obtained the files or reviewed them. Therefore the Intervenors requested the information from PEF. After PEF refused to produce the information, the Intervenors filed and were granted a motion to compel disclosure of the files. LPB-10-23 MEMORANDUM AND ORDER (Granting Motion to Compel Disclosure of Groundwater Modeling Information) (December 22, 2010).

After the DEIS was issued, PEF also filed two motions seeking dismissal of portions of Contention 4. In motion to dismiss the portion of Contention 4 related to dewatering because 1)the production wells had been moved off site, 2) that the State had issued Conditions of Certification (COCs) and 3) that the DEIS analysis of active dewatering differed from and did not rely on Progress's analysis. The ASLB denied the motion on February 2, 2011 in LBP-11-01 (Denying Motion to Dismiss Portions of Contention 4 as Moot).

On October 4, 2010, PEF moved for summary disposition of Contention 4 with respect to the issues of salt drift and passive dewatering. PEF argued there was no genuine issue of material fact because the scope and magnitude of salt drift and passive dewatering were known and could not noticeably destabilize the affected aquatic resources. The ASLB denied the motion in Memorandum and Order (Denying Motion for Summary Disposition of Aspects of Contention 4) (February 2, 2011).

3. Written pre-filed statements of position and testimony

The parties pre-filed statements of position and exhibits on June 26, 2012. Rebuttal statements of position and exhibits were submitted on July 31, 2012. In addition, the parties submitted legal briefs regarding questions raised by the ASLB. The ALSB took into evidence the following pre-filed testimony:

a. Intervenors

Intervenors submitted written pre-filed testimony by four highly qualified experts regarding the scientific and regulatory deficiencies in the FEIS. Gareth Davies (**Exhibit INT001R** and **Exhibit INT501R**) is an expert in the hydrogeology of karst regions who is employed as a consultant hydrogeologist for Cambrian Ground Water Co. and also works for the Tennessee Department of Environment and Conservation in the Department of Energy Oversight Office. Dr. Tim Hazlett (**Exhibit INT101R** and **Exhibit INT601**) is an expert in hydrogeology, integrated groundwater-surface water modeling, and the use of numerical models for the quantitative assessment of groundwater and groundwater-surface water systems. He is President and CEO of DHI Water & Environment, Inc., a consulting service business in the U.S. and Canada.

David Still (**Exhibit INT201R** and **Exhibit INT601R**) is an expert on water management issues with 18 years of experience as a regulator in the Suwanee River Water Management District ("SRWMD"). He was Executive Director of the SRWMD from 2008 until May of 2012. Recently retired from SRWMD, Mr. Still is a consultant on technical and policy issues related to water management in Florida. Dr. Sydney Bacchus (**Exhibit INT301R** and **Exhibit 801R**) is a hydroecologist specializing in the assessment of hydroecological environmental impacts in the southeastern coastal plains physiographic province, with particular emphasis on man-made alterations of natural hydroperiods, in particular karst hydrology of the Floridan aquifer system. Dr. Bacchus is a hydroecologist specializing in the assessment of hydroecological environmental impacts in the southeastern coastal plains physiographic province, with particular emphasis on man-made alterations of natural hydroperiods within the regional karst Floridan aquifer system. She was employed as a hydroecologist for the U.S. Environmenal Protection Agency for six years. Dr. Bacchus, who is currently employed by Applied Environmental Services, L.L.C. as a hydroecologist, has studied the hydroecology of the Floridan aquifer system for 40 years and has authored more than 32 peer-reviewed publications concerning the effects of anthropogenic water withdrawals on wetlands, particularly depression wetlands such as occur at LNP.

b. NRC Staff

The NRC Staff presented direct testimony by a panel of eleven witnesses: Mallecia A. Sutton, Ann L. Miracle, Michael T. Masnik, J. Peton Doub, Lara M. Aston, Dan O. Barnhurst, Lance W. Vail, Rajiv Rasad, Vince R. Vermeul, Kevin R. Quinlan, and Larry K. Berg. **Exhibit NRC090.** The Staff also presented rebuttal testimony by the same panel of witnesses, excluding Ms. Sutton and adding Gerry L. Stirewalt. **Exhibit NRC091.**

The hydrology portions of the Staff's testimony were provided by Mr. Barnhurst, Mr. Vail, Dr. Prasad, Mr. Vermeul, and Dr. Stirewalt. The terrestrial ecology portions of the Staff's testimony are sponsored by Mr. and Ms. Aston. Dr. Masnik and Dr. Miracle provided the aquatic ecology portions of the Staff's testimony. Mr. Quinlan and Dr. Berg provided the atmospheric portions of the Staff's testimony.

Ms. Sutton is employed as a Project Manager in the Environmental Projects Branch 1, in the Division of New Reactor Licensing in the Office of New Reactors (NRO) at the NRC. Ms. Sutton has a Bachelor of Science degree in Biology, and she has worked as an environmental project manager at the NRC for five years. Dr. Miracle is a scientist in the Environmental Assessment Group, Earth Systems Science Division, Energy and Environment Directorate at the Pacific Northwest National Laboratory (PNNL). Dr. Miracle has a Bachelor of Arts in Biology from the University of Virginia, a Master of Science in Molecular Genetics from the University of Florida, and a Doctor of Philosophy in Molecular Immunology from the University of South Florida. Dr. Masnik is the Ecology Team Leader, in the Division of Site Safety and Environmental Analysis, NRO, NRC. He is also an aquatic ecology technical reviewer for this COLA. Mr. Doub is an Environmental Scientist in the Division of Site Safety and Environmental Analysis, NRO, NRC. He received a B.S. in Botany from Cornell University in 1982 and an M.S. in Botany from the University of California at Davis in 1984.

Ms. Aston is a scientist at PNNL who currently works in the Coastal Ecosystem Research Group, Marine Sciences Laboratory, Energy and Environment Directorate. She received her Bachelor of Science in Environmental Science from Western Washington University in 1999 and Masters of Science in Environmental Science from the University of Washington in 2004. Mr. Barnhurst is a hydrologist in the Division of Site Safety and Environmental Analysis, NRO, NRC. He is a technical reviewer for hydrological alterations, water use, and water quality issues associated with the LNP COLA. Mr. Barnhurst is a licensed professional geologist. Mr. Vail is a Senior Research Engineer in the Hydrology Group, Environmental Technology Division, Energy and Environment Directorate of PNNL. Mr. Vail holds a Bachelor of Science degree in environmental resources engineering from Humboldt State University and a Masters of Science degree in civil engineering from Montana State University. Dr. Prasad is a Scientist in the Hydrology Group, Environmental Technology Division, Energy and Environment Directorate of

PNNL. Dr. Prasad has a Bachelor of Engineering in civil engineering from the Regional Engineering College in Durgapur, India, a Master of Technology in civil engineering from the Indian Institute of Technology, and a Doctor of Philosophy in Civil and Environmental Engineering from Utah State University. Mr. Vermeul is a Senior Research Engineer in the Environmental Systems Group, Earth Systems Science Division, Energy and Environment Directorate of PNNL. Mr. Vermeul has a Bachelor of Science in agricultural engineering and a Masters of Science degree in civil engineering (environmental) both from Oregon State University.

Dr. Stirewalt is the Senior Geologist in the Geosciences and Geotechnical Engineering Branch of the Division of Site Safety and Environmental Analysis in the Office of New Reactors at the U.S. Nuclear Regulatory Commission. Dr. Stirewalt was the lead geologist on NRC's review of the LNP Final Safety Analysis Report (FSAR). Mr. Quinlan is a Physical Scientist specializing in meteorology in the Division of Site Safety and Environmental Analysis, NRO, NRC. Mr. Quinlan, who holds a Master of Science in Atmospheric Science and a Bachelor of Science in Meteorology. Dr. Berg is a Research Scientist in the Atmospheric Chemistry and Meteorology Technical Group, Atmospheric Sciences and Global Change Division, Energy Directorate at PNNL. Dr. Berg holds a Doctor of Philosophy in Atmospheric Sciences and a Master of Science in Atmospheric Science.

c. PEF

Dr. Mitchell L. Griffin (Exhibits PEF001 and PEF016) addresses passive dewatering during construction and operation of the LNP, as well as active dewatering during the LNP's construction. Dr. Griffin is a Principal Technologist in Water Resources with CH2M HILL, Inc.

in Gainesville, Florida.

James O. Rumbaugh, P.G. (Exhibits PEF100 and PEF104) addresses the design and calibration of the regional computer model used in predicting the impact on water resources from groundwater withdrawals during construction and operation of the LNP. He is a licensed Professional Geologist in Florida and Pennsylvania. Mr. Rumbaugh specializes in groundwater modeling. He designed and calibrated the regional groundwater model used by the SWFWMD in evaluating water use permit applications

Jeffrey D. Lehnen, P.G. (Exhibits PEF200 and PEF218) addresses computer modeling of the effects on water resources from active groundwater withdrawals during construction and operation of the LNP. Mr. Lehnen is a Senior Hydrogeologist with CH2M HILL, Inc. in Gainesville, Florida. He holds a B.S. degree in Geology from the University of Florida, and is licensed by the State of Florida as a Professional Geologist.

Dr. William J. Dunn (Exhibits PEF300 and PEF315) addresses the potential direct, indirect and cumulative impacts on water resources from active dewatering during operation of the LNP and from active dewatering during construction of the LNP. Dr. Dunn is a founder and partner with Dunn, Salsano & Vergara Consulting, LLC, in Gainesville, Florida, where he is the firm's principal scientist. He holds a Ph.D. in Systems Ecology from the University of Florida.

Dr. Kevin M. Robertson (Exhibits PEF400 and PEF404) addresses whether wildfires will be caused by active and passive dewatering during construction and operation of the LNP, as well as the potential impacts on water quality and the aquatic environment due to increased nutrients allegedly resulting from such wildfires. Dr. Robertson is a Fire Ecology Research Scientist and the Fire Ecology Program Director at Tall Timbers Research Station and Land

Conservancy in Tallahassee, Florida.

Dr. George Howroyd (Exhibits PEF500 and PEF506) addresses the maximum amount and dispersion of salt deposition from the LNP's mechanical draft cooling towers. Dr. Howroyd is a Vice President and Technology Fellow at CH2M HILL, Inc. in Atlanta, Georgia. He holds a Ph.D. in Mechanical Engineering, an M.S. in Mechanical Engineering, and a B.S. in Mechanical Engineering, all from the University of Waterloo, in Ontario, Canada. He is licensed as a Professional Engineer in Georgia and Mississippi.

Dr. Eldon C. Blancher (Exhibits PEF600 and PEF608) addresses the impact on water resources of salt deposition from the LNP's mechanical draft cooling towers. Dr. Blancher is Chief Scientist and CEO of Sustainable Ecosystem Restoration in Mobile, Alabama. He holds a Ph.D. in Environmental Engineering Sciences from the University of Florida, an M.S. in Zoology and Physiology from Louisiana State University, and a B.S. in biological sciences from the University of New Orleans.

Dr. Paul C. Rizzo (Exhibit PEF700), responds to the Intervenors' testimony asserting that groundwater at the LNP flows through preferential conduits due to the presence of karst. Dr. Rizzo is the founder of Paul C. Rizzo Associates, Inc. ("PCR"), located in Pittsburgh, Pennsylvania. Dr. Rizzo holds a B.S., an M.S., and a Ph.D, all in civil engineering from Carnegie Institute of Technology. Dr. Rizzo and his team assessed the geologic and geotechnical conditions of the LNP site to develop a plan for designing and constructing the LNP's foundations. It should be noted that Dr. Rizzo testified extensively on the geology of the LNP site, but is not a geologist.

Peter G. Hubbell (Exhibit PEF800) responds to the Intervenors' testimony challenging the SWFWMD's processes for water use permitting and the protection of water resources. Mr. Hubbell is a co-founder, Principal, and Senior Hydrologist for Water Resources Associates, Inc., an environmental engineering firm located in Tampa, Florida. Mr. Hubbell holds a B.S. in Hydrology and Water Resource Management from the University of Maryland.

4. Motion to strike portions of Intervenors' testimony

On August 10, 2012, the Staff and PEF filed motions to strike portions of Intervenors' rebuttal testimony regarding the FEIS' inadequate discussion of alternatives and failure to provide an adequate opportunity for public comment. The ASLB granted the motions on September 6, 2012. Order (Granting in Part and Denying in Part Motion in Limine and Motion to Strike). The ASLB did not, however, strike Intervenors' testimony with respect to alternative water sources or mitigation of environmental impacts. *Id.* at 7.

5. Evidentiary hearing

On October 31 and November 1, 2012, the ASLB conducted an evidentiary hearing in which it questioned witnesses for all of the parties regarding their written pre-filed testimony. The oral testimony clarified a number of points on which there is no dispute. These undisputed points form a crucial basis for our decision below.

IV. FINDINGS OF FACT

A. Site Characterization

1. Site geology and its relevance

The parties agree that the aquifer from which PEF proposes to draw its service water is karstic limestone. Exhibit PEF200, A.13 (Lehnen); **Exhibit INT001R**, A.9 (Davies); **Exhibit NRC001** at 5-26. All parties agree that in well-developed karst preferential flow pathways form along the bedding planes of the limestone as water penetrates into small voids, but that such pathways may be supplemented by fractures formed during uplift and through other mechanisms.

While there is some dispute about whether the site may be considered "well-developed karst," the Staff acknowledges that there could be inter-connected preferential pathways for groundwater flow below the site and PEF acknowledges that there are voids below the northern site, but questions whether they are interconnected. The parties disagree, however, about the degree to conduits are likely to be present in the karst and the extent of the fractures that are present. As discussed in detail below in Section IV.A.3, the dispute over whether the site is a well-developed karst is largely semantic. Even PEF geologists have acknowledged that fractures and voids are present, although a dispute remains about the extent to which the voids are inter-connected to form conduits. The issue of whether preferential flow pathways that transmit much of the flowing groundwater are present at the site is relevant to our disposition of this case because the monitoring plan would need to take account of such pathways. Based on Model 2, PEF and the NRC Staff have assumed that that the rock is homogeneous and that the wells will draw water evenly over a large and uniform area surrounding the wells. Tr. 1261 (Lehnen). Using these assumptions, depression of water levels would be spread relatively evenly over a circular area on the ground surface. *Id.* In contrast, if the Intervenors are correct, the impacts could look more like a star pattern aligned along vertical fractures and conduits. For example, if the nuclear island blocks conduits, nearby springs such as Big King Spring and Little King Spring and the wetlands that they feed could be affected because the northern site is likely within the catchment area of these springs. Exhibit INT501R, A.4 (Davies); Tr. at 1287-88 (Davies); *see also* Exhibit INT301R, A.12 (Bacchus). In addition, if PEF's supply wells draw from underground conduits or vertical fractures, the water removal may fatally depress water flow to wetlands that either are fed by the conduit flow, or lie along vertical fractures. Tr. 1285 (Cite Bacchus). As the NRC Staff concedes: "groundwater pumpage in formations containing preferential pathways could result in larger impacts to portions of the wetland system if large-scale fracture networks or dissolution channels are in direct hydraulic connection with a wetland feature." Exhibit NRC090**,** A.33 (Vermeul). This shows that the Staff understands that the existence of fractures and conduits is critical to the assessment of wetland impacts, but for some reason failed to incorporate this understanding into the FEIS.

Furthermore, although the presence of preferential flow pathways that feed the well-field may result in less impact on average, it could result in faster and more concentrated impact at locations that will not be monitored because they are not in the predicted circle of impact. Thus, the presence of preferential flow pathways would negate the Staff's logic that the monitoring and mitigation plan will detect and then mitigate any impact.

Finally, regardless of the questions regarding the existing groundwater flow patterns on the site, there is no question that PEF plans to build major concrete structures in the wetlands that could impede water flow through any geological medium. The impact assessment for this large disturbance to the aquifer system consisted of some hand calculations by a geologist who did not consider whether the structures could affect the Big and Little King springs. PEF015. This assessment erroneously relies on the assumption that the flow will divert around the impermeable structures in a predicable manner, whereas it is more likely that these islands will intersect some of the large conduit network that conveys water to Big and Little King springs. Exhibit INT301R, A.12 (Bacchus); Exhibit INT501R**,** A.4 (Davies); Tr. at 1287-88 (Davies).

2. Nature and extent of site investigations and groundwater modeling

a. Site characterization

As discussed above in Section III.A.3, the record shows that PEF has done minimal work to characterize the environmental characteristics of the northern part of the LNP site beyond 0.6 miles around the nuclear island, and none at all to characterize the environmental characteristics of the southern part of the site where the water withdrawal wells would be located. Tr.1215 (Rizzo).

The area within a 0.6 mile radius of the nuclear islands was characterized by 118 vertical boreholes to about 500 feet. *Id.* Later, PEF used shallower wells to monitor groundwater levels at the southern end of the north parcel. Tr. 1239 (Lehnen). These wells were monitored continuously for water level for a year, but PEF did not measure transmissivity. Tr. 1387 (Vermeul).. The water level information was incorporated into Model 2. Tr. 1243 (Lehnen)..

The focus of PEF's investigation on the north parcel was the safety of construction and operation of the reactors. As. Dr. Rizzo explained, the study addressed:

> (1) the impact of the transmissivity and the storativity of the Avon Park Formation on dewatering and the excavation, (2) the postulation that dissolution activity in the Avon Park Formation could activate or change over the lifetime of the LNP, (3) the impact of the LNP on the flow of groundwater around and beneath the foundation and (4) the assessment of the behavior of the LNP Site under postulated extreme seismic events.

Exhibit PEF700**,** A.5 (Rizzo). The study was not designed to address environmental impacts. Tr. 1248 (Rizzo). Because of the safety focus, boreholes were concentrated around the reactors and the nuclear island. Tr. 1215 (Rizzo).

PEF also conducted reconnaissance level mapping of sinkholes and lineaments in a five-mile zone around the center of the reactors. Tr. 1215 (Rizzo). The area extends to the

Withlacoochee Florida Barge Canal and Rainbow Springs. *Id.* Dr. Rizzo testified that PEF found vertical fractures in this larger, area, but they were filled with soil or weathered limestone. Tr. 1220 (Rizzo). PEF found a definable pattern of vertical fractures and traced them back to the north parcel, but did not trace them to the south parcel. Tr. 1220-21 (Rizzo).

For instance, the Staff claims that the LNP site is in the Avon Park formation, based on site characterization that is limited to a 0.6 mile radius around the nuclear island. Tr. 1132-34 (Stirewalt). According to Dr. Stirewalt, that is "very well characterized for both the depth and the breadth of what parts of the Avon Park are indeed dolomitized." *Id.* Tr. 1132 (Stirewalt).

The parties agree that the Ocala Formation is predominantly calcium carbonate that is highly soluble. PEF and the Staff have argued that the Avon Park formation, which contains more magnesium carbonate is less soluble. However, at the hearing it became clear that these distinctions are less than clearcut and Ocala is present in the southern area of the site. Mr. Barnhurst testified that at the northern LNP site, the Ocala limestone did not occur because it was not deposited or because it had eroded away. Tr. 1162. Notably, PEF found predominantly limestone on top of the Avon Park in some of the boreholes. Tr. 1241 (Lehnen). This is consistent with PEF's view that as you move to the southern the site transitions from being purely Avon Park, to being Ocala underlain by Avon Park. Tr. 1235 (Rizzo). However, PEF's witnesses cautioned that the classifications of these rocks are not clearcut. Tr. 1237 (Rizzo); Tr. 1240-41 (Lehnen). Morever, Mr. Davies testified that conduits can form in the Avon Park and the Ocala, and that the presence of Big and Little King springs shows that to be the case, because those springs are in the Avon Park and must be fed by a large conduit network to flow at 5 Mgd.

The NRC Staff witnesses testified that they relied on USGS regional maps showing that the transmissivity of the area near the LNP site was not over 100,000 GPD. On the north parcel, pump testing was performed in the surficial aquifer and in the Upper Floridan Aquifer to determine site parameters such as transmissivity. Tr. 1154, 1156 (Barnhurst). Transmissivity is a parameter that describes the ease at which the aquifer transmits flow. Tr. 1154-44 (Barnhurst). High transmissivity is one indication of large subsurface conduits. Tr. 1155 (Barnhurst). Mr. Barnhurst testified that transmissivity values on the north parcel were between 62,000 and 69,000 feet squared per day and that the USGS considers much higher flows of 250,000 to a million gallons per day to demonstrate the existence of well-developed karst. Tr. 1155. Similarly, according to PEF, the models and the field data indicate transmissivities of around 70,000 sq. feet/day near the nuclear island. Tr. at 1419 (Lehnen). Moving to the south site, these transmissivities estimated by the model increase to around 100,000 to 200,000 sq. feet/day. *Id.* Even further south, the transmissiviities estimated by the model are in the millions. *Id.* According to USGS the transition to a well-developed karst occurs at around 250,000 sq. feet per day. Tr. at 1402 (Rumbaugh). Thus, in terms of the USGS definition, the site transitions to well-developed karst as we move to the south.

No pump testing was done on the south parcel. Exhibit NRC090, A.41 (Vermeul, Barnhurst, Vail, Prasad). *See also* tr. 1156, 1176 (Barnhurst). No testing of the south parcel was done for the Regional Model. Tr. 1182 (Vermeul). However, pump testing of the south parcel is feasible and is planned for after license issuance as part of the Aquifer Performance Test. Tr. 1157 (Barnhurst). The NRC Staff believes that once these tests are made, uncertainty will be greatly reduced. Exhibit NRC090, A.41 (Vermeul, Barnhurst, Vail, Prasad).

Dr. Stirewalt also testified that although he inspected the north parcel for signs of karst development that could affect the safety of the reactors, he did not visit the south parcel. Tr. 1184, 1192. And although he looked at aerial photos that included the south parcel, he did not assess the photos of the south property "as thoroughly" as for the north parcel because the purpose of his inspection was safety-related. Tr. 1192-93. Mr. Barnhurst and Mr. Vermeul testified that they had visited the south parcel, but did not describe any systematic inspection for karst development. Tr. 1193. While Mr. Barnhurst cited a USGS map showing the general locations of sinkholes over the entire state of Florida (Exhibit NRC076**)**, he could point to no smaller-scale study or personal observation. Tr. 1194.

Although the NRC Staff relied on a USGS map for the southeastern U.S. that shows transmissivity values of less than 100,000 GPD in the general area of the LNP site, the Staff did not know whether the USGS had any data points on the south parcel. Tr. 1177 (Barnhurst, Vermeul, Stirewalt). The Staff testified that the USGS had two wells within a mile or two of the south property. Tr. 1183 (Vermeul). These wells were sampled for water level, but not necessarily transmissivity data. *Id.*

The NRC Staff testified that in addition to the pump testing, it relied on U.S. Geological Survey ("USGS") transmissivity distribution maps for the region. Tr. 1159 (Vermeul). This information was already included in the model, however. Tr. 1383 (Vermeul). Therefore it does not constitute additional independent information.

Finally, PEF has not performed any geological characterization work with respect to the Big and Little King Springs beyond relying on the Springs of Florida publication.. Tr. 1459 (Lehnen). During the simulations, PEF did not even look at how the flows in the springs changed. *Id.* The post-construction monitoring program also fails to look at the springs. Tr.

1554 (Dunn). This is apparently because the SWFWMD tends to focus on wetlands and not springs. *Id.*

b. Groundwater modeling

As discussed above in Section III.A.3, instead of measuring the aquifer properties below the southern part of the LNP site, PEF relied on extrapolations derived from regional groundwater modeling. PEF performed two iterations of SWFWMD's regional groundwater model to simulate groundwater usage impacts. Exhibit NRC001 at 5-7. Model 1 was a "telescoping mesh refinement" of SWFWMD's DWRM2 regional groundwater flow model. Tr. 1382 (Vermeul). PEF applied a set of codes to reduce the size of the study area from the entire region to a 20 by 20-mile area. *Id.* (Vermeul). *See also* tr. 1404 (Rumbaugh). No measurements of water levels on the site or other additional information for the smaller area was inserted into the model. *Id.* At the hearing, this process was accurately characterized as like blowing up a tiny area of a large digital picture; inevitably the result is highly pixilated. Tr. at 1384 (Vermeul). Based upon the results of Model 1, SWFWMD recommended the issuance of a water use permit to PEF and formulated to Conditions of Certification. *Id.*

In response to a question from the NRC Staff, Model 1 was modified to include Big and Little King Springs as drain cells. Tr. 1415 (Lehnen). Model 1 predicted a conical drawdown impact on the surficial aquifer on the order of 0.4 to 0.5 feet in areas immediately adjacent to wellheads over a 60-year period of groundwater pumping with drawdown at the surface expanding in a circle. Exhibit NRC001 at 5-27.

The water level predictions of Model 1 were lower than on-site measurements collected by PEF by around 8 to 9 feet. Tr. at 1371-72 (Vermeul); 1421 (Vermeul). In addition, the predictions of Model 1 did not correlate with nearby measurements of the hydraulic head at the TJ Ranch. Tr. 1385 (Vermeul). Although there was some dispute about the accuracy of that location, Dr. Rumbaugh said he regards it as a measurement of the water level of the surficial aquifer. Tr. at 1409-10 (Rumbaugh).

Given these anomalous results, the NRC Staff requested PEF to recalibrate the model "using site-specific and regional hydraulic head data to improve the model's goodness of fit." *Id.* PEF recalibrated the model by incorporating water level data collected from 23 wells on the south end of the north property. Tr. 1243 (Lehnen); tr. 1388 (Vermeul); Exhibit NRC001 at 2-26. PEF also included regional water level data from the USGS. Tr. 1387 (Vermeul). PEF re-submitted the recalibrated model, which we will refer to as "Model 2."

Model 2 predicted even larger drawdowns than Model 1 by up to a factor of 4. Tr. 1375, 1390 (Vermeul) . As summarized in the FEIS:

> Predictive simulations using the recalibrated model indicate that annual average LNP groundwater usage from the Upper Floridan aquifer would, over 60 years of operation, result in surficial aquifer drawdowns of as much as 2.5 ft in areas near the wellheads, with a drawdown of 0.5 ft extending up to 3 mi from the wellheads (Figure 5-5).

Exhibit NRC001 at 5-26. However, Model 2 suffered from a number of important deficiencies. For example, an artificial recharge of 5 Mgd was added to the model by placing a river cell within the model, even though there was no river there and this effectively added non-existant rainfall. Tr. 1422-1424 (Lehnen). Other deficiencies of Model 2 and the Staff's rejection of both Model 1 and Model 2 is described in Section IV.B.2 below..

3. Evidence of preferential flow paths

This section addresses whether preferential flow paths exist beneath the site. This discussion has sometimes been conflated with the question of whether there is "well-developed karst"[2] on the site. We believe that these are separate questions. Whether or not the site is geologically classified as "well-developed karst" it is indisputable that the karstic feature of preferential flow paths occur on the site. A fair reading of all the evidence documents that fractures that could serve as preferential flow paths for wetland dewatering dissect the site. In addition, the site is covered with many depressional pond-cypress wetlands that are indicators of karstic conduits.

All parties found evidence of preferential flow pathways below the site. The pathways consist of vertical fractures extending laterally and horizontal conduits that can form at the junction of bedding planes in the limestone. With regard to vertical fractures, all parties acknowledge that they exist and could be permeable, but intervenors believe they are more prevalent. *Compare* tr. 1216, 1219 (Rizzo) with tr. 1280-86, **Exhibit INT369, INT370**.

With regard to conduits, the parties interpret the available evidence differently. Intervenors' experts believe there is an interconnected network of fractures and provided evidence of interconnected karst-related conduits flowing to the Big and Little King Springs to the north and to the Withlacoochee Canal to the south, Staff believes such a network could exist to the south, but not to the north, while PEF believes that voids are present in the aquifer underlying the northern site, but that these voids are not interconnected.

With regards to conduits, the Staff acknowledged that the site is karst, but terms it "surficial type karst dissolution." Tr. 1148 (Barnhurst). By this Mr. Barnhurst meant that there

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2 Defined by a lower limit of Transmisivity of 250,000 ft^2/day

was no evidence of an interconnected network of conduits. Tr. 1145-46 (Barnhurst). However, this characterization applies only to the Avon Park, not to the south of the site, where the surficial Ocala is present. Tr. 1138 (Barnhurst). Notably, the Staff was unaware of the sinking stream that flows west from the site as well as other sinking streams in the vicinity Tr. 1342, 1343 (Bacchus) (*Compare* Tr. 1153 (Vermeul) to **Exhibit INT373.**

In the southern portion, the Staff believed that preferential flow pathways could be present and might be found by further investigation. Tr. 1185 (Vermeul). The Staff also acknowledges that the presence of Big and Little Springs is evidence of "karst related spring flow" close to the north boundary of the site. . Tr. 1146 (Barnhurst). Thus, the Staff believes that the existence of such a flow network in the southern area is possible but has not yet been proven, but had no explanation for why it apparently believes that the Big and Little King springs cannot be fed by a conduit network that includes the northern part of the site.

With regard to the northern parcel,, PEF acknowledged that there is "minor karst activity" on the northern area that was investigated because it found voids of size 3 to 19 feet with evidence of dissolution at the edge of the voids. Tr. 1249-52 (Rizzo). However, PEF believed these voids are not conduits because they are not inter-connected, based upon grout take testing. Tr. 1253 (Rizzo). Nonetheless Dr. Rizzo stated that the classic situation where conduits form is where there is a "plus sign" of vertical fractures leading down to the almost horizontal bedding planes of the limestone. Tr. 1208-09. This situation is present at the site, but, because the vertical fractures were filled with soil and weathered limestone, PEF dismissed the possibility that conduits were present. Tr. 1219-20 (Rizzo). However, even if fractures are filled with limestone and soil, they remain permeable. Tr 1260 (Lehnen). Filled fractures can therefore serve as preferential flow pathways to dewater wetlands under induced recharge from pumping. Tr. 1286 (Bacchus).

With regard to the southern site, PEF states that the transition on the site from surficial Avon Park-type limestone to Avon Park overlain by Ocala-type limestone on the southern site is gradual. Tr. 1226-27 (Rizzo); 1240 (Lehnen). In addition, the distinction between Avon Park and Ocala is not sharp, because both are mixtures of dolomite with calcium carbonate. *Id.* The distribution of the two types also varies from borehole to borehole. Tr. 1241 (Lehnen). Because the Avon Park is more brittle, it is more susceptible to fracturing. Tr 1259 (Lehnen), while the more soluble Ocala is more susceptible to dissolution.

Many features of karstic landscapes have been observed close to the site. Big King and Little King Spring are around 3,000 feet from the northern site to the northwest and have a combined flow of approximately 5 Mgd. Tr 1269 (lehnen). These springs formed in the Avon Park formation to the northwest of the northern site. Tr 1234; 1235 (Rizzo). Although they are in an area of less transmissivity according to **Exhibit NRC018,** Figure 56 (see discussion tr. 1175), the presence of the springs is in itself evidence of the existence of an interconnected conduit network with a large catchment area of around 10-15 km by 10-15 km. Tr. 1288 (Davies).

Springs have been also observed along the Withlacoochee Canal. *See, e.g.,* **Exhibit INT337 (**Bacchus)(springs delineated by blue triangles). Dr. Rizzo characterized these springs as constituting only "seeps," although he conceded that there are "many" along the canal. Tr. 1351 (Rizzo). Dr. Rizzo's characterization was based on his personal observation, and he did not describe the use of standard technology that is available for locating springs and measuring their flow, such as airborne thermal imaging and Doppler technology, as PEF used for evaluation of offshore currents in the COL application. **Exhibit INT301R,** A.16. Additionally, the FEIS specifically mentions freshwater springs in the Withlacoochee Canal. **Exhibit NRC001** at 2-93.

A sinking ephemeral sinking stream or swallet indicative of conduit flow has been observed just off the edge to the northern site, less than 0.3 miles south of the Big and Little King springs. **Exhibit INT339, Exhibit INT372, Exhibit INT344.** *See also* tr. 1342-43 (Bacchus). Other sinking streams have been observed near to the site within the area of geographical impact. Tr. 1342-1343 (Bacchus).

The parties differ on the degree to which preferential pathways could be studied. PEF initially contended that investigating or identifying preferential flow pathways would be nothing more than a "research project" (PEF SOP at 3). In contrast, at the hearing, the NRC Staff and PEF stated that the Aquifer Performance Testing would characterize the presence or absence of these pathways during, Tr. 1185-86 (Verneul); Tr. 1487 (Hubble) ("All these questions about transmissivity and leakage and all the aquifer characteristics that we are talking about over the last day-and-a-half will be addressed through the APT test."). The Board concludes that Intervenors have presented ample evidence that basic methods for identifying preferential flow pathways in the form of fractures have been well-established in the field hydrogeology, and, most relevant to this decision, the hydrogeology of Florida. For instance, Intervenors cite numerous peer-reviewed published papers dating back to 1973 that demonstrate preferential flow paths can be identified by relatively simple methods. These include the following papers:

- A paper by Faulkner from 1973 shows that fractures, including faults, are important controls for orientation of solution channels and development of groundwater circulation patterns. **Exhibit**

INT370.

- In 1982, Brooke and Sun illustrated that relict sinkholes, including depressional wetlands and open-water areas ranging in size from ponds to lakes, are aligned along fractures throughout the Floridan aquifer system and fracture intersections are important because they are a factor associated with the increased probability of subsidence such as sinkholes, **Exhibit INT352.**
- In 1983, Brooke and Allison used the distribution and shape of sinkholes in the Floridan aquifer system to map fractures in the Ocala limestone, **Exhibit INT355.**
- In 1984, Littlefield, Culbreath, Upchurch, and Stewart showed that features such as joints, fracture zones or faults widespread throughout west-central Florida can be detected at all scales by the presence of ancient sinks, such as the depressional cypress wetlands on and surrounding the proposed LNP site. **Exhibit INT354.** Geophysical methods used in the Littlefield et al. study included horizontal electrical profiles, vertical electrical soundings, tri-potential profiles, and microgravity and triple-track gravity profiles. All or at least some of these established investigations should have been performed by PEF and or Staff.
- In 1988, Brook, Sun and Carver illustrated that supply wells associated with fractures were more productive (produced more water) than wells not associated with fractures. **Exhibit INT358.**

Intervenors and Staff also agree that demonstrating that tracer tests may be used to detect preferential pathways. **Exhibit INT001,** A.5 (Hazlett); **Exhibit 501R, A.13** (Davies); tr. 1154 (Vermeul).

Preferential flow through fractures in the Floridan aquifer system in response to pumping has been well-established since at least the 1980s. *See* **Exhibit INT355** (Brook, 1985). Another relevant example is a 2005 paper by Bacchus and Barile, peer reviewed and published by the Geological

Society of America showing that karst conduits also can be sinuous, with similar associated hydroperiod alterations and preferential flow resulting in adverse water quality and quantity impacts many kilometers from the source of the problem. **Exhibit INT368.** The Staff's expert Mr. Barnhurst testified that Staff were aware of these relic sinkholes and their associated depressional pond cypress wetlands. Tr. 1283.

We conclude that the existence of fractures that could act as preferential flow paths for the dewatering of wetlands has been firmly established and is not in serious dispute. With regard to conduits, the site investigation that has been conducted is too limited to firmly establish whether conduits are present or not. However, in this respect we agree with the Staff that preferential flow paths may be present on the Site. Indeed, there is ample evidence that to the south the transmissivities increase consistent with increasing conduit flow. We therefore believe that their existence is probable on both sites for the following reasons:

i) The key karst features described above indicate that there are conduits associated with the site;

ii) The springs that are probably present along the Barge Canal show conduits re present on the southern parcel of the site;

iii) The dissolution at the edge of the voids in the borings done for the northern part of the site would not have occurred without significant water flow;

iv) The fractures provide a vertical flow pathway that extends laterally for miles and facilitates conduit formation; and

v) Conduits can form most easily in the southern part of the site, where the Ocala is present at the surface, but the distinction between the Ocala and the Avon Park is not clear cut.

We also believe it is feasible for PEF to investigate the presence of these preferential pathways.

Therefore, to ensure that the monitoring programs looks for impacts in the right places, PEF and the Staff must do more to characterize the locations of the preferential flow paths and must take account of their presence when predicting wetland impact. This is not a task that can be left until after the project is licensed. Taking account of the fposible presence of conduits and fractures is necessary for an informed and reasonable prediction of potential environmental impacts from water withdrawals.

B. Findings Regarding Significance of Wetlands Impacts

1. The FEIS concludes that impacts to wetlands may be significant but were not accurately predicted.

Based on the results of groundwater modeling by PEF, the FEIS concedes that the environmental impacts of water withdrawals from the underlying aquifer on surrounding wetlands could be significant. **Exhibit NRC001** at 5-47. The NRC Staff also states that "[t]he hydraulic properties in the vicinity of the proposed wellfield have not been characterized and are thus relatively uncertain." **Exhibit NRC091,** A.14. In other words, the Staff has decided that it does not have enough information to rule out significant wetlands impacts.

The Staff has not quantified the level of uncertainty. Tr. 1188 (Vermeul). According to the Staff, quantification of the uncertainty was unnecessary. Tr. 1199 (Vermeul). According to Mr. Vermeul, an uncertainty analysis was not needed because the Staff could compare the results of Model 1 and Model 2 and see that "it was plausible that we could have a case where the impacts were larger than what's predicted from the original model." Tr. 1391. *See also* Tr. 1201 (Barnhurst) (stating that the uncertainty was "bounded" by the "regional studies that have taken place and the proximity of the wellfields to the area on the north parcel that was characterized.")

2. Modeling of impacts on wetlands and springs was inconclusive

As discussed above, PEF produced two versions of the groundwater model, which was based on a regional model for water allocation. Model 1 was merely a blow up of the regional model that initially contained no site-specific information and underestimated measured water levels by 8 to 9 feet. At NRC's prompting, PEF added Big and Little King springs into Model 1, but ultimately, the NRC Staff asked for a recalibration based on site-specific data. Model 2 was a site-specific model that predicted up to four times more drawdown than Model 1.

The Staff believed Model 1 was a poor fit to the measured data because its predictions of water levels were incorrect by about 10 feet. Tr. 1385-86 (Vermeul). Model 2 was calibrated to measured water levels on the site, but not to measured transmissivities. Tr. 1373-74 (Vermeul). Model 2 used water levels for 23 on-site wells drilled by PEF for calibration purposes. Tr. 1389 (Vermeul). These wells were on the north parcel, not the south parcel. Tr. 1239 (Lehnen). Unfortunately, Model 2 transmissivities disagreed with measured values on the site. Tr. 1457-58 (Lehnen). In addition, Model 2 did not simulate the projected increase in water usage from 3,51 mdg to 10.3 mgd in the modeled area. Tr. 1374-75 (Vermeul). This increase could increase predicted drawdowns by up to a factor of 3. Tr. 1374 (Vermeul). SWFWMD did not review the results of the Model 2, even though they were aware of its existence. Tr. 1376 (Vermeul). The Staff regarded Model 2 as a substitute for sensitivity analysis to determine how sensitive the predictions of impact were to changes in input parameters. Tr. 1381 (Vermeul). Because Model 2 predicted four times the drawdown predicted by Model 1, the Staff concluded that neither model produced sufficiently accurate predictions of drawdown to be useful for predicting wetlands impacts. Tr. 1390 (Vermeul).

The model does not simulate wetland directly instead wetland impacts are inferred from water levels. Tr. 1416-17 (Lehnen). The model also failed to include the nuclear islands. Tr. 1417 -18 (Lehnen). An artificial recharge of up to 5 Mgd was added to the model by placing a river cell within the model, even though there was no river there and this effectively added non-existent rainfall. Tr. 1422-1424 (Lehnen). This was needed to allow the model to be calibrated with the T&J ranch data. Tr. 1424 (Lehnen). This added approximately 3 to 5 mgd of water input to the model that does not really exist. *Id.* The simulations produced were based on constant recharge and did not simulate drought conditions. Tr. 1424-25 (Lehnen). PEF acknowledged that a lack of field data was one cause of model uncertainty. Tr. 1426 (Lehnen).

The model does not simulate preferential flow paths directly, but instead uses variations transmissivity to represent those features. Tr. 1433-34 (Hazlett). The preferred approach would be to embed the major flow pathways directly into the model, but tracer and other tests are needed to determine where these flowpaths are. Tr. 1436-37 (Hazlett). Transmissivity variations can simulate karst conditions at the regional level. Tr. 1439 (Hazlett). However, such variations cannot accurately simulate effects on local features such as wetlands and springs, especially given the large cell size of 250 square feet. Tr. 1440 (Hazlett). Illustrating that a different conceptual approach could have been taken, various agencies in Florida have used integrated surface water/groundwater models. Tr. 1440-41 (Hazlett).

We find that the Staff did little or no investigation of the geological characteristics of the area surrounding the well-field, and thus had little information about it. This lack of information was compounded by use of a model that incorporated features that did not exist and omitted some features that either do exist, like the vertical fractures, or will exist, like the nuclear islands. We conclude that the Staff did not have an adequate amount of information with which to make a reasoned and informed evaluation of the direct environmental impacts of the LNP water withdrawals to wetlands. The Staff correctly stated that it did not have enough information to rule out significant impacts, illustrating that it has not done a sufficient analysis to meet NEPA's purpose of providing an understanding of what the impacts will be. As discussed immediately below, the lack of sufficient information to support a reasonably well-informed impacts analysis also precluded the Staff from evaluating the adequacy of proposed mitigation measures.

2. Proposed reduction of environmental impacts through monitoring and mitigation

As discussed above, the FEIS concludes that the environmental impacts to wetlands caused by dewatering may be significant. Nevertheless, the FEIS concludes that ultimately, the impacts to wetlands will be rendered "SMALL to MODERATE", *i.e.,* insignificant, based on the Conditions of Certification imposed by SWFWMD on PEF's water use permit. **Exhibit NRC001** at 5-30. As stated in the FEIS:

> Because of the inherent uncertainty that exists with groundwater models, and to ensure that the proposed use of groundwater for the LNP project does not cause adverse impacts on wetlands and surface waters, the State of Florida imposed the following conditions in the final site certification issued under the PPSA (FDEP 2011a), to which PEF has committed:
>
> - Aquifer Performance Testing (APT) Plan that includes hydraulic testing during drilling and construction of the proposed water-supply wells to obtain site-specific hydraulic property estimates and determine whether the wellfield can meet groundwater-usage impacts without significantly affecting water levels in the surficial aquifer.
>
> - Alternative Water Supply Plan to investigate the feasibility of developing alternative water supply projects to offset groundwater use.

- Environmental Monitoring Plan (based on the SWFWMD Wetland Assessment Procedure) to assess the relative biological and physical condition of surface waters and wetlands in areas potentially affected by groundwater withdrawals.

Exhibit NRC001 at 5-30.

The NRC Staff predicts that the APT and EMP will be effective in detecting adverse impacts, thus allowing PEF to stop or mitigate them before they become severe:

> Considering the uncertainty associated with existing groundwater modeling for the LNP site, operational impacts from groundwater withdrawal to wetlands on and around the LNP site could affect the hydrological and hence ecological properties of wetlands within a localized area (see Table 5-2 and Figure 5-5). However, if adverse environmental impacts on wetlands and surface waters are predicted or detected through wellfield APT, revised groundwater modeling, or environmental monitoring of wetlands, PEF would be required either to mitigate the adverse impacts or implement an approved alternative water-supply project (FDEP 2011a).

Id. In this regard, the FEIS also relies on the effectiveness of SWFMWMD's performance review standards that are applicable to the EMP:

> In accordance with SWFWMD's review criteria, groundwater withdrawal cannot cause unacceptable adverse impacts on wetlands or other surface waters. The SWFWMD performance review standards applicable to the Environmental Monitoring Plan, upon which potential impacts on wetlands would be judged, include the following (as summarized from PEF 2009g):
>
> - Wet season water levels shall not deviate from their normal range.
> - Wetland hydroperiods shall not deviate from their normal range and duration to the extent that wetlands plant species composition and community zonation are adversely affected.
> - Wetland habitat functions, such as providing cover, breeding, and feeding areas for obligate and facultative wetland animals, shall be temporally and spatially maintained and not adversely affected as a result of withdrawals.
> - Habitat for threatened or endangered species shall not be altered to the extent that use by those species is impaired.

Id.

a. Insufficient factual basis for conclusion re effectiveness of mitigation measures

The problem with the Staff's conclusion is that it depends on the implicit assumption that if PEF monitors in the immediate location of the wellfield it will detect significant "localized" adverse environmental impacts. **Exhibit NRC001** at 5-30. In fact, however, the NRC has not gathered enough information about the behavior of groundwater in the vicinity of the LNP to reach any such conclusion. As discussed above, neither PEF nor the NRC Staff collected *any* empirical data regarding water levels or transmissivity on the south parcel where the wellfields are located, despite strong indications that transmissivity increases as one moves southward from the location of the reactors. Neither PEF nor the Staff made any attempt to look for or identify preferential pathways such as faults, fractures or conduits on the south parcel, despite established recognition of fractures **Exhibit INT 352, 354, 355, 370, 368, 37O** and strong evidence that other preferential pathways are found on the site Tr. p.1328 (Hazlett) p. 1323 (Davies)

The EMP also ignores offsite springs that may be affected by the wellfields and by the concrete structure under the nuclear island. -For the Big and Little King springs approximately 3,000 ft to the northwest of the northern site, no baseline Tr. 1539 (Bacchus) construction, or operational monitoring will be done Tr.1554 (Dunn). In addition, the EMP is based on Model 1, the Staff rejected for the LNP site. **NRC001** 2-29.

As discussed above, under the APT, baseline measurements of monitored wetlands are proposed, but not until the construction phase, when impacts may have already started to occur.

We conclude that because there are no reliable predictions for when or where impacts on springs and wetlands could occur, it is currently very difficult to design a monitoring strategy that does not monitor every wetland and spring. The current monitoring plan is based on the notion that impacts will be isotropic and homogeneous expanding slowly in all directions, but in fact the impacts are likely to be heterogeneous and isotropic (star shaped) because they will be aligned with preferential flow pathways and fissures. The impacts will also develop more quickly than anticipated because flow velocities in the preferential flow pathways are much faster than in an equivalent porous medium. Finally, significant impacts may occur offsite, where PEF has no plans to monitor. Given that it has little or no information regarding where or when impacts will occur, the NRC Staff's assertion in the FEIS that they can be detected and prevented or mitigated is tautological.

b. Lack of development of mitigation measures

Apart from the various technical deficiencies discussed above the EMP suffers from other major flaws. First, despite the NRC Staff's heavy reliance on the various elements of the CoC, including the EMP and the APT, it did not review them before declaring they would render the environmental impacts of the LNP on wetlands insignificant. Tr. 1529 (Doub). In fact, neither document has been finalized. Tr. 1481 (Hubbell); tr. 1486 (Hubbel).

Second, the EMP may be discontinued after five years, whether or not impact is observed **Exhibit PEF** 005 2.a.1. **INT201 A.19** As Dr. Bacchus testified, it is well established that adverse impacts to pond-cypress (*T. asendens*) wetlands using the monitoring methodolgy proposed in the EMP may not be detected until well after five years have elapsed. **Exhibit INT801R,** A.9 (Bacchus). By the time the monitoring proposed in the EMP detects those adverse impacts those impacts are irreversible. **Exhibit INT801**, A.9, A.10. As Mr. Still testified, impact monitoring should be required for the life of the plant. **Exhibit INT701R,** A.10 (Still).

Third, the EMP relies on the notion that if unacceptable impact is observed, it can ultimately be mitigation by installing a desalination plant. However, PPEF's own witness declared such a plant to be infeasible. Tr. 1516 (Hubbel) .If the FEIS assessment that all the other feasible alternatives is correct, this means the EMP is little more than an illusory promise to install a water supply that would be prohibitively expensive in reality.

In addition, the EMP will be based on an inappropriate baseline, because the baseline data is currently due to be taken during construction, when 90,000 gallons per day of groundwater is being extracted. **Exhibit INT701R,** A.11. Baseline conditions, if they are to mean anything, should be determined before *any* dewatering begins at the site. *Id.* The EMP fails to monitor for potential far-field impacts on springs and wetlands. *Id.,* A.12. The EMP also fails to align the monitoring along the lines of conduit flow and could therefore miss impacts. *Id.,* A.13. Furthermore, the EMP fails to monitor for water quality. *Id.,* A.18. Mr. Still notes the absence of minimum flows and levels ("MFLs") and a Groundwater Basin Regional Inventory Assessment. **Exhibit INT701,** A.24. DR. Bacchus is also concerned that the EMP does not provide for establishment of a valid "baseline" for monitoring impacts to wetlands, because the initial monitoring would not take into account alterations of the natural hydroperiods that have occurred already or would occur during construction. **INT301***,* A. 46, A.49 **INT801** A.8

Finally, the EMP is too narrowly focused on impacts whose sole cause is the groundwater pumping, rather than impacts which the construction and operation of the LNP plant could contribute in addition to other factors. **Exhibit INT301** A.12.

In addition, Dr. Bacchus testifies that the EMP makes no mention of any type of monitoring to assess the impacts from salt drift and deposition on the vegetation and water on the proposed LNP and surrounding vicinity. The EMP's failure to include any type of monitoring of the impacts of salt deposition is a grave omission considering the sensitivity of vegetation to ionic changes, particularly salt, is well established. **Exhibit INT801R,** A. 7

Finally, Dr. Bacchus addresses the EMP's proposal to "deepen production wells" as a mitigation measure in the EMP **Exhibit INT801R,** A. 11. She opines that this alternative would not eliminate induced recharge and capture because water still would be pulled downward from the surficial aquifer and laterally from surrounding springs, streams and other surface waters in the vicinity, such as the numerous springs discharging into the Withlacoochee canal. Induced recharge from the proposed LNP groundwater withdrawals also would result in induced saltwater intrusion from the coast and would increase the potential for contamination of the aquifer system due to upconing, or upward induced recharge, of more saline water at deeper intervals. *Id.,* A.7.

Finally, the NRC places undue reliance on the prediction of rigorous enforcement of the EMP. Although Florida Law is designed to prevent impact on isolated wetlands, such as those at the LNP site, in practice the processes established under these laws often fail to prevent such impact. Tr. 1539-40 (Bacchus); Tr. 1452 (Bacchus (citing **Exhibit INT420);** Tr. 1496 (Hubbel); **Exhibit INT701** (Still). There is no similar process to prevent impact on springs, which appear to have been omitted from the Staff's analysis of whether the EMP process would be sufficient to control potentially large impacts on wetlands. Large impacts on springs are possible here, but have gone unaddressed. Impacts on the Big and Little King springs would have impacts on the wetlands that these springs feed. Again, these potential impacts have been omitted from PEF's and the Staff's analysis of impact, monitoring, and mitigation.

3. Cumulative impacts

As Dr. Bacchus testified, PEF proposes removing significant amounts of water from an ecosystem already stressed from alterations in natural hydroperiods. This removal will take place in many different ways, including: mechanical dewatering from pumping from the proposed LNP supply wells, and dewatering for excavation of the nuclear islands; passive dewatering from capture and impoundment of water in the stormwater ponds; evaporative loss from the stormwater ponds, ditches, swales and other features to reroute water; alteration of historic sheet-flow via "stormwater management;" disruption in the existing preferential flow pathways caused by the huge nuclear islands; and withdrawing freshwater from the Withlacoochee Canal via the Cooling Water Intake System ("CWIS").

The NRC Staff asserts that the cumulative impacts of the LNP, when taken together with other impacts, are "MODERATE," in other words big enough to be noticed but not big enough to be significant. Tr. 1121 (Martin). These cumulative impacts include the direct impacts of the LNP, combined with other impacts such as salt intrusion, salt drift from LNP cooling towers, climate change effects, and impacts from nearby mining operations. The principal contributor to these cumulative impacts is the dewatering of wetlands by PEF's water withdrawals. The NRC Staff, however, has gathered very little information about the dewatering impacts, and much of it is concededly faulty. Therefore it is not possible for the NRC to make a reasoned assessment of how these direct impacts combine with other impacts.

As stated in the NRC Staff's rebuttal testimony, for instance, the FEIS' conclusions about the potential for saltwater intrusion are based in part on the groundwater modeling results of Model 1 and Model 2 (attributing insignificant cumulative impacts of saltwater intrusion in part to "relatively small drawdowns" at a distance from the wellfield). As demonstrated above, however, these models are demonstrably inapplicable to the specific characteristics of the LP site. Because the FEIS fails to adequately analyze the direct impacts of dewatering, it is not possible to adequately address the cumulative effects that may be caused by dewatering in combination with salt intrusion, salt drift, competing industrial water uses, and wildfires.

In some respects, the FEIS did not even attempt to add the effects of dewatering to other impacts. For instance, the modeling of salt dispersion was also based on long term average meteorological conditions. **Exhibit PEF500, A.17, PEF 506 A.19.** (Howroyd). In addition, **NRCOO1**(p. 7-19) acknowledges that sea level may rise, but fails to address the cumulative effects of these changes in combination with the effects of dewatering, hydroperiod alterations and salinization. *See* **Exhibit INT401,** A.45 (Bacchus).

The FEIS also relies on out-of-date information about severe conditions in Florida that will affect the impacts of LNP, including increasing periods of drought. When utilizing freshwater from highly dynamic coastal karst systems, one cannot rely upon long term averaging of rainfall conditions. In the short term, during times of drought, the resource can be destroyed by over-pumping, which leads to saltwater intrusion. The FEIS grossly oversimplifies the hydroecological conditions of the LNP site and the geographic area of adverse impacts, averaging data regarding rainfall (Tr. p.1426 (Lehnen), Tr. p. 1403 (Rumbaugh) Exhibit **INT201** A.8 (Still), and hydroperiods **Exhibit INT**301 A. 3 (seasonal fluctuations in water levels) on which the plants and animals in the LNP wetlands depend.

VII. CONCLUSIONS OF LAW

As discussed above, the question at the heart of this case is whether the NRC Staff lawfully may rely on a promise to reduce potentially significant environmental impacts to an insignificant level by monitoring their occurrence and attempting to swiftly prevent or mitigate them before those impacts become irreversible, when the NRC concededly has very little information about how, when or where those impacts will occur. We conclude that the FEIS falls short of taking the "hard look" at wetlands impacts that is required by NEPA. *Robertson,* 490 U.S. at 349.

As is clear from the hearing record, neither PEF nor the NRC Staff conducted any technical investigation whatsoever into the geology of the southern portion of the LNP site, where PEF proposes to locate its groundwater withdrawal wells. And little study was made of the geology of the north parcel beyond the immediate surface footprint of the proposed reactors. The FEIS simply assumes that the limestone rock beneath the site is uniformly porous, that water will draw down uniformly, and therefore it will be adequate for PEF to look for adverse effects in a wide radius around the service-water wellfield. The NRC has ignored substantial evidence, documented by the Intervenors in this proceeding, that the karstic limestone under the site is laced with preferential flow pathways, such as vertical fractures extending for many miles into surrounding counties and dissolution conduits along the bedding planes, that can laterally conduct a large volume of water rapidly and to off-site locations such as offsite springs. By the same token, if water is drawn from these features they can also serve to rapidly and drastically dewater springs and wetlands, both in the immediate vicinity and for considerable distances offsite. PEF has made no effort to identify or monitor along these preferential flow pathways, prevention or mitigation of adverse impacts will fail. In addition, the large structures that PEF plans to build may block overland flow of fresh water through the wetlands as well as groundwater flow to nearby springs.

The NRC Staff concedes that the environmental impacts of the LNP to wetlands may be significant, but claims that any significant adverse impacts to wetlands will be prevented or mitigated by PEF's planned measures for monitoring and mitigating them. It is clear on this record that the NRC lacks any assurance that monitoring and mitigation will be successful, because PEF does not know how, when or where the impacts will occur. In formulating the monitoring plan PEF relied upon the outputs of Model 1 even though it was a poor fit to the data and did not include the localized effects of the fractures. Although PEF has promised to investigate the geology of the site more fully *after* the LNP license has been issued, NEPA requires the NRC to understand the effects of its licensing action now, before the action is taken. *Robertson,* 490 U.S. at 349.

The NRC Staff argues that it is not necessary to know more now about the environmental impacts of water withdrawal on wetlands, because any such impacts will be detected and mitigated under PEF's monitoring plan. But NEPA's "rule of reason" requires us to reject this circular reasoning. *San Luis Obispo Mothers for Peace v. NRC,* 751 F.2d 1287, 1301 (D.C. Circuit 1984), vacated in part and rehearing en banc on other grounds, 760 F.2d 1320 (D.C. Circuit 1985). As the Supreme Court recognized in *Robertson,* a mitigation plan cannot be approved if it does not provide enough information "to ensure that environmental consequences have been fairly evaluated." 490 U.S. at 1847. If the Staff does not know now how or where the environmental impacts of water withdrawal will occur, then it does not know enough to judge the effectiveness of proposed mitigation measures to reduce those impacts to an acceptable level. Indeed, the evidence affirmatively shows that PEF's proposed wetland monitoring and mitigation plans are based on the very groundwater model that NRC Staff judged inadequate to predict impacts to the wetlands.[3] The Staff is merely kicking the can down the road, an action clearly prohibited by NEPA.

The last-resort mitigation measure is supposedly to install an alternative water supply five years after operation commences if impacts prove too great, but PEF's own witness said that this is not feasible, calling into question whether this is merely an empty promise. Just as the "hard look" standard is not satisfied by generalizations about the future effectiveness of an agency's regulatory program, *see State of New York v. NRC,* 681 F.3d 681, 481 (D.C. Cir. 2012), neither is it satisfied by generalizations about the likely success of future mitigation plans and alternatives that have not been developed. Furthermore, an alternative water supply would not resolve the other widespread environmental harm from the proposed LNP, such as the myriad excavations and their impacts on ground and surface water flow.

Given the NRC's lack of information about the geology of the LNP site and environs, or

[3] We agree with the NRC Staff that that the groundwater model is an inappropriate basis for designing the mitigation plan for three important reasons. First, the model is conceptually wrong. It is not sufficiently realistic, it failed to model the measured water levels accurately, and it is designed for water resource allocation, not to predict wetland impacts. Second, the model is not designed to take account of the preferential flow pathways that form the bulk of the groundwater flow at the LNP site and in the vicinity. If groundwater withdrawal wells draw from conduits and fractures in the underlying limestone, water withdrawals could severely affect localized springs and wetlands, even at a significant distance from the LNP site. In addition, if the nuclear islands cut off flow to Big and Little King Springs, those will be significantly affected. Finally, the recalibrated groundwater model underestimates environmental impacts by: a) using annual average rainfall data in prediction mode and therefore fails to take into account periods of drought; and b) adding in 5 mgd of artificial recharge that does not really exist.

how that geology affects the LNP's environmental impacts on wetlands, we find that the NRC Staff has no factual basis for concluding that PEF will know where or when to monitor for adverse environmental impacts, let alone how to prevent or mitigate them. Therefore, we conclude that the existence of a State-approved monitoring and mitigation plan does not support the FEIS' conclusions regarding the insignificance of LNP's environmental impacts. We also conclude that the Staff erred by placing unquestioning reliance on the State's imposition of conditions, without independently evaluating their adequacy. *Calvert Cliffs Coordinating Comm. v. U.S. AEC,* 449 F.2d 1109, 1123 (D.C. Cir. 1971). Without further investigation into the hydrogeological and hydroecological characteristics and features of the LNP site and independent analysis by the NRC Staff, the FEIS lacks an adequate factual basis for its finding that the direct environmental impacts of groundwater withdrawals at the LNP site will be insignificant. Moreover, during the hearing even PEF conceded that the monitoring plan designed to satisfy the state conditions does not include any monitoring for Big and Little King springs. In addition, the baseline data for the small number of wetlands that will be monitored is scheduled to be taken after construction commences, when impact could already have occurred.

Finally, because the NRC lacks the most basic information about the direct environmental impacts of water withdrawals for construction and operation of the LNP reactors, it cannot claim to have taken a "hard look" at the indirect and cumulative impacts of the LNP, including but not limited to the combined impacts of water withdrawals with salt drift from LNP cooling towers, LNP construction impacts such as onsite and offsite excavations, subterranean plugging of the aquifer by the nuclear islands, impacts from nearby mining operations, climate change, salt drift, passive dewatering during times of drought, increased fire frequency and other contributors to lowering of freshwaters levels and increasing salt inputs to the sub-surface.

Louisiana Energy Services, 47 NRC at 87.

Therefore, we conclude the FEIS is insufficient to satisfy NEPA and remand it to the NRC Staff. In the meantime, given the lack of an adequate supporting environmental analysis, PEF's application for a COL is denied. 10 C.F.R. § 51.20(a)(2).

Respectfully submitted,

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December 5, 2012

Certificate of Service

I hereby certify that on December 5, 2012, I posted copies of Intervenors' Proposed Findings of Fact and Conclusions of Law on the NRC's Electronic Information Exchange. It is my understanding that the following individuals or offices were served as a result:

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