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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: PROGRESS ENERGY FLORIDA, INC. (Levy County Nuclear Power Plant, Units 1 and 2)	Docket Nos. 52-029-COL, 52-030-COL June 26, 2012

INITIAL PRE-FILED TESTIMONY OF DR. SYDNEY BACCHUS IN SUPPORT OF CONTENTION C-4 REGARDING ENVIRONMENTAL IMPACTS OF LEVY UNITS 1 AND 2 ON WATER RESOURCES AND ECOLOGY

I. INTRODUCTION AND PURPOSE OF TESTIMONY

Q.1. What is your name and your employment?

A.1. My name is Sydney Bacchus and I am employed by Applied Environmental Services, LLC as a hydroecologist, specializing in the assessment of environmental impacts in the southeastern coastal plains physiographic province of the U.S.

Q.2. In what capacity are you providing testimony today?

A.2. I am providing testimony as an expert hydroecologist 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. My expert testimony also encompasses the fields of Plant Physiology and Pathology; Water Chemistry; Aerial Photo-interpretation and Wetlands, Estuarine and Aquatic Ecology. I have been accepted as an expert in all of these fields in previous hearings and

Exhibit INT301R
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have more than thirty years of education and experience in these fields, as described more fully in my attached curriculum vitae ("CV") (**Exhibit INT302**) and in the testimony that I will provide.

I have a Bachelor of Science degree in biology and design and a Master of Science degree in the field of botany and marine and aquatic ecology from Florida State University ("FSU"). I also have a multidisciplinary doctoral degree in the fields of hydrology, ecology and plant pathology and physiology from the University of Georgia. The focus of my doctoral research was adverse environmental effects of anthropogenic - man-induced - groundwater alterations. My dissertation was entitled "New Approaches for Determining Sustainable Yield from the Regional Karst Aquifer of the Southeastern Coastal Plain." My research was conducted through representative subregions of the regional Floridan aquifer system, which extends throughout the entire State of Florida and the coastal plains portions of Georgia, South Carolina and Alabama.

During my doctoral program, I received several grants from state agencies in Florida and federal agencies that supported my doctoral research. One of my grants from United States Geological Survey ("USGS") supported geophysical research to evaluate the degree of connection between the Floridan aquifer and depressional wetlands throughout Florida and south Georgia. Other grants supported a controlled experiment, observing responses of native tree species, particularly pond-cypress (*Taxodium ascendens*) to prolonged water stress and fungal pathogens. Those grants are listed in my CV. I worked for approximately eight years with the predecessor agency for the Florida Department of Environmental Protection (formerly known as Florida Department of Environmental Regulation), first for the Office of Coastal Zone Coordination ensuring compliance with federal Coastal Zone Management requirements. I provided oversight

for the state-supported restoration projects throughout Florida for the Water Resources Restoration and Preservation Section of that agency, and later acted as the Field Project Director over all state restoration projects in Florida for that agency. My final position with that agency was with the Jurisdictional Evaluation Section evaluating wetlands throughout the state, including evaluating various levels of "disturbance" in wetlands and determining what the pre-existing condition had been at those sites. I also was employed as the Marine and Aquatic Ecologist for the Florida Natural Areas Inventory (“FNAI”) Program, evaluating “habitat of concern” throughout the state. Later I was the Lead Environmental Specialist for the St. Johns River Water Management District for approximately two years, reviewing all environmental aspects of permit applications under the jurisdiction of the central Florida office, including evaluating impacts of proposed projects on federally-listed species and compliance with environmental regulations. I also was employed approximately six years as a Hydroecologist for the Ecological Support Division of the United States Environmental Protection Agency (“USEPA”) in Region IV, which has oversight for Florida, Georgia, Alabama, Louisiana and numerous other states.

I am familiar with the body of published literature relevant to my fields of expertise and have authored or co-authored approximately 40 refereed (peer-reviewed) publications in those fields, specifically regarding groundwater/surface water interactions, karst aquifers, and flood plains/wetlands, also known as special aquatic sites. My publications have been based on research I have conducted in wetlands and other special aquatic sites, as well as other ecosystems, including marine, estuarine, and freshwater aquatic ecosystems throughout Florida. I also have served as a peer reviewer for manuscripts, related to the

fields that I referenced previously, that have been submitted to professional journals for publication. A list of my relevant peer-reviewed publications, awards and recognition of my work in the fields described previously, as well as a description of my professional experience and affiliations with professional societies and other organizations, are provided in my CV.

Q.3. What is the purpose of your testimony?

A3. The purpose of my testimony is to explain why I disagree with the conclusion of the Final Environmental Impact Statement for Combined Licenses for Levy Units 1 and 2, 2012 ("FEIS") (**Exhibit NRC001**) that the cumulative environmental impacts of construction and operation of the proposed reactors on terrestrial ecosystems would be "SMALL," and on aquatic ecosystems would be "SMALL to MODERATE" (FEIS Vol. 1 at 7-54). In my opinion, the FEIS for Levy Units 1 and 2 ("LNP") fails to provide an adequate evaluation and to acknowledge a range of significant direct, indirect and cumulative environmental impacts that will be caused by the construction and operation of the proposed LNP. First, active and passive dewatering during construction and operation of the proposed LNP would have a more substantial and irreversible adverse effect on wetlands, wildlife habitat, the aquatic environment and endangered and threatened species than the FEIS presents, including on the underlying Floridan aquifer system and Outstanding Florida Waters such as the Withlacoochee and Waccasassa Rivers. Second, salt drift and deposition from LPN cooling towers would result in LARGE adverse impacts on water quality and the terrestrial and aquatic ecosystems, which provide habitat for endangered and threatened species and other wildlife. Finally, I believe the FEIS has serious deficiencies because it fails to identify and characterize adequately the proposed LNP's zone of environmental impacts, impacts on Federally listed species and species currently considered for listing, irreversible and irretrievable environmental impacts,

and appropriate mitigation measures- mitigation that is proposed without possibility of review or public comment.

The deficiencies in the FEIS have several overarching themes or characteristics. Principally, the FEIS grossly oversimplifies the hydroecological conditions of the LPN site and the geographic area of adverse impacts, erroneously assuming that it is acceptable to evaluate environmental impacts based on averages and ignoring well-documented preferential flow paths associated with depressional pond-cypress wetlands. Although the FEIS recognizes the existence of hydroperiods, for example, it does not actually analyze the significant roles they play in the ecological health of the region, which are critical determining factors in hydroperiod responses. In addition, the FEIS grossly oversimplifies the geology and hydrology of the region. The FEIS also ignores or downplays significant contributors to the cumulative impacts of the LPN, such as the effect of water withdrawals from the Withlacoochee Canal, that is referenced in the FEIS as the "Cross Florida Barge Canal" ("CFBC"), on salinity levels in Withlacoochee Bay. The FEIS also fails to analyze the cumulative effects of the proposed Tarmac mine, Knight Sand mine, and Adena Ranch on the environmental impacts of the proposed LPN. In addition, the FEIS fails to examine the cumulative effects of dewatering and other hydroperiod alterations when combined with deposition and drift of salt from the LPN cooling towers and fires that are essential in maintaining important ecosystems in the vicinity of the proposed LNP but will become destructive wildfires because of the dewatering and other hydroperiod alterations associated with the proposed LNP.

It is also my opinion that the geographic scope of the FEIS is far too narrow, and thus the FEIS fails to address significant impacts of dewatering, and more specifically, of hydroperiod alterations, as well as the effects of salt deposition, on both plants and animals in wetland, upland, aquatic and coastal habitats on the proposed LNP site and surrounding vicinity. Finally, the

proposed plan for mitigation of adverse environmental impacts of dewatering and salinization is inadequate and ineffective.

I have organized my testimony into the following sections:

A. Environmental Impacts of Hydroperiod Alterations from Dewatering and Other Alterations

B. Environmental Impacts of Salt Deposition and Drift

C. Cumulative Environmental Impacts

D. Geographic Scope of the FEIS

E. Mitigation Measures

F. Changes Needed to the FEIS

Q.4. As part of the preparation of your testimony have you carefully examined the relevant portions of all the documents referenced in your testimony that you relied on to form your opinions?

A.4. Yes, I have.

Q.5. Do those documents include the Draft EIS (DEIS) and the FEIS?

A5. Yes.

Q.6. Do you also have personal knowledge of the conditions at the proposed site of the Levy Nuclear Power Plant and the surrounding vicinity?

A6 Yes I do. As part of my preparation for this testimony I visited the site and vicinity of the proposed LNP on numerous occasions and have compiled a composite attachment of representative photographs that I took of the proposed LNP site and vicinity during those various visits (**Exhibits INT303-333** and **Exhibits INT393-INT400).** (Exhibit INT303 is my narrative of the photos.) I also have visited the vicinity of the proposed LNP site numerous times prior to the selection of the proposed LNP site in Levy County. My personal knowledge of the environmental conditions of that vicinity date back to the 1970s when I was an expert witness for the Florida Department of

Environmental Regulation ("FDER"), now known as the Florida Department of Environmental Protection ("FDEP") defending FDER's proposed denial of the proposed Crystal River nuclear power plant, referenced in the FEIS as the Crystal River Energy Complex ("CREC").

Q.7. Do you have new figures to illustrate the deficiencies of the FEIS to address the direct, indirect and cumulative impacts of the proposed LNP?

A.7. Yes. I have nine (9) figures to illustrate the inadequacies of data collection and analysis in the FEIS, which are included as **Exhibits INT335 through INT343**. A detailed description of those figures is provided in **Exhibit INT344.**

Q8. Have you prepared other documents detailing the opinions you have formed about this case?

A.8. Yes, I have prepared a series of affidavits and comments referencing the Environmental Report ("ER") or the Draft Environmental Impact Statement ("DEIS"). Because the FEIS has not resolved the concerns raised in my affidavits and comments, I have attached them to my testimony. In chronological order they are:

- Expert Declaration by Sydney T. Bacchus in Support of Petitioners' Standing to Intervene in this Proceeding (February 6, 2009) (**Exhibit INT345**);
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- Letter from Bacchus to Hambrick and Bruner re: preliminary comments on Draft EIS (DEIS) of Proposed Combined Licenses for Levy Nuclear Plant Units 1 and 2 (October 26, 2010) (**Exhibit INT346)** ;
- Affidavit of Sydney T. Bacchus in Support of Joint Interveners' Responses to Environmental Impacts of Proposed Levy Nuclear Plant Units 1 and 2 (November 15, 2010) (**Exhibit INT347)** ;
- Letter from Bacchus to Hambrick and Bruner re: Supplemental comments on Draft Environmental Impact Statement (DEIS) of Proposed Combined Licenses for Levy Nuclear Plant Units 1 and 2 (November 27, 2010) (**Exhibit INT348)**;
- Letter from Bacchus to Hambrick and Bruner re: Second Supplemental Comments on Draft Environmental Impact Statement (DEIS) of Proposed Combined Licenses for Levy Nuclear Plant Units 1 and 2 (March 12, 2012) (**Exhibit INT349**); and
- Letter from Bacchus to Hambrick and Bruner re: Third Supplemental Comments on Draft

Environmental Impact Statement (DEIS) of Proposed Combined Licenses for Levy Nuclear Plant Units 1 and 2 (April 26, 2012) (**Exhibit INT350**).

-Q.9. For those documents and any others that you authored and are providing copies of with your testimony, do you swear in accordance with 28 U.S.C. § 1746, under penalty of perjury, that these documents are true and correct?

A.9. Yes I do. My testimony in this case comprises responses to your questions based in part on information contained in documents previously submitted to the referenced regulatory entities and in part on new information.

II. CONCLUSIONS OF FEIS

Q.10. How does the FEIS categorize the potential ecological and other environmental impacts that would result from construction and operation of the proposed Levy Nuclear Power Plant LNP?

A.10. The FEIS asserts that the cumulative environmental impacts of construction and operation of the proposed LNP on terrestrial ecosystems are "MODERATE" and on aquatic ecosystems, for the purpose of my testimony including freshwater, estuarine, and marine aquatic habitats and associated biota, are "SMALL to MODERATE" (FEIS Vol. 2 p. 7-54). "SMALL" impacts are defined in the FEIS as"[e]nvironmental effects [that] are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource." In contrast, "MODERATE" impacts are defined as "[e]nvironmental effects [that] are sufficient to alter noticeably, but not to destabilize, important attributes of the resource" and "LARGE" impacts are defined as "[e]nvironmental effects [that] are clearly noticeable and are sufficient to destabilize important attributes of the resource. (FEIS Vol. 2 p. xxxii.)

III. DISCUSSION OF EXPERT OPINION

A. Environmental Impacts of Dewatering

Q.11. Does the FEIS adequately assess the potential ecological and other environmental impacts that would result from dewatering caused by construction and operation of the proposed Levy Nuclear Power Plant?

A.11. No it does not. In my opinion, the fact that the FEIS does not even discuss that irreversible adverse impacts to the natural hydroperiods on the proposed LNP site and surrounding vicinity would occur from dewatering and other alterations that would be caused by construction and operation of the proposed LNP may be its most serious failing. Irreversible adverse impacts to the natural hydroperiods will result in adverse impacts to both plants and animals in wetland, upland, aquatic and coastal habitats on the proposed LNP site and surrounding vicinity. In addition, there are numerous other environmental stressors the proposed LNP would cause or exacerbate. Among those are salt deposition, eutrophication, salinization, dewatering, and the diversion of historic overland flow. I believe that, although there is a degree of uncertainty regarding the geographic extent of the adverse environmental impacts beyond the off-site vicinity described in the FEIS, there is no doubt that the adverse environmental impacts described in my testimony WILL occur. For example, the groundwater model relied on in the FEIS predicted drawdowns in the surficial aquifer of 0.5 feet for an area extending three miles from the proposed LNP supply wells, yet the FEIS included no analysis of this aspect of hydroperiod alteration on all of the wetlands within that three-mile area. Yet we know from past cases and projects in this same aquifer system that the hydroperiod-related impacts described in my testimony have occurred within areas with model-predicted drawdowns of 0.5 feet. Therefore, without considering any cumulative impacts and based solely on the recalibrated model-predicted drawdowns in the FEIS, the hydroperiod alterations extending three miles off-site from the proposed LNP supply wells would result in LARGE adverse impacts to wetlands and other associated wildlife habitat.

Q.12. Please explain how these environmental impacts will occur.

A.12. Most impacts will occur because 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 (erroneously referred to in the FEIS as the Cross Florida Barge Canal "CFBC") via the Cooling Water Intake System ("CWIS").

To facilitate my explanation of how these adverse environmental impacts will occur and why they will occur far beyond the zone of impact considered in the FEIS, I will refer to the illustrated cross-section of Floridan aquifer system (**Exhibit INT351**) that was included as an un-numbered figure on page 3 of the Florida Water Resources Atlas by Fernald and Purdum (1998), then subsequently republished with permission in Chapter 2 of a peer-reviewed public-access book by Bacchus (2005). This cross-section of the Floridan aquifer system shows how interconnected karst features such as sinkholes and other cavities serve as relatively large underground pathways for preferential flow of water, shown in blue, and how that groundwater flows for considerable distances from inland areas to discharge in coastal areas. In simple terms, preferential flow is groundwater flow with greater volume and speed than in other parts of the aquifer system.

Other examples of preferential flow paths include fractures and relict sinkholes that underlie depressional wetlands such as pond-cypress wetlands and which are aligned along fractures. These 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. I prepared a figure (**Exhibit INT352)** that includes an illustration from a report by Brook and Sun (1982) on the left of the figure I prepared, showing depressional wetlands and open-water areas aligned along fractures in numerous areas throughout the northern extent of the Floridan aquifer system. The image on the right of the figure I prepared was created by Popenoe et al. (1984) and illustrates fractures occurring throughout the northeastern extent of Florida, both on-shore and off-shore, in the same aquifer system. Also refer to Littlefield et al., 1984, **Exhibit INT354, p. 189-195**) for additional examples of modern sinkhole development associated with large-scale photolinear features. Photolinear features, which are used synonymously with the term "lineaments" are defined as follows (Stewart and Stedje, 1990): (**Exhibit INT361)**

> Photolinears are linear trends identified on aerial photographs that may represent zones of increased fracture density. Photolinears that are determined to represent ones of increased fracture density are termed fracture traces. Fracture traces are vertical zones of generally higher hydraulic conductivity that can be vertical pathways for ground-water flow between the surficial and semi-confined aquifers.

When pumping wells are located in the vicinity of these types of fracture networks, the capacity of those wells to supply water increases because water can flow more easily through fractures and associated relict sinkholes (Brook, 1985, **Exhibit INT355**; Brook and Allison, 1983, **Exhibit INT357**; Brook et al., 1988, **Exhibit INT358**). As a result, that pumping causes hydroperiod alterations in the relict sinkholes and wetlands associated with those fractures. My Figures 1 through 4 (**Exhibits INT335** through

INT343) show similar fractures in close proximity to the proposed supply wells on the proposed LNP site and extending throughout the surrounding vicinity.

Illustrations of cross-sections representative of the relict sinkholes underlying pond-cypress wetlands are shown in Figure 1 of Bacchus (1998, **Exhibit INT359, p. 509**), showing different degrees of sub-surface subsidence and infilling within those relict sinkholes. See also Figure 5 of Bacchus (2000), p. 470 (**Exhibit INT360).** Figures 4 and 5 on pages 9 and 10, respectively, of Stewart and Stedje (1990, **Exhibit INT361, p. 1-103**) show photolinear features indicative of fractures associated with pumping wells at those sites within the Southwest Florida Water Management District ("SWFWMD"). Figures 2 and 3 on pages 5 and 6 of Stewart and Stedje (1990) show the distribution of those pond-cypress wetlands surrounding those pumping wells, that is similar to distribution of pond-cypress on the proposed LNP site and surrounding vicinity.

Q.13. Please explain what you mean by hydroperiod.

A.13. Ecological systems such as wetlands depend on natural fluctuations of the water table - the surficial aquifer - to maintain their essential functions. These fluctuations of the water table are known as the "hydroperiod." Three important aspects of a wetland hydroperiod are: (1) the depth or stage of fluctuating ground and surface water; (2) the duration of the water level at a given depth or stage; and (3) the periodicity or seasonality of the water level fluctuations. Disruption of any one of these three aspects can lead to the degradation and ultimate destruction of the wetland and the biota it supports (Bacchus, 1998) (**Exhibit INT359**).

As an example, abnormally low or high water levels may have little impact during winter, the normal dormant period for vegetation. However, the same perturbations can result in irreversible adverse impacts to those wetlands if these perturbations occur during the active growing

season of even a single year. Likewise, repeated periods of these perturbations have more severe impacts on the ecological systems than a single event. The seasonal component is important because most vegetation becomes dormant during the winter months. Therefore, perturbations of the natural hydroperiod during this period of time have less impact on the vegetation than the same perturbations during periods when new growth, flowering, or fruiting may occur, such as in the spring, or during periods of the growing season when high temperatures occur, such as in the summer.

Based on SWFWMD historic rainfall records from 1915 through 2010 for Levy County, (http://www.swfwmd.state.fl.us/data/wmdbweb/rainfall_data_summaries.php, **(Exhibit INT203),** rainfall is most limited during the active growing season. Based on historic temperature records from the National Weather Service's Brooksville station for the period of 1948 through 2010, (http://amazon.nws.noaa.gov/hdsb/data/archived/index.html, (**Exhibit INT362, pp. 1-65**), air temperatures also are high during March through May in the vicinity of Levy County, when most native plant species in the vicinity of the proposed LNP, including pond-cypress, are fully leafed-out. During this March-May period, rainfall is still low but loss of water is greater due to evapotranspiration, increasing the reliance of these native plant species on groundwater to survive, thrive and reproduce. Many animal species, including those within the vicinity of the proposed LNP, such as frogs and birds, also reproduce in the spring and early summer and experience the greatest water stress when water availability is limited. Seasonal drawdowns generally occur during the spring or summer when ecosystem needs are greatest.

Q.14. What is groundwater mining and how does it affect hydroperiods?

A.14. Groundwater mining is the mechanical pumping of water from aquifer storage. This pumping dewaters the shallow surficial aquifers where wetland and upland vegetation is rooted, thereby altering natural hydroperiods (Bacchus, 1998, **Exhibit INT359**; Bacchus, 2006, **Exhibit INT363**). Causal links between groundwater mining in Florida and more comprehensive adverse environmental impacts documented by state agency and legislative reports and independent research have been summarized in the peer-reviewed literature (Bacchus, 2000, **Exhibit INT360,** pp. 457-481) and include the following:

- Catastrophic wildfires
- Induced sinkhole activity and large scale land-mass subsidence
- Lowered water levels and altered hydroperiods in wetlands, lakes and streams
- Rapid and severe desiccation and oxidation in soils
- Loss of overstory trees and wildlife
- Complete loss of natural habitat; and
- Other adverse environmental impacts

Q.15. Please explain why you believe the FEIS does not adequately address the alterations to natural hydroperiods that will be caused by dewatering during construction and operation of LNP.

A.15. The FEIS fails to identify correctly the alterations to natural hydroperiods from water withdrawals and other alterations because it fails to consider the periodic nature of water in the LNP environment. The area of the proposed LNP and surrounding vicinity is a highly complex and sensitive ecological area where plants and animals have evolved to depend upon natural seasonal fluctuations and periods of drought. They are not adapted to the results of man-induced alterations of the natural hydroperiod. Therefore, impacts to the seasonally specific natural hydroperiods of the

proposed LNP site and vicinity should have been examined and evaluated in the FEIS. Hydroperiods, and their importance, are nowhere meaningfully discussed in the FEIS. Rather, throughout the FEIS, the NRC generalizes about the impacts of water withdrawal, without considering and explaining effects those withdrawals would have on the natural seasonal fluctuations of hydroperiods.[1]

With respect to water availability, long-term averages are mathematical calculations with no applicability to living ecosystems. They are irrelevant to living organisms struggling for survival during annual dry seasons and during periods of drought when contending with man-induced hydroperiod alterations. Under the guise of "long-term average," the wetlands and other ecosystems affected by salt drift could be destroyed from the combined, cumulative impacts of salt drift and hydroperiod alterations, while the long-term average rainfall theoretically remained adequate. As addressed in my affidavit, in Answer 29 and 33, there is no expectation that the rainfall averages of the past will continue into the future. A more relevant method than computing averages would be for the FEIS to use a "worst case" scenario, such as during a multi-year drought similar to the conditions currently existing at the proposed LNP site.

Some examples of FEIS deficiencies in assessing alterations of the natural hydroperiods include: FEIS page 5-30, paragraph 2, the term "hydroperiod" is mentioned only in relation to a SWFWMD condition, with no evidence that wetland hydroperiods are considered in the FEIS

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[1] See, for example, p. 2-148 (discussing "Average" water usage by the counties without regard to the critical consideration of natural seasonal fluctuations of hydroperiods or hydroperiod components); p. 4-22 (describing "average" water withdrawals without regard to seasonal influences on natural hydroperiods or hydroperiod components; Figure 4-1 at p. 4-23 (depicting "Surficial Aquifer Drawdown" without regard to seasonal impacts on the natural hydroperiod or hydroperiod components), p. 5-5 (discussing wetlands impacts from long-term operation of the proposed LNP without regard to seasonal impacts on the natural hydroperiod or hydroperiod components); p. 5-7 (discussing groundwater use without addressing seasonal impacts to natural hydroperiods or any other hydroperiod components)

analysis of cumulative impacts; page 9-158, paragraph 3 of the FEIS refers to hydroperiods only in relation to an alternative site, without acknowledging that ecosystems and organisms have specific and distinct hydroperiod requirements.

The life cycle of frogs, amphibians that are at the base of the wildlife food chain, requires surface water of specific depth, during a specific time of year, for a specific duration, to allow eggs to hatch into tadpoles and tadpoles to mature into frogs. If any of these components of the natural hydroperiod is disrupted during the period from mating to emergence of a new generation of frogs, that entire year of reproduction will be lost and higher levels of the food chain will be deprived of food (Moler and Franz, 1987) Therefore, while the lifecycles of wetland plants and animals are indeed adapted to fluctuating water levels, as the FEIS points out (FEIS Vol 1, p. 2-48), the authors fail to explain or perhaps even comprehend, that if any of the hydroperiod components (duration, extent, timing) is altered, those fluctuations can be fatal. As with the example of frogs previously referenced, the reproduction and survival of other animals such as federally listed wood storks and red-cockaded woodpeckers, as well as plants, such as the pond-cypress throughout the proposed LNP and surrounding vicinity are threatened if wet and dry periods do not occur during the normal seasons or last for different durations, or are more drastic than those for which the living beings have adapted.

Because the surficial aquifer that maintains wetland soils and rootzones is hydrologically connected to the Floridan aquifer system (FEIS, p. 5-19) the NRC had more than enough information to recognize the importance of the hydroperiod to its assessment of LNP's environmental impacts. Therefore it should have collected the necessary data, or at the very least conducted a qualitative analysis.

It is ironic that, despite the failure of the FEIS to address adverse impacts to hydroperiods on site and off site from the proposed LNP, the PEF Wetland Mitigation Plan (Entrix, 2010, **Exhibit INT364, p. 6-27**) includes the following discussion of hydroperiod components and the importance of hydroperiods:

> The quantity of water in an assessment area, including the timing, frequency, depth and duration of inundation or saturation, flow characteristics, and the quality of that water, may facilitate or preclude its ability to perform certain functions and may benefit or adversely impact its capacity to support certain wildlife. Hydrologic requirements and tolerance to hydrologic alterations and water quality variations vary by ecosystem type and the wildlife utilizing the ecosystem.
>
> Hydrologic conditions within an assessment area, including water quantity and quality, must be evaluated to determine the effect of these conditions on the functions performed by area and the extent to which these conditions benefit or adversely affect wildlife. …. Landscape features outside the assessment area, such as impervious surfaces, borrow pits, levees, berms, swales, ditches, canals, culverts, or control structures, may affect hydrologic conditions in the assessment area. Surrounding land uses may also affect hydrologic conditions in the assessment area if these land uses increase discharges to the assessment area, such as agricultural discharges of irrigation water, or decrease discharges, such as wellfields or mined areas.

The FEIS is deficient because although hydroperiods and the significant ways in which the very features at Levy will alter hydroperiods are clearly spelled out in the Entrix mitigation plan that the Staff should have examined, the FEIS provides no evaluation of these important parameters.

Q.16. Do you agree with the FEIS that the operation of LPN would not significantly affect the hydrology of the area?

A.16. No. At p. 5-4, the FEIS states that:

> The review team determined that the operation of LPN Units 1 and 2 would not alter the surface-water hydrology of the Withlacoochee River, Waccasassa River, Spring Run Creek, and Direct Runoff to Gulf drainages. LNP Units 1 and 2 would not use any surface water from these waterbodies. The LNP site is not hydrologically connected with the portion of the Withlacoochee River upstream of Lake Rousseau or with the Wacassassa River. Surface runoff from the LNP site does not provide substantial contribution to Spring Run, Direct Runoff to the Gulf, or the Lower Withlacoochee River.

I do not believe this conclusion is supported, and in fact it is contradicted by the Final Safety Analysis Report ("FSAR") which states that the LNP site can be drained by overland flow directly to the Lower Withlacoochee River or the Gulf of Mexico (FSAR, rev.2 p. 2.4-3) (**Exhibit INT365**). *See also* FSAR rev.2 p. 2.4-92 (asserting that groundwater moves downgradient from LNP 1 and 2 and resurfaces within the Lower Withlacoochee River, a distance of approximately 7 km (4.3 mi.)). Florida's natural depressional wetlands have historic water connections to navigable waters of the United States, as regulated under the Clean Water Act, and exist in relict sinkholes connecting to the underlying regional karst aquifer system and thereby to navigable waters (Bacchus, 1998; Bacchus, 2000; Bacchus, 2006; Bacchus, et. al., 2003 (**Exhibit INT366**)). The FEIS includes the following (underline added):

> Two of the wells monitored the surficial aquifer and two wells monitored the Upper Floridan aquifer. Average specific conductance, salinity, and alkalinity values were lower than average values for the other three wells (510 S/cm, 170 mg/L, and 160 mg/L, respectively), which might indicate a stronger influence from surficial recharge at this location. Water-quality parameters for the other surficial aquifer well were comparable to those for the two Upper Florida aquifer wells, providing additional evidence of connectivity between these two aquifer systems. (p. 2-38, Section 2.3.3.2)

and:

> Because the surficial aquifer that supports local wetlands is hydrologically connected to the Florida aquifer system, groundwater withdrawals from the Floridan aquifer system could affect wetlands on and around the LNP site. (FEIS p. 5-19, paragraph 2)

There is an extensive body of published literature regarding the interconnections between these wetlands and the surficial aquifer and with the underlying Floridan aquifer. But based solely on the preceding statements that acknowledge the connection, the FEIS should have realized that surface water and groundwater withdrawals proposed for the LNP would affect wetlands on and

around the LNP site by changing natural hydroperiods. Groundwater withdrawals exacerbate the effects of hydroperod fluctuations. Yet, as I previously explained, hydroperiods are not considered in the FEIS's discussions of impacts.

Elsewhere in the FEIS the NRC admits that service-water pumping from groundwater wells for proposed LNP Units 1 and 2 may cause a reduction of 0.4 Mgd to the lower Withlacoochee River and Lake Rousseau watersheds (FEIS Vol. 1, p. 5-58). This 400,000 gpd is a significant volume that would result in LARGE adverse impacts to natural hydroperiods in my opinion. Similarly, the FEIS (at p. 5-11) states that:

> During operation of LNP Units 1 and 2, the CFBC-OWR system would be subject to the following fluxes: (1) a net intake of 122 Mgd (190 cfs) for normal plant operations, (2) discharge of leaked freshwater from the Inglis Lock and freshwater spring inflow just downstream of the Inglis Lock (estimated to be 50 cfs by PEF), and (3) discharge of freshwater from the Lake Rousseau spillway that enters the CFBC via the OWR. Freshwater is discharged from the Lake Rousseau spillway during flood events and, therefore, is intermittent. During low-flow conditions (i.e., no discharge from Lake Rousseau spillway), the USGS estimated a seepage of freshwater into the OWR below the Inglis Dam of 70 cfs (USGS 2009). Figure 5-4 above shows the conceptualization of the CFBC-OWR system during low flows, ignoring any tidal effects from the Gulf of Mexico. (FEIS, Vol 1, 5-11, paragraph 3)

These excerpts from the FEIS confirm that during low flow periods, more than 122 Mgd (190 cfs) of fresh water that previously discharged into the estuary, would be withdrawn by the LNP Intake System for cooling. This is in addition to the reductions due to pumping by the proposed LNP supply wells.

In summary, it is my professional opinion that the wetlands on and surrounding the proposed LNP site are connected to the Waccasassa River, Waccasassa Bay, Withlacoochee Bay and the Gulf of Mexico. At the very least, the wetlands on the proposed LNP are "adjacent wetlands" with respect to the Waccasassa River, Withlacoochee River and Withlacoochee Canal, because they are connected via ground water.

Q.17. Has the FEIS addressed the risk that dewatering will cause salinization?

A.17. Based on the volume of freshwater input to the Withlacoochee Canal, as represented in the FEIS above, it is my opinion that under low-flow conditions, such as annual dry seasons and drought, none of the freshwater entering the Withlacoochee Canal may flow into the estuary. Additionally, by reducing or eliminating fresh groundwater discharging currently to these areas, groundwater withdrawals from the proposed supply wells would exacerbate the increase in salinity of the Withlacoochee River, Withlacoochee Canal, Withlacoochee Bay, Waccasassa River, Waccasassa Bay State Park and Gulf of Mexico. The FEIS appears to have addressed increased salinity only within the Withlacoochee Canal, due to LNP withdrawals, when it states:

> It is anticipated that higher-salinity water from the estuarine portions of the nearshore Gulf of Mexico would be slowly drawn up the CFBC toward the intake structure during operations. These water-quality changes could result in minor changes to shoreline vegetation along the CFBC, perhaps causing establishment of brackish water vegetation in some areas presently supporting freshwater vegetation (FEIS, Vol 1, p. 5-33, paragraph 1).

Additionally, page 2-93 of the FEIS describes freshwater contributions from springs "near" the Inglis Lock with no more detailed analysis. But impacts to the natural hydroperiods cannot be quantified accurately if the collective freshwater contribution of the springs to surficial waters is not determined. The analysis should have been more finely tuned by the use of airborne thermal imaging for locating springs in the area and Doppler technology for quantification of flows (as PEF used for evaluation of offshore currents in the COL application). Without the use of these technologies, the conclusions in the FEIS are too vague and remain unsubstantiated by factual data. In other words, the FEIS needs to more accurately determine the source and flow of groundwater before it can reasonably assess the environmental impact of the LNP. Refer to my Figures 1A-E (**Exhibits INT335 through INT339**) and Figure 4 (**Exhibit INT343**) for the locations of

the freshwater springs, shown as blue triangles, that I identified along the Withlacoochee Canal from the location of the proposed surfacewater connections for the proposed LNP.

Pages 5-12 and 5-13 of the FEIS describes the salinity analysis that was done, again without regard to impacts on seasonal or any other hydroperiod components and without regard to karst features, such as fractures and relict sinkholes, that are known to result in preferential groundwater flow in response to groundwater withdrawals. Similarly, the salinity of runoff and the effect of evaporation on the salinity of runoff is discussed on page 5-16, paragraph 3 of the FEIS (Section 5.2.3.2), without regard to impacts on seasonal or any other hydroperiod components. This is another example of the failure of the FEIS to address cumulative impacts. The FEIS (p. 5-85 and p. 5-86) also discusses the average salt content based on the world's oceans as if it were relevant to the proposed LNP site. It is not, because ocean salinity is approximately twice the salinity concentration of estuaries such as Waccasassa Bay State Park and Withlacoochee Bay, as shown in the salinity map produced by the National Oceanic and Atmospheric Administration ("NOAA") and included as **Exhibit INT367.**

Q .18. Do you have other concerns related to salinity?

A.18. In my professional opinion, based on the field of published literature described previously in my testimony and more than 30 years of experience with similar hydroperiod alterations, the proposed surface and groundwater withdrawals at the LNP would cause the small springs to stop flowing. The locations of the springs that I identified along the Withlacoochee Canal are shown as blue triangles, in discharging along the Withlacoochee Canal would cease flowing. Reference my Figures 1A-E (**Exhibits INT335** through **INT359** and **Exhibit INT343**, respectively).

Those proposed withdrawals also would eliminate the lens of freshwater overlying the saltwater wedge in the tidally influenced Withlacoochee Canal, Withlacoochee River and tidal

creeks, that I have measured during the NRC licensing period for the proposed LNP. With regard to surface water, the FEIS fails to recognize that the proposed surface water withdrawals from the Withlacoochee Canal, not only for the Cooling Water Intake System ("CWIS") but also in combination with inadvertent groundwater withdrawals from the Withlacoochee Canal via permitted supply wells, would result in that water body becoming saline and would reduce the input of freshwater to the coastal waters. I am very concerned about the effects of increased salinity on coastal estuaries and the plants and animals that live there.

These areas are rich in diversity, as the FEIS indicates: "Estuarine and marine essential fish habitats have been designated by the National Marine Fisheries Service (NMFS) the CFBC and immediate nearshore Gulf of Mexico…" (FEIS, Vol. 1 p. 2-123). As an example of how the habitat could change, the FEIS states that currently the "salinities just outside the mouth of the CFBC in the Gulf of Mexico average 17.83 pss (practical salinity scale) at the surface and 25.91 pss at 4 m" (FEIS, 2-93). With the ambient salinity of the Gulf at 35 pss (FEIS 5-15) this represents a significant change to the relative salinity of the estuarine waters, reflecting the importance of freshwater discharges near the Withlacoochee Canal (referenced in the FEIS as "CFBC"). First, these values document the presence of a less saline layer or lens of water at the surface. Therefore, the depletion of freshwater to the canal by the proposed LNP withdrawals of surface and groundwater would eliminate this less saline lens. Based on in situ salinity measurements I have made during the period the proposed LNP application has been considered by the NRC, salinities in the canal vary significantly with the tides and due to discharges to the canal of fresh ground water via numerous small springs (Figures 1A-E and Figure 4). The FEIS fails to note whether those measurements in the canal were made during more saline high-tides and that those measurements were not representative of areas where fresh groundwater discharges were occurring.

Q.19. How would increased salinization affect plants and wildlife?

A.19. The FEIS acknowledges that freshwater vegetation would be affected by the increased salinity caused by proposed surface water withdrawals from the Withlacoochee Canal (emphasis added):

> Water withdrawals would increase salinity levels in the CFBC and thereby alter shoreline habitat along the CFBC, including tidal marshes near the entrance of the CFBC to the Gulf of Mexico. (FEIS Vol 1, p. 5-19)
>
> Because the Gulf of Mexico essentially represents an unlimited source of water even during drought conditions, withdrawal is predicted to have a negligible effect on water levels in the DFBC (PEF 2009a). However, <u>it is anticipated that higher-salinity water from the estuarine portions of the nearshore Gulf of Mexico would be slowly drawn up the CFBC toward the intake structure during operations</u>. These water-quality changes could result in <u>minor changes to shoreline vegetation along the CFBC, perhaps causing establishment of brackish water vegetation in some areas presently supporting freshwater vegetation</u>. (FEIS, Vol 1, p. 5-33)

A change from fresh-water vegetation to brackish water vegetation is hardly "minor," for the salt-sensitive cypress trees, and freshwater aquatic vegetation that manatee feed on, will be killed and replaced by opportunistic species, including noxious algae capable of tolerating a more saline environment. Obviously the cumulative impacts of brackish water vegetation replacing freshwater vegetation meets the NRC's definition of LARGE, with clearly noticeable environmental effects that are sufficient to destabilize important attributes of the resource.

Although the FEIS considers the Gulf of Mexico the source of the cooling water (FEIS Vol 1, p. 2-13), as described above, the Withlacoochee Canal would become saline and inputs of freshwater to the coastal waters would be reduced or eliminated. Reduced discharges to the tidally influenced Withlacoochee Canal, Withlacoochee River and tidal creeks would allow salt water to move further inland, as another form of induced saltwater intrusion, because as the volume of water flowing from these systems towards the bay decreases, brackish and saline water from the bay and Gulf has less resistance during high tides and during storms. Both would result in the death of

freshwater vegetation, including vegetation that provides food for manatees and green sea turtles in that area. Specifically, there is no analysis and no consideration for the LARGE impacts to the species inhabiting these ecosystems and relying on these ecosystems for breeding and feeding.

The photographs I have provided in **Exhibit INT304-333** and described in **Exhibit INT303** confirm that existing reductions in freshwater discharges already have resulted in the death and premature decline of numerous native species of trees in the vicinity of the canal. Therefore, existing alterations to the natural hydroperiods already have resulted in clearly noticeable, and thus LARGE, adverse impacts and reflect a destabilized environment on and surrounding the proposed LNP site. Therefore, any further salinization would destabilize the ecosystem.

Q.20. Are there other examples of the inadequacies of the FEIS in assessing the potential ecological and other environmental impacts related to hydroperiod alterations caused by the LNP project?

A.20. Yes. Underlying karst features such as relict sinkholes, fractures, faults, swallets and other karst conduits that can serve as preferential flow paths connecting wetlands in the vicinity of the LNP, have not been considered and accurately identified. As a result, the FEIS does not properly address passive and active dewatering and aquifer flow issues that affect natural hydroperiods. This is a critical failing because without accurately assessing the changes to natural hydroperiods, there is no way for affected agencies evaluating impacts of the proposed LNP, such as the USFWS and USEPA, to know exactly how the plants and animals at Levy will be affected. This is a critical failing because without accurately assessing the changes to natural hydroperiods, there is no way for affected agencies, such as the USFWS and USEPA, in evaluating the impacts of the proposed LNP to know that the plants and animals at Levy will be affected.

Historically, the surficial aquifers overlying the Floridan aquifer have provided natural recharge to, and received natural discharge from, the regional aquifer system via diffuse flow

through lower-permeability layers and more concentrated recharge vertically and laterally through dissolutionally enlarged karst such as relict sinkholes, springs, and subterranean cavities.. Open bedding planes and fracture networks also are important preferential flow paths, particularly in response to groundwater pumping in the Floridan aqufer system. These conduits in the aquifer system historically facilitated considerable submarine groundwater discharge of freshwater in coastal areas (Bacchus and Barile, 2005, **Exhibit INT368, p. 220)**. Refer to my response to Question 12 regarding more examples of the types of preferential flow-paths that occur in this aquifer system and how groundwater withdrawals in particular result in increased preferential flow and concomitant adverse hydroperiod impacts.

Q.21. Have those types of underlying karst features - relict sinkholes, fractures, faults, swallets and other karst conduits of preferential flow - been identified on the proposed LNP site and surrounding vicinity?

A.21. Yes. For example Vernon (1951, **Exhibit INT369**), and Faulkner (1973, **Exhibit INT370**) identified linear features representative of fractures and faults that coincide with the proposed LNP and surrounding vicinity of the proposed LNP, as shown in my Figures 1 through 4 and described in the accompanying description of those figures.

Q.22. How do karst features contribute to dewatering that affects biological organisms?

A.22. Research in the same regional karst Floridan aquifer system where the proposed LNP site would be located has confirmed that depressional wetlands occupy relict sinkholes and are aligned along fractures, as I described previously. Preferential flow occurs through those fracture/sinkhole connections in response to groundwater pumping from supply wells so that the supply wells dewater these depressional wetlands and other associated surface waters. This dewatering associated with groundwater pumping is known as "induced recharge." Examples of the published

work of those researchers include Brook and Sun (1982), Littlefield et al. (1984) **(Exhibit INT354)** Southwest Florida Water Management District (1996) (**Exhibit INT371)** and Stewart and Stedje (1990) (**Exhibit INT361**). Bacchus et al. (2003) (**Exhibit INT366**) illustrated how pond-cypress in depressional wetlands, like those throughout the Goethe State Forest and the surrounding vicinity of the proposed LNP site, that are connected via preferential flow through these karst features, suffer from premature decline and death when groundwater withdrawals change the natural hydroperiod.

Q.23. Have you observed depressional wetlands on the proposed LNP site and surrounding vicinity?

A.23. Yes. I observed, inspected and photographed the depressional pond-cypress wetlands indicative of relict sinkholes on the proposed site during the site inspection on January 11, 2012. I also have observed, inspected and photographed similar depressional pond-cypress wetlands that occur throughout the adjacent Goethe State Forest north of the proposed LNP site. I also have observed, inspected and photographed swallets immediately west of the proposed LNP site and further west in Gulf Hammock Wildlife Management Area. Examples of those photographs from the proposed LNP and surrounding vicinity are included in **Exhibits INT304 through INT333** and the description of those photographs is included in **Exhibit INT303**. I also have submitted affidavits and videos that local residents have taken, of swallets immediately west of the proposed LNP including with surface water flowing underground. The affidavit and video of Emily Casey are provided in **Exhibits INT372 and INT 373**.

Q.24. Please define the term "swallet."

A.24. The Glossary of Geology (Jackson, 1997) defines "swallet" as, "the opening through which a sinking stream loses its water to the subsurface. Syn: insurgence."

Q.25. Please explain in more detail how karst features you previously described relate to the absence of an adequate assessment of cumulative impacts from the proposed LNP.

A.25. The presence of karst features has an effect on hydroperiods by creating preferential pathways for groundwater flow. Although this effect is significant because it extends the adverse effects of dewatering over a greater area than if no preferential pathways existed, it has not been considered in the FEIS. The FEIS also improperly calculates aquifer recharge, which would be dependent on the extent to which the proposed stormwater ponds intersect preferential flow paths in the karst aquifer system. As a result of groundwater removal, water is rerouted through different preferential flow paths, and as a result, some vegetation is denied the water it requires to survive and thrive. Because these preferential flow paths have not been identified, evaluated or even considered in the FEIS and these preferential flow paths magnify consequences of alterations to the natural hydroperiods, it is impossible to accurately assess the impact of dewatering at LNP.

Q.26. Does the FEIS adequately consider the combined environmental effects of dewatering and precipitation, including periods of drought?

A26. The FEIS assumes maximum daily usage conditions will last for only one week and assumes "normal" precipitation conditions (FEIS Vol. 1, p. 5-8). But the FEIS does not account for the annual dry seasons and periods of drought, such as the current drought conditions in Levy County, when both natural vegetation and wildlife are most sensitive to altered hydroperiods.

Q.27. Is there any evidence of adverse environmental impacts that have become evident during the current, on-going drought in the vicinity of the proposed LNP site?

A.27. Yes. There are striking illustrations of the environmental effects that have become evident during the on-going drought conditions in the vicinity of the proposed LNP. In Manatee Spring State Park and Fanning Spring State Park, flows in freshwater springs have been reduced and the water has turned brown. Two examples are provided in the April 5, 2012 Chiefland Citizen article "Fade to Brown" (http://www.chieflandcitizen.com/content/fade-brown, **Exhibit INT374)**

and the April 19, 2012 Chiefland Citizen article "Groundwater levels continue to plummet – wells running dry" (**Exhibit INT375)**. In addition to municipal wells going dry, other wells have been contaminated with salt water, including private residential wells immediately west of the proposed LNP project site and in the combined vicinity of the proposed LNP, Tarmac/King limestone aggregate mine and Knight sand mine. As one example, I have included an affidavit from Dan Hilliard regarding saltwater contamination of his private residential well (**Exhibit INT376**) and a map showing the location of that well (**Exhibit INT377**). Thus, the aquifer system clearly is under stress already, but the FEIS made no attempt to establish how the aquifer system could support any additional surface and groundwater withdrawals and hydroperiod alterations or what the direct, indirect and cumulative impacts of the additional impacts would be to wetlands, floodplains, special aquatic sites, other waters, wildlife habitat and federally endangered and threatened species. Of particular concern are those groundwater withdrawals proposed for the LNP that, relative to existing private residential wells, are LARGE (See Question 38). Unfortunately, the FEIS fails to take a hard look at these issues and adverse effects.

Q.28. Has the FEIS adequately addressed the issue of passive dewatering from construction of "nuclear islands?"

A.28. No. The FEIS additionally fails to address the impact of excavating and then filling with concrete, the nuclear islands. These islands are approximately 2 acres in area (FSAR figs. 2.5.4.5-201A, B, **Exhibits INT378, INT379**) and extend down approximately 100 feet below ground level (FEIS p. 3-13). As discussed in the Testimony of Gareth Davies (A. 17), excavating to a depth of 100 feet for construction of these islands would have a LARGE adverse effect on groundwater flow with respect to altered hydroperiods and environmental impacts. In my opinion, the excavation itself would result in adverse impacts to hundreds of acres of wetlands directly, indirectly and

cumulatively by altering the natural flow of surficial and upper Floridan water, which will affect the hydroperiods of the surrounding vicinity. I am also concerned that the nuclear islands themselves, which would each be composed of impermeable concrete approximately an acre in area and 100 feet in depth, would significantly and permanently alter the natural flow of groundwater through the proposed LNP site, and thus the natural hydroperiods.

The FEIS provides no scientific basis for its claims that the water level fluctuations resulting from dewatering two 100-foot deep, acre-sized pits into the aquifer will be "within the range of variability to which these wetlands systems have adapted" (FEIS, Vol 1, p. 4-34). To the contrary, in my professional opinion, the proposed excavations and dewatering of the approximately 100-foot deep pits under the two proposed nuclear islands for the considerable time of "two to four years" (FEIS Vol 1. p.4-34) will dewater all of the remaining wetlands on the proposed LNP and surrounding wetlands, resulting in the death of all of the pond-cypress trees and constituting LARGE adverse impacts. My opinion is based, in part, on more than 30 years of observing depressional pond-cypress wetlands before and following excavations of even relatively small, shallow stormwater ponds, approximately 1 meter – or 2 to 3 feet deep - and less than one-tenth the areal extent of the proposed LNP stormwater ponds.

Q.29. Has the FEIS adequately addressed the issue of passive dewatering from stormwater ponds?

A.29. The FEIS fails to account for evaporative dewatering from stormwater ponds. Numerically, evaporative loss is estimated at 46 to 50 inches per year (Affidavit of Mitchell L. Griffin, par. 22 (Aug. 17, 2010) (**Exhibit INT380**). According to the FEIS (p. 2-21), average rainfall is only 53 inches per year, only slightly more than the rate of evaporation. The FEIS, however, again relies on averages, thus failing to address two critical aspects that would result in LARGE adverse hydroperiod impacts: 1) evaporative loss exceeds rainfall during the entire dry

season of every year and 2) evaporative loss exceeds rainfall during droughts. Nor does the FEIS address the environmental impacts of PEF's plan to divert, capture and impound natural overland flow on the proposed LNP as "stormwater." By ignoring the detrimental effects of this capture and elimination of historic overland flow, the FEIS overstates the ability of the proposed stormwater ponds to recharge the aquifer (FEIS p.5-26). Clearly this redirection of surface water also would not be preferable to the natural, uncontaminated overland flow. PEF has quantified the extent of the proposed stormwater ponds' diversion and capture of this historical overland flow as "more than 88 acre-feet" (Griffin at 10). Specifically, storm water would not follow natural drainage patterns and it would contain contaminants from the industrial surfaces. FEIS Vol. 1, p. 3-19, confirms this: "After the site is graded, a stormwater-drainage system would be created around the facilities to direct stormwater away from the operational areas. Drainage ditches and pipes would route surface water to three water-retention and/or infiltration ponds."

According to the FEIS, stormwater ponds, whether for detention or retention, can compensate for the altered historic sheet-flow and resultant, altered hydroperiods. I do not agree. These excavated ponds cannot compensate for altered historic sheet-flow and natural hydroperiods because by their very nature, they will be passively dewatering the local area. That the adverse impacts from these excavated ponds would be LARGE, is based in part on the following statement from the FEIS:

> The review team acknowledges that during certain portions of the year water would be removed from the aquifer through evaporation from the wet ponds; however the loss associated with evaporation from these ponds would be smaller than a natural system such as an equivalent-sized saturated wetland due to the additional loss due to transpiration in the wetland. …. (FEIS, p. E-74)

This is, in my opinion, incorrect thinking, especially since it equates natural loss due to transpiration with the artificially induced water loss due to evaporation. So the estimation of impact

is also flawed. No scientific documentation is provided to support that statement. In fact, the peer-reviewed published scientific literature refutes the FEIS claims that transpiration from pond-cypress wetlands on the proposed LNP site exceeds water loss from evaporation from similar excavations. (Bacchus, 2006) **(Exhibit INT363)**.

The FEIS, as described previously, fails to consider that wetland and other ecosystems are composed of living organisms that evolved to depend on natural hydroperiods. An "equivalent sized wetland" possesses its own seasonal rhythms of high and low water and the lifecycles of associated plants and animals depend on those natural conditions for existence. Additionally, it is important to note that the evaporative losses from the excavated ponds are in **addition** to water lost through normal wetland evapotranspiration. The quote above implying that it is somehow preferable to replace 105 acres of wetlands with man-made excavations for stormwater ponds also has no scientific basis.

The stormwater ponds would cover 105 acres and the PEF engineer stated that the ponds would be dug 6-8 feet below ground level (Griffin Affidavit, p. 4). The FSAR states the water table lies less than 1 foot below ground surface in rainy periods to approximately 5 feet below ground surface during drier periods (FSAR rev.2 p. 2.4-78). Thus, even using PEF/NRC's own figures, it is clear that during the dry season and periods of drought, when evaporation is highest, and rainfall the least, the stormwater ponds will actually dewater, not recharge, the groundwater system. These periods of dearth are when the wetlands and other wildlife habitat on the proposed site and in the surrounding vicinity of the proposed site are most reliant on the water that will, because of the LNP, be prevented from reaching its historical destinations.

Q.30. Have you had any previous experience with projects constructing stormwater ponds similar to those for the proposed LNP?

A.30. Yes. The vast majority of projects that I evaluated while I was employed as the Lead Environmental Specialist for the St. Johns River Water Management District had stormwater ponds that were similar to the ones for the proposed LNP. I conducted pre-construction and post-construction site inspections for those projects to evaluate the condition of the depressional wetlands before and after construction. In each case, the "preserved" wetlands in proximity to the stormwater ponds exhibited LARGE adverse impacts from hydroperiod alterations related to those stormwater ponds.

Q.31. Do you have any other concerns about the stormwater ponds?

A. 31.Yes, I do. When other stormwater ponds have been excavated over or near areas prone to sinkholes, the increased weight and recharge of the impounded water has actually caused sinkhole collapse. One example is the significant sinkholes that opened up when the Suncoast Parkway and stormwater ponds were under construction (Heung and Gobin, 2010, **Exhibit INT381**).

Q.32. In your opinion, did the FEIS adequately analyze the potential effects of sinkholes caused by dewatering?

A.32. No. The FSAR rev.2 (p. 2.5-72) **(Exhibit INT388)**. states, "Anthropogenic factors include over-pumping of groundwater that reduces the shear-strength of the near-surface materials, and causes higher intergranular stress and a resulting reduction in the load carrying capacity of the soils, as well as the placement of structures over geologic features that have the potential for sinkhole activity. These factors often trigger sinkhole activity and ground subsidence." The FEIS asserts that currently there are few sinkholes in the LNP area (FEIS Vol. 1, p. 5-26). But the FEIS does not address the potential that future groundwater withdrawals at LNP will increase the likelihood of sinkholes. This is a significant omission. Relict or historic sinkholes occur throughout the vicinity of the proposed LNP. When new sinkholes open up, they expose the underlying water to evaporation

and contamination. Induced sinkholes can affect the quality of human drinking water in local wells, and also the quality of drinking water for wildlife. The FEIS does not address these effects. It is my professional opinion that similar subsidence/collapse events and subsequent "passive dewatering" of the aquifer system and re-opening of relict sinkholes will occur if the stormwater ponds for the proposed LNP are constructed and collect water.

Q.33. Does the FEIS adequately assess the potential impacts of other projects in the area on Outstanding Florida Waters such as the Withlacoochee and Waccasassa Rivers?

A.33. No. The FEIS fails to account for water quantity and hydroperiod impacts from the proposed LNP alone and cumulatively with the hydroperiod impacts from the proposed Tarmac limestone mine, the proposed Knight sand mine and the proposed Adena Ranch. These impacts from hydroperiod alterations will be significant on Outstanding Florida Waters such as the Withlacoochee and Waccasassa Rivers. In fact, the FEIS suggests a total lack of understanding regarding what cumulative impacts are. Cumulative impacts, also referenced as cumulative effects, are not some nebulous concept. The term is defined by **40 CFR § 1508.7** as follows and a synopsis of what constitutes cumulative effects, based on the Council on Environmental Quality 1997 Cumulative Effects Report, is included in **Exhibit INT382**:

> "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions."

The FEIS (Vol. 1 p. 4-24) suggests that the effects of the proposed Tarmac mine would be the same order of magnitude as the proposed LNP, but there is no discussion of cumulative effects on Outstanding Florida Waters, especially since, as noted in my previous testimony, the sheet flow of surface water that would be terminated by Tarmac flows directly into the Withlacoochee River (FSAR rev.2 (p. 2.4-92). Likewise, the FEIS fails to assess the cumulative impacts on Outstanding

Florida Waters such as the Withlacoochee and Waccasassa Rivers or any other surface waters or wildlife habitat from Adena Ranch's proposed groundwater withdrawals up to 13.3 MGD, from the same Floridan aquifer system supplying the proposed LNP withdrawals. The FEIS also fails to provide an accurate evaluation of the cumulative water quality impacts that will ensue in the coastal estuary system, including Withlacoochee Bay and Withlacoochee and Waccasassa Rivers, due to the LNP's proposed withdrawals of substantial freshwater and groundwater currently flowing into tthem.

The underestimated impacts by the FEIS of dewatering the proposed LNP site and vicinity is illustrated further in the FSAR rev.2 (p. 2.4-92):

> The focus of this evaluation is groundwater that moves downgradient from LNP 1 and 2 and resurfaces within the Lower Withlacoochee River, a distance of approximately 7 km (4.3 mi.). The Lower Withlacoochee River flows to the Gulf of Mexico with freshwater supplied from the Inglis Bypass Channel. Minimum flow into the Lower Withlacoochee River from the Inglis Bypass Channel is 22.4 m3/s (790 cfs) based on monthly averages from 1990 – 2006 (Reference 2.4.13-201).

This flow into the Withlacoochee River is not referenced in the FEIS. Therefore, we must assume that the adverse environmental impacts from alterations of this groundwater flow to the Withlacoochee River also was not included in the FEIS.

In addition to the failure of the FEIS to provide any scientifically valid analysis for adverse impacts of reduced freshwater discharge of surface and ground water and concomitant hydroperiod impacts on Outstanding Florida Waters such as the Withlacoochee and Waccasassa Rivers, the FEIS fails to provide any scientifically valid analysis of the impacts of increased salinities in Outstanding Florida Waters from decreased water quantity and the addition of salt to surface and ground water via salt drift and aerial deposition from the proposed LNP. For example, FEIS Vol 1, p. 5-24 includes the following statement:

> Although evapotranspiration would contribute to the loss of (and thus increase in potential salt concentrations in) surface waters on the site, abundant precipitation (on the order of 53 in./yr) in the region would result in a dilution greater than that assumed above, and therefore the concentration estimated above is conservative.

Despite this statement from the FEIS correctly attributing increases in salt concentrations to loss of surface waters, this loss of water more accurately will result from evaporation rather than evapotranspiration, because the surface waters on the site are man-made excavations and impoundments that evaporate water, not stands of vegetation that transpire water. Additionally, this FEIS statement is misleading because it discusses increases in salt concentrations based on average precipitation, ignoring significantly greater salt concentrations that will result during the dry season and periods of drought, and immediately following the dry season and droughts when the first rain events flush the concentrated salt deposited via salt drift into surrounding Outstanding Florida Waters and other surface waters and the aquifer. Yet another flaw is the fact that the pre-application groundwater monitoring relied on for the FEIS is based on only one year's data from 2007 (FEIS, p. 2-41). A single year of data is insufficient for determining concentrations of salt or any other contaminants, particularly considering the considerable variations in precipitation that have occurred in Levy County from 1915 through 2010, based on the rainfall data available from the SWFWMD (http://www.swfwmd.state.fl.us/data/wmdbweb/rainfall_data_summaries.php, **Exhibit INT204).** For example, during March and July of 2007, mean precipitation in Levy County was 2.07 and 10.45 inches, respectively. During those same months in the preceding year, mean precipitation in Levy County was only 0.12 and 6.04 inches, respectively. Those months are critical months for new growth, reproduction and full leaf-out of plants, as I described previously in my testimony.

Q.34. Does the FEIS adequately assess the potential impacts of the water quantity changes you just described on wildlife habitat and federally endangered and threatened species and

other species relying on those Outstanding Florida Waters and associated surface and ground waters?

A.34. No. The FEIS makes no assessment of the direct, indirect or cumulative adverse impacts of reducing existing groundwater discharges into these critical wildlife habitats. These freshwater discharges provide essential drinking water and support vegetation for endangered species such as the Manatee that use these areas for feeding on aquatic vegetation, and as nursery areas, as described in the Division of Administrative Hearings ("DOAH") ruling dated November 18, 1996 (**Exhibit INT383 pp. 1-27**).

Currently, springs in nearby state and county parks as well as King Spring and its Spring Run Creek have exhibited severe changes that have been attributed to drought, without considering alterations of natural hydroperiods that already have occurred. Illustration of the cumulative impacts of hydroperiod alterations on these springs during periods of drought are shown in several exhibits, including the photograph taken on May 22, 2012 by Dan Hilliard of the dry channel where Spring Creek Run has stopped flowing from Big King into Gulf Hammock and ultimately to the bay (**Exhibit INT384)**; the June 3, 2012 guest column by Dan Hilliard in the Citrus County Chronicle (**Exhibit INT385)**; the April 5, 2012 Chiefland Citizen article "Fade to Brown" (http://www.chieflandcitizen.com/content/fade-brown, **(Exhibit INT374)** and the April 19, 2012 Chiefland Citizen article "Groundwater levels continue to plummet – wells running dry" (**Exhibit INT375)**. Also refer to my testimony in A. 27. The FEIS also fails to analyze the indirect and cumulative impacts of reductions in groundwater discharges to the multitude of smaller springs that are closer to the LNP. In my professional opinion, these cumulative impacts will be LARGE for all of these small but ecologically significant ecosystems.

Q.35. Does the FEIS adequately assess the potential impacts on water quality and the aquatic environment due to alterations and increases in nutrient concentrations caused by the removal of water from construction and operation of the proposed LNP?

A.35. No. In addition to the failure of the FEIS to address water quantity and hydroperiod impacts on the aquatic environment that I described previously, the FEIS also fails to address water quality impacts. For example harmful increases in nutrient levels, known as eutrophication, will result from the LNP's withdrawal of large quantities of water from the Withlacoochee Canal and from the aquifer relative to the 3.51 MGD withdrawal from existing private residential wells (FEIS, Vol 1, p. 2-31), because the proposed LNP withdrawals will concentrate the existing nutrient pollution in the remaining, flow-depleted waters. In fact, the FEIS does not appear to include even a single reference to eutrophication as one of the LARGE adverse impacts of construction and operation of the proposed LNP, although these impacts clearly meet the definition of LARGE: "Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource." (FEIS Vol. 2, p. xxxii.)

Although the FEIS does not include a definition of eutrophication, the USGS defines eutrophication as, "a process where water bodies receive excess nutrients that stimulate excessive plant growth" (toxics.usgs.gov/definitions). The USEPA provides the following, more detailed description of eutrophication on the agency's web site (http://www.epa.gov/acidrain/glossary.html):

> A reduction in the amount of oxygen dissolved in water. The symptoms of eutrophication include blooms of algae (both toxic and non-toxic), declines in the health of fish and shellfish, loss of seagrass beds and coral reefs, and ecological changes in food webs.

In my professional opinion, the proposed withdrawals from the Withlacoochee Canal and aquifer, combined with the proposed stormwater ponds capturing, impounding and evaporating water previously flowing through the site as overland flow into wetlands, floodplains, special

aquatic sites, and other waters, would result in LARGE adverse impacts to water quality and increase the harm from existing concentrations of nutrients in the water by decreasing the volume of water available to dilute nutrient contaminants in the surface waters in the vicinity of the proposed LNP.

Q.36. Does the FEIS adequately assess the potential impacts on water quality and the aquatic environment due to alterations and increases in nutrient concentrations caused by wildfires?

A.36. No. Eutrophication also would increase in the aquatic environment in the vicinity of the proposed LNP from aerial deposition of particulate nitrogen associated with destructive wildfires that result from hydroperiod alterations, such as those associated with the proposed LNP and proposed mines in the vicinity. Examples of these destructive wildfires are the ones that occurred in Levy County in April through June 2011 and May of this year, as documented in the April 8, 2011 Levy Wildfire Report by the Florida Forest Service (**Exhibit INT386)** and the Florida Highway Patrol warning issued for Levy roads. These wildfires were located in Goethe State Forest, in the vicinity of existing Lebanon Station mine north of the proposed LNP project site. According to the Florida Forest Service (**Exhibit INT386)**, the 2011 destructive wildfire burned 3,124 acres. In my professional opinion, based on more than 30 years observing these types of destructive wildfires, these long-lasting smoldering fires only occur in areas where the natural hydroperiod has been altered by excavations, groundwater pumping, or a combination of those actions, not in areas solely with a build up of leaf litter. In fact, during site inspections of those areas of Goethe State Forest prior to those destructive wildfires I documented typical signs of premature decline and subsidence of organic soils indicative of hydroperiod impacts that lead to destructive wildfires, as described in Bacchus et al. (2003).

Wildfires not only are beneficial for the natural ecosystems within the "affected area" of the proposed LNP, those fires and prescribed burns intended to simulate those wildfires also are

essential to the maintenance of those natural ecosystems. Fires are essential for maintaining the natural communities on the proposed LNP and extended vicinity and for reducing accumulated leaf litter. Both wetland trees such as pond-cypress, and upland trees, such as long-leaf pines, have evolved protective adaptations to co-exist with and benefit from fires, but in areas of hydroperiod alterations these same trees die. Because of changes in soil moisture and related conditions due to the hydroperiod alterations, soil moisture is depleted so the trees are not properly hydrated and the fires kill them. (Bacchus, 2007; **Exhibit INT390**). In other words, when natural hydroperiods are altered, fires that would have been beneficial -- and even essential -- become lethal.

The following quote from the FEIS (Vol 2, p. 7-33) concedes that nutrients would be introduced into the aquifer from fires and that those nutrients may affect nutrient loading in surface waters:

> Nutrients introduced to groundwater from natural or man-made events such as fires may affect nutrient loading in surface waters. Nutrients would be discharged to groundwater through infiltration of surface waters located as stormwater-detention ponds on the LNP site and are not expected to affect offsite waterbodies such as the Withlacoochee River or Lake Rousseau. Furthermore appropriate stewardship of the site by the applicant is expected to significantly reduce the potential for uncontrolled fires involving onsite vegetation.

Despite these admissions the FEIS concludes, without any evidence or supporting documents, that this additional nutrient loading "is not expected to affect offsite waterbodies such as the Withlacoochee River or Lake Rousseau (FEIS Vol 2, 7-33)." Such unsupported expectations of the FEIS are suspect until additional groundwater flow modeling is performed, and the hydrological connection between the Floridan and surficial aquifer acknowledged in the FEIS previously and in the FSAR rev. 2, p. 2.4-92).

Therefore, the FEIS fails to consider the direct, indirect and cumulative impacts of eutrophication from increased destructive wildfires due to hydroperiod alterations.

Q. 37. Do you have any further concerns about wildfires?

A .37. Yes. The FEIS (p. 5-31) further suggests that PEF's proposed "Wetland Mitigation Plan" (Entrix, 2010) for the proposed LNP proposes "controlled burns" to "reduce fuel loads in upland and wetland areas on and around the LNP site" and that "rapid fire response would be expected" if "wildfires unexpectedly occur around the LNP project" for "offsite fire-protection resources.

But land managers from water management districts, state and federal agencies and private organizations trained in prescribed burns and control of wildfires have failed repeatedly in attempts throughout Florida at "restoration of a more natural fire regime" in areas of hydroperiod alteration (Bacchus, 2006). In fact, wildfires burned out-of-control for approximately two months in Goethe State Forest in site 2011 and again in 2012, in the immediate vicinity of the proposed LNP site and on the proposed LNP site, despite efforts to control these fires. Therefore, although the FEIS relies on a belief that "rapid fire response would be expected, drawing from both onsite (LNP) and offsite fire-protection resources," (FEIS Vol. l, p.5-31) even if the response were rapid, there is no evidence to support a conclusion that the fires could be contained or controlled when attempts to control similar fires in that area have been unsuccessful, as described in the April 8, 2011 Levy Wildfire Report by the Florida Forest Service (**Exhibit INT386)** Therefore, it is my professional opinion that those claims have no scientific basis and will be impossible to achieve, whether the fires are natural or set by humans as prescribed burns. Thus, the alleged "management" of wildfires represents yet another adverse environmental impact of the proposed LNP.

Another issue resulting from wildfire is erosion. Based on my research in groundwater alterations throughout Florida during the past 30 years, the hydroperiod alterations from the construction and operation of the proposed LNP project would result in the premature decline and death of wetlands and upland native vegetation such as cabbage palms, pine, pond-cypress and oak

trees (see also Bacchus, 2007) **(Exhibit INT390)**. That vegetation not only provides wildlife habitat, it also stabilizes soil. The loss of that vegetation would result-in additional soil destabilization and erosion and would degrade water quality further (Bacchus, 2007).

B. <u>Environmental Impacts of Salt Drift and Deposition</u>

Q.38. Does the FEIS adequately assess the potential impacts to wetlands, floodplains, special aquatic sites, and other waters, associated with salt drift and salt deposition resulting from cooling towers that use saline water being situated in an inland, freshwater wetland area of the proposed LNP site?

A.38. No. The FEIS assumed, without any adequate, scientifically based analysis,, that the impact associated with salt drift and salt deposition would be negligible. That finding is without any scientific foundation because it is based on experience with saltwater cooling towers located on the coast, not inland, as for the proposed LNP. Several additional deficiencies contribute to the improper assessment of hydroecological impacts from salt drift and salt deposition during construction and operation of the LNP, as described in the FEIS.

First, the salt drift and deposition model relied on by the FEIS uses wind directions from Tampa that do not correlate closely enough with the data from the LNP site. Specifically, the FEIS Vol 1, p. 5-86) says the highest deposition rate would be "at a location west of the cooling towers." The prevailing wind directions measured at the site during this period were from the east-northeast and from the west (FEIS Vol 1, p. 2-181). The on-site winds would mean that significant amounts of salt drift would be deposited to the southwest. The supply wells, causing most of the active dewatering at the LNP, with "drawdowns as much as 2.5 ft in areas near the wellheads" (FEIS Vol1 p.5-27), are south of the nuclear islands. Therefore, the LARGE adverse impacts from the induced recharge that would result from the proposed LNP supply wells also would result in cumulative adverse impacts from this salt deposition pattern. Thus, the induced recharge with more saline water

also would increase groundwater contamination and groundwater discharge of this salt-contaminated water in the Withlacoochee Canal, Withlacoochee River, Withlacoochee Bay, Gulf Hammock Wildlife Management Area and Waccasassa Bay State Park.

Second, that model apparently does not consider excavations into the water table such as the mines that already occur in the vicinity of the proposed LNP site and the numerous additional mines, as well as the stormwater ponds that are proposed to be excavated on the LNP site and vicinity (FEIS, p. 2-8). The proposed mines, existing mines and other excavations expose areas of the aquifer system that previously were protected to various degrees by the soils and formations previously covering those areas (Bacchus, 2006). Therefore, in those exposed areas the aquifer would suffer contamination directly from aerial deposition of salt particles. Indirect contamination of the aquifer with salt from aerial deposition also will occur via infiltration of the deposited salt following rainfall events. The computer modeling in the FEIS for salt drift and deposition inaccurately portrays salt deposition rates and locations and underestimates the ensuing effects.

Scientific methodology for quantifying "drift" such as salt emissions from power plant cooling towers has been available at least since 1979. Moser (1979, **Exhibit INT391**) described scientific methodology for collecting and quantifying airborne salt droplets and particles, via impingement and sedimentation and included the following statements relevant to the proposed LNP:

> Once aloft, salt particles and droplets may come in contact with vegetation by sedimentation, impingement, or in rainfall. Impingement of windborne particles is by far the major means by which salt accumulates on the aerial portions of plants in coastal areas. Accumulation of salt by impingement also will most likely represent the greatest threat to vegetation growing in the wake of drift from salt-water cooling towers. (p. 1002)

Neither PEF nor the DEIS appears to have even a single year of air concentration and vertical deposition data or sedimentation measurements from a comparable site as support for

allegations that drift from the proposed LNP cooling towers would not result in significant adverse environmental impacts. Moser (1979**)** described the importance of site-specific measurements of air concentration, vertical deposition and sedimentation as follows:

> Salt will accumulate rapidly on vegetation under windy conditions. This accumulation by impingement may be several times that which accumulates by simple sedimentation. For this reason measurements of air concentration and vertical deposition are as significant as sedimentation measurements when assessing potential effects on vegetation. This is particularly true under windy conditions. (p. 1006)

Not only did PEF and the FEIS fail to quantify salt drift that would occur from the proposed LNP cooling towers using comparable existing cooling towers, but also neither PEF nor the FEIS quantified or assessed the combined and cumulative impacts of salt drift from operating cooling towers similar to the proposed LNP cooling towers **combined** with naturally occurring airborne salt deposition from the coast in the vicinity of the proposed LNP site. Dispersal of airborne salt is not consistent from day to day or even within the same season. For example, during two consecutive days of onshore winds during the summer, in June, Moser (1979) documented salt deposition levels three times higher than any other measurements during the summer.

The FEIS (p. 5-20) underscores the difficulty of determining the effects of salt drift when it states, "Chronic effects, however, are less obvious and harder to quantify (NRC 1996)." The fact that these effects are difficult to evaluate does not eliminate the requirement for the FEIS to take whatever measures are necessary to conduct an adequate evaluation of those impacts.

Additionally, the FEIS uses corn as an indicator species, but corn cannot be used as an indicator of vegetative harm from salt drift, because there is no corn in the vicinity and there is no scientific documentation supporting the presumption that corn is as sensitive as the native species in the area, such as the cypress in wetlands on the proposed LNP site and surrounding vicinity. Corn

is a short-term crop typically grown with irrigation and there will be no reliable water supply for the native vegetation.

Moreover, the FEIS fails to account for normal dry seasons and for drought conditions, while admitting that "Florida is susceptible to droughts. Recent periods of droughts include the early 1970s, the early 1980s, 1989–1990, and 1999–2001." (FEIS Vol. 1, p. 2-182) Even in the single year of data provided in the FEIS, there was a shortage of rainfall. (FEIS Vol. 1, p. 5-22.) The FEIS fails to consider the vulnerability of the aquifer, and the resulting cumulative damage to wetlands from the synergistic effects resulting from drought *combined* with anthropogenic (man-made) changes in the natural hydroperiods and *additional* anthropogenic stress from salt drift from the proposed LNP. In fact, the scale of the impact from salt-drift alone is illustrated by the extensive death and destruction of native vegetation that has occurred in the vicinity of the Crystal River Energy Complex ("CREC") in adjacent Citrus County, as shown in the Crystal River Salt Drift Study **(Exhibit PEF606**) (p. 3-19).

The FEIS relies heavily on the CREC salt drift monitoring reports, however, the methodology used at CREC was flawed because during the 13 years of reporting, the cooling towers were not all in operation, as described on page 1-1 in the Crystal River Salt Drift Study, and the monitoring sites were moved periodically (Crystal River Salt Drift Study **(Exhibit PEF 606) (**p. 1-3). The mechanical draft cooling towers (the type proposed for LNP) were operational for only one year before the study was terminated (Crystal River Salt Drift Study 1993-94 Annual Report, p.1-1). The pre-operational modeling for CREC also did not predict where the actual maximum deposition occurred (Crystal River Salt Drift Study p. 1-3).), thus precluding a scientifically valid monitoring design comparing that area to true control areas.

Additionally, the collected data were skewed by errors that were easily preventable, such as the following examples from the Crystal River Salt Drift Study 1993-94 Annual Report:

> …water has been observed seeping through the bottom of the berm which separates the ash pond from the adjacent forest, hydrologic and/or chemical changes associated with ash pond seepage could be contributing to plant mortality as well. (p. 4-5)
>
> <u>However, these values are thought to be lower than what actually occurred because the deposition collectors were placed in forested areas, and the tree canopy may have intercepted some of the sodium and chloride.</u> (emphasis added, p. 4-1)

This Crystal River Salt Drift Study 1993-94 Annual Report released by KBN Engineering and Applied Sciences, Inc., in 1995, corroborates a fact that should be obvious - salt drift from cooling towers located in forested areas will result in interception of a significant portion of the salt by the tree canopy. The trees on the proposed LNP site and surrounding vicinity are not estuarine/marine species such as mangroves that are adapted to salt deposition on leaves. Obviously there are no mangroves or other salt-tolerant vegetation on the proposed LNP site because the site is inland. Therefore, it is NOT easy to assume, as does the FEIS, that constant aerial deposition on the tree canopy will NOT result in the death of these trees.

I am not aware of any studies on the impacts of aerial deposition of salt on the canopy of pond-cypress trees. Because these plants are not adapted for growth along the coast, they would not even be planted in areas subjected to salt exposure. The lack of published literature on the susceptibility of pond-cypress to salt deposition probably is due to the lack of need to conduct research of cypress susceptibility to salt because previous proposals have not considered such an incompatible siting of a project such as the proposed LNP site. There is ample evidence, however, that root exposure to salt causes death of bald-cypress trees (*T. distichum*) which are more robust than the pond-cypress trees that dominate wetlands in the proposed LNP site and surrounding

vicinity. For example, my photographs listed as numbers 0847, 0934, 1031, 1136, and 1156 in **Exhibits INT310, 319, 394, 324, and 326)** illustrate the death and premature decline of bald-cypress and other wetland trees, pines, oaks and cabbage palms due to root exposure to salt. Additionally, a study conducted by the National Academies (1975), used visual symptoms and chemical analysis of leaves and soils to conclude that soil-salt and spray-salt caused much of the twig dieback in hardwoods and needle browning in pines in that study area of vegetation not adapted to salt exposure.

As I testified in response to previous questions, the salt intercepted by the canopy of the trees ultimately will reach the ground, either via rainfall during the rainy season or following droughts or as the salt-encrusted dead leaves fall from the trees. The rain then will carry the salt directly to the shallow roots of these trees combining chronic salt stress with the chronic stress of hydroperiod alterations referenced in my testimony in response to previous questions. This is the nature of cumulative adverse impacts that were not addressed in the FEIS.

Therefore, although the Crystal River Salt Drift Study (p. 4-8) admits that significant damage to natural vegetation occurred due to salinity, the following conclusion, "however it is difficult to elucidate the contribution of salt spray from coastal storms compared to salt spray from the cooling towers" is not relevant to the LNP. The proposed LNP is an inland site that is forested by tree species not commonly exposed to salt spray. The tree species in the Crystal River Salt Drift Study had evolved to tolerate salt or they would not have been growing there in the first place. In my professional opinion, the adverse impacts from aerial deposition of salt alone, in the absence of any alteration of natural hydroperiods or induced saltwater intrusion, would be LARGE and would extend to local, state and federal parks, preserves, and Outstanding Florida Waters associated with the proposed LNP. It is also possible that salt drift considered cumulatively with dewatering, could

affect wildlife as well. For instance, the effects of salt drift on amphibians are discussed on page 5-25 paragraph 2 of the FEIS, again without regard to impacts on seasonal or any other hydroperiod components.

Q.39. Does the FEIS adequately assess impact on federally listed species?

A.39. No. As a result of the omissions and inadequacies described above, the FEIS also fails to adequately identify, and inappropriately characterizes as SMALL, the proposed project's zone of impact on the following federally listed species:

- Eastern indigo snake (threatened)
- Florida scrub jay (threatened)
- Green turtle (endangered)
- Manatee (endangered)
- Red-cockaded woodpecker (endangered)
- Sea-turtles
- Smalltooth Sawfish (endangered)
- Wood stork (endangered)

A composite attachment of documents prepared by the USFWS (**Exhibit INT402**) regarding that agency's Multi-Species Recovery Plan provides additional information about some of these species to help illustrate deficiencies of the FEIS in taking a hard look at the direct, indirect and cumulative impacts of the proposed LNP on species listed and proposed for listing as endangered and threatened. The first document (http://www.fws.gov/endangered/whatwedo.html, (**Exhibit INT402, pp. 1-2**) describes the three basic types of permits USFSWS issues regarding endangered and threatened species, including "incidental take permits." Because the FEIS fails to identify the adverse impacts to the endangered and threatened species that I just referenced in my testimony as LARGE due to the inevitable and irreversible adverse impacts to the natural hydroperiods, the USFWS was not able to determine the number of incidental take for each endangered species and to issue those permits.

Exhibit INT402, **p. 2**). The second document, a copy of the Endangered Species Act of 1973, includes the definition of "take" (**Exhibit INT410, p. 3**), which includes "harm." Unpermitted take of endangered and threatened species is identified as a prohibited act (**Exhibit INT410**, **p. 25**). In my professional opinion, the proposed LNP would result in unpermitted take of the species that I listed previously.

Based upon the demonstrable lack of definitive plans such as the Environmental Monitoring Plan and Avian Protection Plan, it is impossible for the FEIS to have assessed the direct, indirect and cumulative adverse impacts on endangered and threatened species or any other wildlife. Examples of these types of impacts on coastal species, particularly federally endangered and threatened species, are described by Bacchus (2001). Despite this obvious deficiency of the FEIS, I will provide specific examples of the failure of the FEIS to take a hard look at direct, indirect and cumulative adverse impacts on endangered and threatened species.

Green turtles feed in seagrass beds in coastal areas within the zone of impact from the proposed LNP project, according to the USFWS fact sheet on green turtles. Page 2-103 of the FEIS, Vol 1, admits that seagrass abundance in the immediate vicinity of the Withlacoochee canal declined between 1995 and 2001 from salinity and other factors. The proposed LNP relies on withdrawals of fresh surface water from the Withlacoochee canal and 5.8 million gallons per day (MGD) peak withdrawals of fresh ground water adjacent to the Withlacoochee canal, with no limit on maximum withdrawals, as confirmed in the SWFWMD Water Use Permit ("WUP") (**Exhibit INT215)**. The FEIS, however, fails to evaluate the cumulative impacts of these freshwater withdrawals on the seagrass beds in the downstream waters where salinity levels already have resulted in a decline in seagrass abundance. The FEIS also fails to take a hard look at the additional cumulative impacts of aerial deposition of salt from the proposed LNP increasing the salinity of

both surface water discharges and groundwater discharges to the Withlacoochee canal and exacerbating the increased salinity from proposed withdrawals.

For the Manatee, groundwater withdrawals would reduce or eliminate coastal freshwater spring discharges in the area, which Manatees use for drinking and which support the aquatic vegetation Manatees eat. Page 5-29 of the 54-page USFWS West Indian Manatee fact sheet describes the habitat requirements of Manatees, which includes access to freshwater springs (**Exhibit INT405**). Withdrawal of fresh water that normally flows down the Withlacoochee Canal would threaten the local coastal habitat the Manatees rely on for survival and recovery. In addition, the increased salinity of the Withlacoochee Canal and Withlacoochee River also would degrade existing Manatee habitat including Manatee nursery areas in the vicinity of the proposed LNP, as described in the Division of Administrative Hearings ("DOAH") ruling dated November 18, 1996 (**Exhibit INT383 pp. 1-27**).

Successful nesting, reproduction and survival of red-cockaded woodpeckers require older growth stands of live native pine trees, according to page 4-475 of the 30-page USFWS Red-cockaded Woodpecker Plan (**Exhibit INT406**). Florida's native species of pines are among the native trees most sensitive to hydroperiod alteration, and also are sensitive to salt, as illustrated by my photographs of pine trees in the vicinity of the Lower Withlacoochee River and Gulf Hammock Wildlife Management Area that have been killed or are experiencing premature decline due to increasing groundwater salinity (identified by the following numbers; 0847, 1010, 1011, 1035, 1193, 1231). Approximately 30 active red-cockaded woodpecker nest trees have been documented in the Goethe State Forest Daniels Island Tract, which is part of PEF's Mitigation Plan (Entrix, 2010, Exhibit 2-5-6, p.2-23 **Exhibit INT412)**. The Daniels Island Tract is adjacent to the northeast boundary of the proposed LNP shown in Exhibit 1-4 p. 1-12 of PEF's Mitigation Plan

and the east boundary of the proposed Knight Farm sand mine. The adverse direct, indirect and cumulative impacts of the proposed LNP project, such as salt drift from the proposed cooling towers, proposed groundwater withdrawals, excavated stormwater ponds and proposed sand mine would result in irreversible destruction of significant stands of natural pine that could be used by red cockaded woodpeckers for nesting, including the approximately 30 active red-cockaded woodpecker nest trees documented in the Goethe State Forest Daniels Island Tract.

The FEIS (p. 2-114) acknowledges that the smalltooth sawfish *(Pristis pectinata)* is a federally listed and state listed aquatic species within the "affected environment" but fails to provide the status of this cartilaginous fish. According to the National Oceanic and Atmospheric Administration (NOAA, http://www.nmfs.noaa.gov/pr/species/fish/smalltoothsawfish.htm), the smalltooth sawfish is listed as endangered. The NOAA web site for the smalltooth sawfish also includes the following habitat description:

> Habitat
> Sawfish species inhabit shallow coastal waters of tropical seas and estuaries throughout the world. They are usually found in shallow waters very close to shore over muddy and sandy bottoms. They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths. Certain species of sawfish are known to ascend inland in large river systems, and they are among the few elasmobranchs that are known from freshwater systems in many parts of the world.

The FEIS (p. 2-120) also acknowledges that since "2000, four smalltooth sawfish jueveniles have been either caught or sighted offshore of Citrus County," one at the mouth of the Withlacoochee Canal, where both surface water and ground water would be withdrawn for the proposed LNP, and another "outside the CREC discharge canal (FMNH 2009b)." Despite the confirmation of the smalltooth sawfish in the "affected area" of the proposed LNP where the water would be extracted, the FEIS fails to address how this species will be affected by the direct, indirect and cumulative impacts of the proposed LNP that I have described in my testimony.

Florida Scrub-jay habitat requirements are provided on pages 4-264 through 4-265 of **Exhibit INT403.** Extreme environmental degradation will severely impact indigo snake and scrub jay habitat.

It is my professional opinion that formal consultations with the USFWS for the proposed LNP project are invalid because of the grave inadequacies of the FEIS in identifying the LARGE and irreversible impacts of this proposed project, particularly the hydroperiod impacts that will jeopardize the survival and recovery of the federally listed species previously referenced. Until the entire zone of impact and magnitude of adverse environmental impacts from the proposed LNP project have been determined accurately and scientifically, a reliable consultation with the USFWS cannot be completed as required by the Endangered Species Act and NEPA.

Q.40. How does the FEIS address the adverse indirect and cumulative impacts of the proposed withdrawals from groundwater supply wells that have been permitted for the proposed LNP?

A.40. The FEIS does not address the adverse indirect and cumulative impacts of the proposed groundwater supply wells that have been permitted for the proposed LNP. Also, statements in the FEIS about the proposed groundwater supply wells also are not consistent with the permitting documents from the SWFWMD files for the permitted supply wells for the proposed LNP.

Paragraph 3 of page 3-13 in the FEIS addresses groundwater wells and includes the following statement: "Four groundwater wells would be located south of the LNP site and north of the CFBC (Figure 3-1)." Figure 3-1 is located on page 3-3 of the FEIS and is titled, "Proposed LNP Site Footprint (modified from PEF 2009a)."

This FEIS figure and statement are inconsistent with the information provided by the SWFWMD regarding permitted groundwater withdrawals for the proposed LNP. The SWFWMD WUP File of Record clearly shows that five supply wells were permitted for the proposed LNP, not

four, and that supply well #5 is located in the north LNP parcel, in proximity to the proposed location for proposed LNP #2 (**Exhibit INT336, p. 3 of 5**). My Figure 1B (**Exhibit INT336)** clearly shows the location of LNP's permitted supply well #5 in the LNP's north parcel, in addition to LNP's permitted supply wells #1-4 in LNP's south parcel and LNP's permitted monitoring wells in LNP's north parcel.

Figure 3-1 of the FEIS fails to show the permitted LNP supply well #5, based on the absence of any well symbols in the north parcel. More significantly, Figure 5-1 of the FEIS (Vol 1, p. 5-6), "Simulated incremental Surficial Aquifer System Drawdown Associated with LNP Operations (PEF 2010a)," clearly omitted the proposed LNP supply well #5 from the model drawdown, also based on the absence of any well symbols in the north parcel. These failures in the FEIS make it impossible for the agencies responsible for the FEIS and the affected agencies, such as the USFWS, to take a hard look at the direct, indirect and cumulative impacts of the proposed LNP. These failures also precluded the public from participating fully in the FEIS process.

It is critical to provide a perspective of the quantities of groundwater permitted to be withdrawn for the proposed LNP in the SWFWMD WUP issued on August 26, 2009 (**Exhibit INT215, p. 3 of 5**) and to recognize that those permitted amounts are more conservative than the conditions for the proposed LNP in the 2011 Conditions of Certification ("COC"). A total of 1,580,000 average gallons per day ("GPD") is permitted for withdrawal from proposed LNP supply wells #1 through #4 with 395,000 GPD permitted for withdrawal from **each** of those four proposed wells. An additional 90,000 average GPD is permitted for withdrawal from well #5, with 5,850,000 peak gallons per day permitted from wells #1 through #4 and 330,000 peak gallons per day from well #5. The permit does not constrain these withdrawals during times of drought, nor does the permit impose a maximum withdrawal per day (**p. 1 of 5**). Those constraints are reserved

for certain types of agriculture, as shown in the electronic mail from the SWFWMD Hydrologist to Cara Campbell in May of this year (**Exhibit INT432).**

Based on those more conservative withdrawals permitted by SWFWMD in the WUP, **each** of the proposed LNP supply wells #1 through #4 exceeds the current quantities permitted for withdrawal for the municipal wells for Cedar Key Water and Sewer District and the Suwannee Water and Sewer District northwest of the proposed LNP, which are 302,600 GPD and 365,900 GPD, respectively**.** Therefore, considering only conservative quantities permitted by the WUP for withdrawals from proposed LNP supply wells #1 through #4, those withdrawals would be equivalent to groundwater withdrawals for four new municipalities located on and withdrawing ground water from the proposed LNP site.

Additionally, considering only the conservative quantities permitted by the WUP for withdrawals from proposed LNP supply well #5, that amount is more than the permitted municipal groundwater withdrawals for Horseshoe Beach Utilities (**Exhibit INT415**) and Steinhatchee Water Association, Inc. and more than half of the permitted municipal groundwater withdrawals for Taylor Beach Water System (**Exhibit INT207)**, municipalities northwest of the proposed LNP site. All of these municipalities encountered water quality problems, such as saltwater intrusion, while withdrawing smaller volumes of water under previous permits and were forced to either relocate their wells further inland or to implement reverse osmosis to remove the salts (see testimony by Mr. David Still, who addresses this issue in his testimony). Therefore, the failure of the FEIS to consider modeled effects of drawdown from proposed LNP supply well #5 in the north LNP parcel is tantamount to failing to consider the impact of withdrawals from municipal supply wells for Horseshoe Beach Utilities and Steinhatchee Water Association, Inc. As described in my testimony, saltwater intrusion not only contaminates private and municipal wells, it also kills native vegetation

that relies on fresh groundwater for survival. Therefore, the only logical conclusion is that the proposed groundwater withdrawals from each of the five proposed LNP supply wells is that the adverse impacts from each of these wells individually would be LARGE.

The fact that there are no permit requirements to halt or reduce groundwater withdrawals during times of drought ensures that both on-site and off-site adverse environmental impacts from groundwater withdrawals will be intensified and presumably irreversible during times of drought. Without restrictions on groundwater withdrawals during times of drought, LNP could withdraw the maximum amount of water allowed during those times when both plants and animals in the surrounding ecosystems are most reliant on natural groundwater contributions.

For example, the SWFMWD WUP, **(p. 2-3**) allows average withdrawals of 395,000 gallons per day and maximum withdrawals of 1,462,500 gallons per day from wells #1 through #4 . Although the SWFWMD permit includes the coordinates of these wells, it does not include a map of those locations, which are shown in my Figure 1C. The permit also allows average withdrawals of 90,000 gallons per day and maximum withdrawals of 333,500 gallons per day from well #5, which is shown in my Figure 1C**.** The following provision on page 49 of the COC is inconsistent with the provisions of the SWFMWD permit for the five supply wells in that permit (emphasis added):

> **The Licensee may make adjustments in pumpage distribution as necessary up to 125 percent on an average basis, up to 125 percent on a peak monthly basis**, so long as adverse environmental impacts do not result and other conditions of this certification are complied with. In all cases, the total average annual daily withdrawal and the total peak monthly daily withdrawal are limited to the quantities set forth above."

The FEIS fails to take a hard look at or do any type of assessment of impacts by these adjustments in pumpage distribution. In fact, the permit seems to imply that the LNP could pump its

water from only two wells (see Still Testimony). The FEIS does not even include a detailed monitoring plan regarding how "adverse environmental impacts" would be assessed for those 125% "adjustments in pumpage." The permitted requirements for supply well #1, the location of which is shown in my Figure 1C, include: 16-inch Casing Diameter, 150-foot Casing Depth, 500-foot Total Depth, but the Casing Diameter, Casing Depth and Total Depth of the remaining four withdrawal wells and the monitoring wells are not specified in that permit. This is essential information because the diameter of the well/casing influences the volume of water that can be withdrawn during a period of time, while the depth of the casing and well influences the magnitude and extent of the adverse environmental impacts that will occur from the groundwater withdrawals. For example, adverse impacts from groundwater withdrawals from a 500-foot deep well in the Floridan aquifer system will have a far-greater lateral extent via preferential flow-paths than comparable withdrawals from wells 20 to 40 foot deep, such as the private residential wells in the area.

Q.41. How does the FEIS address the adverse indirect and cumulative impacts from the hydroperiod alterations you have described from construction and operation of the proposed LNP on wildlife habitat, including fragmentation of wildlife habitat?

A.41. The FEIS does not adequately address the adverse indirect and cumulative impacts from any of the hydroperiod alterations I have described from construction and operation of the proposed LNP on wildlife habitat, including fragmentation of wildlife habitat. In fact, the FEIS admits that the proposed LNP will increase fragmentation (FEIS Vol 1 p.4-37, 4-46, 4-59 Vol 2, p.7-23). Hundreds of acres of direct impacts to wetlands on and off site, not simply for the transmission lines as the FEIS implies, would occur from actual removal by dredging and filling. The loss of wetlands and other wildlife habitat due to indirect and cumulative impacts from hydroperiod alterations in the extended vicinity surrounding the proposed LNP, as previously discussed, will cause

further habitat fragmentation from loss of wetland functions both on-site and off. Consideration of this fragmentation in conjunction with hydroperiod alterations is omitted in the FEIS. Again, the FEIS provides no discussion of how wetlands and other wildlife habitat surrounding the proposed site would be fragmented by the inevitable and irreversible hydroperiod alterations that would result from the proposed LNP project and how the resulting fragmentation would affect the function of those wetlands, floodplains, special aquatic sites, other waters and other wildlife habitat.

My Figures 3A and 3B illustrate that the most important state-ranked wildlife habitat in the region selected for the proposed LNP (bold black outline), based on the ranked maps from the State Wildlife Habitat Ranking Report **Exhibit INT418)**, are located in the Gulf Hammock Wildlife Management Area (yellow to red), and Goethe State Forest (green and yellow) immediately west and east of the proposed LNP, respectively. Those Figures 3A and 3B also include the position of the lineaments mapped by Vernon (1951, **Exhibit INT369)** as diagonal white and orange lines oriented from northeast to southwest and northwest to southeast. The lineaments, identified as faults by Faulkner (1973) are represented by the diagonal orange lines in those figures. Those figures also include the locations of the four proposed supply wells permitted by the SWFWMD in the south LNP parcel, that are associated with the two lineaments in that parcel, and the fifth proposed supply well, which is located in the north LNP parcel and is associated with the lineament that extends through that parcel. It is important to note that the northern lineament associated with the supply well in the southeast corner of the south LNP parcel extends through the heart of the Gulf Hammock Wildlife Area habitat ranked by the state as most important (red). Because a large amount of water is to be withdrawn from the LNP site, the FEIS should have considered impacts to natural hydroperiods from preferential flow through the fractures represented by those lineaments in

response to the permitted groundwater withdrawals. For example, one of the lineaments associated with a permitted pumping well for the proposed LNP extends northeast through the most important wildlife habitat in Goethe State Forest where the active red-cockaded woodpecker nest trees are located, as shown in the Entrix (2010) Exhibit 2-5-6 (**Exhibit INT364**)

Q.42. How does the FEIS address the adverse cumulative impacts from the hydroperiod alterations you have described from construction and operation of the proposed LNP on saltwater intrusion and other increases in salinity of ground water and surface water?

A.42. The FEIS does not address the adverse cumulative impacts from construction and operation of the proposed LNP on saltwater intrusion and other increases in salinity of ground water and surface water. FEIS VOL 1 page 2-37 states that "(e)xcessive use of the groundwater resource in coastal regions has the potential to increase the likelihood and/or magnitude of saltwater intrusion." No attempt is made, however to determine whether the possibility of salt water intrusion during high water consumption/drought periods could be exacerbated by LNP. It goes on to acknowledge that "Building-related groundwater withdrawals from the Upper Floridan aquifer have the potential to decrease water levels at the site and induce lateral saltwater intrusion from the CFBC and vertical migration of saline waters from deeper Floridan aquifer intervals."(FEIS VOL 1 page 4-27) There was no attempt to define the parameters where the impacts of salt water intrusion would be significant enough to warrant a more thorough analysis. Finally, as stated in Section 7.2.2.2 (FEIS p. 7-18), global climate change can result in a rise in sea level that may induce saltwater intrusion in the surficial and Floridan aquifers. Projected changes in the climate for the region during the life of the proposed units include an increase in average

temperature and a decrease in precipitation.(FEIS Vol 2, p. 9-54). Once again, there was no analysis of the impacts of climate change on ANY aspect of the proposed LNP.

Saltwater intrusion occurs with sea-level rise, but the magnitude in extent and severity increases with withdrawals of groundwater and surface water. Pokhrel et al. (2012). The FEIS fails to consider vertical saltwater intrusion that can occur in response to groundwater supply wells that withdraw water in areas where higher salinity groundwater is present in the vicinity. This type of saltwater intrusion also is known as "upconing." An illustration of upcoming where salt water was pulled upwards through a fracture in response to groundwater withdrawals from the Floridan aquifer system is shown in Figure 4 of Bacchus (2000, **p. 467**). The FEIS also fails to consider the cumulative impacts of saltwater intrusion via this preferential flow through karst conduits, on the freshwater ecosystems in Gulf Hammock Wildlife Management Area and related areas in the vicinity surrounding the proposed LNP.

The FEIS also fails to consider the cumulative impacts of saltwater intrusion in the tidally influenced Withlacoochee Canal, Withlacoochee River and tidal creeks, from passive and mechanical groundwater withdrawals, surface water withdrawals and surface water diversion and impoundments that I described in my previous testimony. As an example, Figure 4 provides some of the myriad locations of thermal infrared signatures (white triangles) indicative of groundwater discharges in the vicinity of the proposed LNP that were identified by Raabe and Bialkowska-Jelinska (2010, **Exhibit INT419**) during a period of low ambient temperatures in March 2009, based on shapefiles provided by the U.S. Geological Survey (USGS) office that conducted that study. This figure illustrates that the majority of these individual points form an "S" shape that coincides with the boundary between the coastal forested hammock habitat and the coastal marsh, suggesting that these groundwater discharges play an important role in maintaining both habitats.

This figure also provides related locations where I took surface water salinity measurements in January 2012 (diamonds) and March 2012 (crosses). Salinity levels ranged from fresh to saline (0.01-5 ppt = dark blue; 5.01-14 ppt = light blue; 14.01-21 ppt = green; 21.01-24 ppt = orange; 24.01-30 ppt = red, respectively). Several inferences can be made from the pattern of these ranges in salinities:

The multiple dark blue crosses located in the center of the Gulf Hammock Wildlife Management Area west of the location of the proposed Tarmac aggregate mine represent several small mines where excavated limestone from the carbonate aquifer system have resulted in large areas of fresh groundwater discharge. The cluster of blue diamonds approximately 8 km north of those small mines and coinciding with the lineament (diagonal red line) extending from the proposed supply well in the southeast corner of the south LNP parcel represents additional small mines. Limestone was excavated from the carbonate aquifer system at these locations, diverting a larger volume of ground water into these pits and exposing the ground water, now as surface water, to high evaporation rates and resulting in irreversible adverse impacts to the natural hydroperiod, as described by Bacchus (2006). See also Swancar et al. (2000, **Exhibit INT433**) regarding how the evaporative loss from water surfaces is significantly larger than those used in calculating pan evaporation exceeds the pan evaporation rates commonly used in water models and how ground water must compensate for this loss of surface water.

The pattern of high and low salinity in surface waters throughout the Gulf Hammock Wildlife Area is not indicative of a "front" of saline water moving inland through an isotropic, homogeneous porous aquifer. Instead, the data suggest a complex, anisotropic karst aquifer system, as described in the testimony of Mr. Davies and Dr. Hazlett, Therefore, heterogeneous preferential flow through features characteristic of karst aquifer systems, such as

dissolution conduits and fractures, should be presumed, as described in Bacchus and Barile (2005; **Exhibit INT 368**), Bacchus et al. (2011), Brook (1985, **Exhibit INT355**), Brook and Allison (1983, **Exhibit INT357**), Brook et al. (1988, **Exhibit INT358**), Lewelling et al. (1998) **(Exhibit INT428)**, Southwest Florida Water Management District (1996, **Exhibit INT429)**, and Stewart and Stedje (1990, **Exhibit INT361**).

Some of the locations where thermal infrared signatures in 2009 were indicative of groundwater discharge to surface waters in the USGS study (Raabe and Bialkowska-Jelinska, 2010; **Exhibit INT419**) were dry in 2012 when I conducted my surveys. Other thermal infrared signatures sites indicative of groundwater discharge clearly had been freshwater areas, based on the tree species and other associated vegetation at those locations, but the surface water no longer was fresh when I conducted my surveys in 2012. Most of those sites with elevated surface-water salinities were surrounded by trees that were dead or in various stages of premature decline indicative of preferential groundwater salinization from mining and/or groundwater withdrawals. Therefore, it is logical to conclude that areas with long-lived native freshwater vegetation, such as cabbage palms and oak and pine trees, that are dead or in a state of severe decline and that coincide with thermal infrared signatures indicative of groundwater withdrawals historically were receiving freshwater discharges that recently stopped or more likely increased in salinity.

Finally, the FEIS fails to consider the direct, indirect and cumulative impacts of hydroperiod alterations on the proposed LNP site and surrounding vicinity from preferential flow through relict sinkholes, fractures, faults, swallets and other karst conduits, particularly in response to groundwater withdrawals.

Q.43. In response to question 6 you indicated that you compiled a composite exhibit of photographs you have taken of the proposed LNP site and surrounding vicinity. Do those photographs provide examples of the types of environmental damage you have described in

your testimony that already has occurred and would become more extensive and severe from the cumulative impacts of the proposed LNP?

A.43. Yes. **Exhibit INT303** is a list and description of the photographs in that composite exhibit (**Exhbit INT304- Exhibit INT333)**. The first set of photographs are from the proposed LNP site and Big King Spring taken on January 11, 2012 during the site visit conducted at the request of the ASLB judges. Compare my photograph number 0819 **(Exhibit INT306)** of the Spring Run Creek discharge from Big King Spring with photograph 2008 of the same area taken by Dan Hilliard on May 22, 2012 **(Exhibit INT384)**, when Spring Run Creek was dry and no longer flowing.

I took the next three sets of photographs on January 12, 2012, January 14, 2012 and January 15, 2012 in the Gulf Hammock Wildlife Management Area, west of the proposed LNP. I took the next set of photographs on March 14, 2012 on the Lower Withlacoochee River, west of the proposed LNP. I took the next two sets of photographs on March 15, 2012 and March 16, 2012 in the Gulf Hammock Wildlife Management Area, west of the proposed LNP. I took the next set of photographs on the Waccasassa River/Cow Creek system, northwest of the proposed LNP, on March 17, 2012. I took the next set of photographs in Goethe State Forest, west of the proposed LNP, on March 18, 2012 after the 2012 wildfire in the State Forest.

All of these photographs, with the exception of the two Big King Spring photographs, illustrate irreversible habitat damage from saltwater intrusion of surface water and groundwater, combined with passive dewatering of the surrounding area by the series of small mine pits already excavated in the Gulf Hammock Wildlife Management area. In my professional opinion, significant hydroperiod alterations already have occurred in the entire area surrounding the proposed LNP site and construction and operation of the proposed LNP would be the final, fatal blow to those ecosystems.

Q.44. Do you have any additional evidence of water-quality related impacts in the vicinity of the proposed LNP that supports your testimony regarding the cumulative impacts that would result from the proposed LNP?

A.44. Yes. As outlined in my Answer 40, many communities in the region are experiencing problems with their municipal wells. Also, private residential wells west of the proposed LNP site are being contaminated with salt water. This is in addition to the contamination of municipal wells northwest of the proposed LNP described in David Still's testimony. Please refer to my testimony in A.27 and A.34. which show severe eutrophication of surface water in the vicinity of the proposed LNP. In my professional opinion, the recent increase in these water quality problems is the direct result of reductions in groundwater related to the same type of adverse impacts that would occur from the construction and operation of the proposed LNP.

C. <u>Cumulative Environmental Impacts</u>

Q.45. How did the FEIS consider the cumulative impacts to natural hydroperiods within the vicinity of the proposed LNP from construction and operation of LNP combined with impacts from climate change?

A.45. In addition to assuming average precipitation, weather conditions and water withdrawals, the FEIS fails to address the cumulative impacts of the construction and operation of the proposed LNP combined with the impacts of climate change. In my professional opinion, this failure is a fatal flaw; the FEIS admits climate change could have significant effects on the LNP besides dewatering, including an "increase in average temperature and a decrease in precipitation in the area of interest" (FEIS, p. 7-46, paragraph 2). As discussed in the FEIS, impacts of climate change could include reduced cooling efficiency, raising the temperature of discharge water; increased severity of water pollution associated with sediments, fertilizers, herbicides, and pesticides, and thermal pollution caused by projected heavier rainfall intensity and longer periods of drought (FEIS

7-46). In addition, the FEIS (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.

Q.46. Please describe the FEIS' cumulative impacts analysis with respect to the issue of normal seasonal variability.

A.46. On page 5-5 of the FEIS, the 8-foot variability in groundwater levels reportedly observed in the vicinity of the proposed LNP site is ***presumed*** to be the "normal seasonal variability in groundwater levels. No evidence is presented in the FEIS that this observed seasonal variability reflects baseline conditions that preceded hydroperiod alterations in the LNP vicinity from existing mines and other excavations, groundwater extractions and surface water impoundments. The seasonal variability stated in the FEIS does **not** represent baseline conditions, which would have established less seasonal variability than 8 feet. My opinion is based, in part, on hydrographs of detailed monitoring of groundwater and surface water fluctuations between January 10, 1989 and January 3, 1991 by the SWFWMD in the same type of pond-cypress depressional wetland ecosystems that occur on the proposed LNP site and surrounding vicinity, including Goethe State Forest. **(Exhibit INT429**) Seasonal water level fluctuations of ***less than*** 8 feet were confirmed in both of those wetland hydrographs in response to permitted groundwater withdrawals. That study concluded that the wetland and wetland hydroperiod were "affected" by the groundwater withdrawals, in part because the water levels no longer included periods of surface water fluctuations. The study also incorrectly concluded that wetland hydroperiod was "unaffected" by the groundwater withdrawals, in part because the water levels did include periods of surface water fluctuations.

In fact, the upper and lower photographs to the right of those hydrographs in **Exhibit INT429** show the monitor wells in each of those wetlands at the end of the two-year monitoring

period. The lower photograph reveals that approximately half a meter of subsidence occurred between the time that monitor well was installed and grouted, resulting in the column of concrete-like grout extending approximately 0.5 m above the existing ground surface. SWFWMD concluded that because the monitor well in the upper photograph did not have similar exposed grout, no hydroperiod alterations and subsidence had occurred. The center photograph, however, shows the base of the pond-cypress tree ***behind*** the monitor well in the upper photograph. This photograph, which I took, clearly shows that a similar amount of subsidence also had occurred, but that subsidence occurred ***before*** the monitor well was installed in January 10, 1989, evidenced by the fact that the lower third of the tree in the photograph is part of the subsurface root mat that now is exposed because the subsidence occurred **before** the subsidence in the lower hydrograph. Therefore, the "ground elevation" established at the beginning of the monitoring period for that wetland, is not the original ground elevation, but the ground elevation ***after*** the subsidence occurred from groundwater withdrawals that were initiated significantly ***before*** the monitoring was initiated. This means that what appears to be periods of surface water in the hydrograph, illustrated as blue areas above the horizontal red line, in reality represents fluctuations that would have been ***below*** the original surface of the ground, and the historic surfacewater fluctuations have been lost in this wetland.

Both of these wetlands were included in my extensive doctoral research of hydroperiod alterations in depressional wetlands. In fact, the pond-cypress trees in both of the wetlands representing the two hydrographs were in a state of severe premature decline, exhibiting all of the signs of stress from hydroperiod alteration described in the peer-reviewed publication by Bacchus et al. (2011**)**. These hydrographs and photographs show that wetlands and surrounding habitats do not respond simultaneously to hydroperiod alterations and that the "8 foot fluctuations" reported in the

FEIS (p. 5-5) support my conclusion that LARGE hydroperiod alterations have already occurred at the proposed LNP site and surrounding vicinity. Any additional alterations of the natural hydroperiods from the proposed LNP would result in cumulative impacts to those already LARGE impacts. Those hydrographs and a more detailed description of the hydroperiod alterations are included in the peer-reviewed publication by Bacchus (1998, p. 514).

Page 5-5 of the FEIS also states that the "recalibrated" groundwater model predicted "surficial aquifer drawdowns of as much as 2 ft in areas where wetlands are present. In addition, the lateral extent of the 0.5-ft drawdown contour extends up to 3 mi. from the pumping well locations (Figure 5-1)." The FEIS provided no scientific support to conclude that these "modeled" drawdowns would not result in LARGE adverse impacts to wetlands and "up to 3 mi. from the pumping well locations" even in the absence of the existing LARGE adverse impacts to the wetlands and other wildlife habitat on the proposed LNP site and surrounding vicinity that I described in my testimony previously. Even if seasonal variability under baseline conditions was 8 feet, an additional 0.5-foot alteration of that seasonal variability could prove fatal to the ecosystems and associated organisms in the 3-mile drawdown predicted in the vicinity of the proposed LNP during the normal dry season and during periods of drought.

Q.47. Are there other significant sources of cumulative environmental impacts that have been overlooked in the FEIS?

A. 47. On October 18, 2011 a new project by OLSC Land Ventures, LLC was approved in the impact zone of the proposed LNP project. This project requires a Consumptive Use Permit ("CUP") for the proposed withdrawal and consumption of 13.267 millions of gallons per day (MGD) of ground water from the same Floridan aquifer system from which the proposed LNP

project would withdraw ground water, resulting in additional adverse cumulative impacts. A copy of the notice for that proposed project, "Adena Ranch" CUP was incorporated as Exhibit C1 in my supplemental comment letter dated March 12, 2012 to the NRC and the Corps regarding the DEIS for the proposed LNP (Attachment B , p. 3) and is posted at: http://floridaswater.com/facts/AdenaSpringsRanchCUP.html. That project would withdraw up to 13.3 million gallons per day "MGD"), from the same Floridan aquifer system as the proposed LNP and would result in cumulative adverse impacts on Outstanding Florida Waters, such as the Withlacoochee and Waccasassa Rivers, and any other surface waters or wildlife habitat, that proposed project and the resulting cumulative impacts are not referenced at all in the FEIS.

That SWFWMD CUP application prompted a letter of concern dated January 27, 2012 from the Save the Manatee Club ("Club") emphasizing that the SWFWMD had not completed research to set Minimum Flows and Levels ("MFL") for that springshed, as required by Florida law The letter of concern requested that the SWFWMD not issue that permit or any other CUP permits until after the MFL research had been completed (**Exhibit INT431**). Ironically, the SWFWMD already had made it clear to the Intervenors in an email to Cara Campbell dated March 6, 2012 that, "there are no plans currently to set minimum aquifer levels in Levy County" (**Exhibit INT432 , p. 1**) That email was included as Exhibit B with my supplemental comment letter dated March 12, 2012 to the NRC and the Corps regarding the DEIS for the proposed LNP.

Current literature, such as Bacchus (2006) and Swancar et al. (2000) also support the conclusion that the proposed Tarmac limestone mine excavations will be a major factor in depleting or dewatering the water supply currently supporting the natural hydroperiods in the LNP vicinity, as described in those peer-reviewed publications. Considering the location of that proposed mine relative to groundwater movement, west-southwest (FEIS, Vol 2, p. 7-13), into local and offshore

(in the Gulf of Mexico) groundwater discharge areas such as King Spring and unnamed groundwater discharge areas, a detailed analysis is required regarding how all of the proposed aspects of dewatering will affect the natural hydroperiods within the zone of impact or geographic area of interest. I am concerned that the groundwater model used in the FEIS did not include the cumulative impacts of construction of the proposed LNP or the cumulative impacts of any groundwater and surface water alterations originating off-site, such as from the proposed Adena Rach project, existing mines and from the proposed Tarmac limerock mine excavations and the proposed Knight Farm sand mine excavations.

The proposed Tarmac limestone mine, proposed Knight sand mine, proposed Adena Ranch and proposed LNP all would contribute to the decline of the local water resources that support the natural hydroperiods of the LNP vicinity. The respective hydroecological impacts of those proposed projects must be addressed cumulatively.

Q.48. Are there any other deficiencies in the FEIS regarding the assessment of direct, indirect and cumulative impacts that would occur from the construction and operation of the proposed LNP?

A.48. Yes. The Integrated Wildlife Habitat Ranking System Map for the LNP Site and Vicinity in Figure 2-17 of the FEIS (p. 2-52, FFWCC 2009h) and the associated narrative on FEIS pages 2-49 through 2-51 provide only another example of the gross deficiencies in the FEIS for assessing predictable indirect and cumulative adverse impacts from the proposed LNP. Figure 2-17 implies that the "Limits of Disturbance" to wildlife habitat from the proposed LNP will be confined to the actual footprint of the structures within the LNP north parcel, south parcel and alignment of the proposed associated roads and pipelines. In reality, the FEIS fails to provide any map showing the extent and magnitude of indirect and cumulative adverse impacts from the proposed LNP, nor could it include such information because the FEIS failed to assess the extent and magnitude of

hydroperiod impacts from the proposed LNP on wildlife habitat. In fact, page 2-51 clearly states that wildlife surveys were performed only on the proposed LNP site, despite the 20 mile geographic area of influence identified in the FEIS (p. 7-13) as the limit for groundwater use impacts, and thus impacts on existing habitat from the proposed LNP. It is important to note that the zone of impact, based on direct, indirect and cumulative impacts from the proposed LNP, also was not determined in the FEIS using any scientific basis, such as the extent of fractures and faults that may extend adverse impacts beyond the arbitrarily constrained geographic area of interest referenced in the FEIS.

Q.49. How do the plans for collection of baseline data in the FEIS affect the analysis of cumulative impacts?

A49. I am concerned that the FEIS defers the establishment of baseline environmental conditions such as seasonal/climatological conditions, biological conditions, and water quality, until the post-licensing environmental monitoring program begins (FEIS Vol. 1 p. 1-124-125). Baseline conditions could have and should have been determined before preparation of the FEIS, in order to allow for a reasonable analysis of the cumulative impacts of the LNP in light of the current condition of the environment.

E. <u>Mitigation Measures</u>

Q.50. Please describe the mitigative measures proposed in the FEIS and indicate if you agree with the FEIS that they are sufficient to ensure that the environmental impacts of the proposed LNP will be small.

A.50. In concluding that LNP's environmental impacts are "SMALL," the FEIS depends upon a number of future mitigation or monitoring measures by PEF, none of which has been developed or approved. The principal mitigative measure relied on in the FEIS consists of a "dewatering plan" to

be completed after the COL is issued. (FEIS Vol. 1 p. 4-34). According to the FEIS, the dewatering plan will include details of the dewatering system, discharge quantities and location, a monitoring plan, and other details needed to demonstrate that the plan meets the State of Florida Conditions of Certification and complies with all applicable ERP dewatering requirements) to be approved by the FDEP and SWFWMD. *Id.*

In addition, the FEIS relies on a future erosion and sedimentation control plan and a storm water pollution prevention plan ("SWPPP") to be approved by the Florida Department of Environmental Protection ("FDEP") (FEIS Vol. 1 p. 4-25); an environmental monitoring plan (FEIS Vol. 1 p. 5-44); a wetland mitigation plan to be approved by FDEP and the U.S. Army Corps of Engineers ("USACE"); and an avian protection plan (FEIS Vol. 4-69).

In my professional opinion, the potential environmental impacts of dewatering (including stormwater management), salt drift and deposition, and erosion are significant. Therefore measures relied on to mitigate those impacts are important. As the FEIS concedes, for example, the wells used to supply fresh water during operation could have a SMALL impact on wetlands, but could have a MODERATE impact on wetlands without timely monitoring and mitigation. (FEIS Vol. 2 p. 9-50) In light of the importance of these mitigation measures, the mere promise of future mitigation measures, without any demonstration of what those measures will be or analysis of their effectiveness, does not support any conclusion that the environmental impacts are "SMALL."

For example, the FEIS acknowledges that groundwater withdrawals could have an effect on wetlands, and also states that groundwater monitoring will "allow a response capable of averting adverse impacts on wetlands." (FEIS Vol. 2 p. 9-250). But the FEIS does not explain, nor is it clear, how groundwater monitoring will allow PEF to or NRC to detect "impacts on wetlands." Groundwater monitoring simply evaluates physical responses of ground water, not biological,

ecological or pathological responses in any of the living organisms comprising wetlands on the proposed LNP site and surrounding vicinity. In the absence of any actual plan for groundwater monitoring, the claim of the FEIS regarding the effectiveness of the plan is dubious.

Therefore, delaying groundwater monitoring until construction is initiated and failure to include long-term groundwater monitoring data from that vicinity prior to the construction of existing mines in the vicinity of the proposed LNP would render any groundwater data invalid regarding inferences about any aspect of the natural hydroperiod in that vicinity.

The extensive peer-reviewed published literature described throughout my testimony supports the conclusion that the proposed groundwater withdrawals for the proposed LNP would result in LARGE and irreversible impacts to wetlands throughout the proposed LNP and surrounding vicinity. Despite this evidence, the referenced quote on page 9-250 of the FEIS concludes with the following statement:

> However, if monitoring indicates that an impact greater than SMALL might occur during operation, desalination would be the environmentally preferable alternative.

The FEIS does not include any analysis of the adverse direct, indirect and cumulative impacts of a "desalination" alternative. Therefore, this proposed "alternative" is not a valid "alternative." Desalination has numerous LARGE adverse environmental impacts associated with this action. One example is the disposal of brine extracted from the saline water.

Q.51. Will the PEF Wetland Mitigation Plan dated April 23, 2010 for the proposed LNP and Associated Transmission Lines result in "no net loss of wetlands" and compensate for the lost wetland functions on site and off site?

A.51. No. Ironically, PEF's Mitigation Plan (Entrix, 2010, p. 2-59) shows that the proposed location of the "On-Site Mitigation Areas" is also the same area where synergistic stressors ensure that these proposed mitigation areas would be subjected to the most severe of the LARGE

adverse direct, indirect and cumulative impacts of altered hydroperiods and salt stress in the vicinity of the proposed LNP. These proposed mitigation areas, shown in red cross-hatching on "Exhibit 1-2 Project Site," are immediately adjacent to the areas where not only would the three multi-acre stormwater ponds be excavated, but also groundwater supply well #5 would be extracting water, and also where the maximum impervious surfaces are located as well as the source of salt drift. The hydroperiod impacts from the excavation of three multi-acre stormwater ponds would be comparable to adverse impacts described in PEF's Mitigation Plan (Entrix, 2010, p. 1-13). That plan attributed hydroperiod alterations to "borrow pits" and those associated with all types of excavations in the southeastern coastal plain (Bacchus, 2006). Exhibit 2-4-6 "Existing Land Use and Land Cover" PEF's Mitigation Plan confirms the locations of additional pond-cypress wetlands in the proposed mitigation areas that would be destroyed by the proposed LNP. See my Figure 1E for a clearer illustration of the location of the proposed stormwater ponds (blue), cooling towers (green) and site access road (brown), based on the shapefiles of those areas provided to the Intervenors by PEF.

In addition, mitigation measures proposed in PEF's Mitigation Plan would *cause* additional adverse impacts, such as from the truck-loads of "limerock" (Entrix, 2010, p. 6-20) which would have to be mined from some location that is not disclosed in the PEF Mitigation Plan or the FEIS. Another example of adverse impacts that would occur from mining if PEF's Mitigation Plan were implemented would occur from mining the sand to fill the ditches, as referenced in Entrix, 2010 page 2-25. The source of this mined material also is not provided in PEF's Mitigation Plan or the FEIS, however, the most likely source would be the proposed Knight Farm sand mine, which would be mined for the sole purpose of providing sand for the proposed LNP, based on the Affidavit by Dan Hilliard regarding the proposed Knight Farm Mine dated June 11, 2012

(**Exhibits INT376**), the copy of the Levy County Agenda dated April 2, 2012 for the proposed Knight Farm Sand that is referenced in Mr. Hilliard's Affidavit (**Exhibits INT437**) and the Levy County staff report dated December 7, 2011 (**Exhibits INT434 p. 14 and 2**).

In addition to causing the mining-related impacts described in Bacchus (2006), this sand mine would extract and remove sand currently functioning as an important local recharge area for the surficial aquifer. In addition to causing the mining-related impacts described in Bacchus (2006), this sand mine would extract and remove sand currently functioning as an important local recharge area for the surficial aquifer. The peer-reviewed published literature (Bacchus, 2006, Bacchus et al., 2011) also supports the conclusion that the approximately 20-foot deep mining proposed on the Knight Farm sand mine, as shown in pages 22 and 23 of the plans approved by the SWFWMD without the cumulative adverse impacts from the proposed LNP, would result in the death of the trees in the Daniels Tract, including active red-cockaded woodpecker nest trees.

Additionally, the southeastern portion of the site access road, south of the meteorological tower shown as the excluded square on "Exhibit 1-2 Project Site", would cut through the proposed on-site mitigation area, creating additional adverse hydroperiod and fragmentation impacts to the largest of the proposed on-site mitigation areas.

Therefore, PEF's Mitigation Plan actually would create additional adverse direct, indirect and cumulative impacts from additional mining of limestone and sand.

E. <u>Irreversible and Irretrievable Impacts</u>

Q.52. Does the FEIS adequately assess irreversible and irretrievable environmental impacts?

A.52. No. All of the impacts that I previously described are irreversible and irretrievable environmental impacts that the FEIS failed to assess. Once living organisms such as historically

long-lived depressional pond-cypress wetlands, are killed, the natural hydroperiods of the vicinity are altered and the soil is contaminated with salt, neither these individual species nor the ecosystems they were an integral part of can be re-established.

F. Geographic Scope of FEIS

As discussed in the testimonies of Gareth Davies and David Still, the FEIS has underestimated the geographic zone of impact of LNP, due to the fact that groundwater withdrawals will affect a very large area in the region. Environmental impacts such as alteration of hydroperiods, and related impacts on plants and wildlife, therefore will extend to a much larger area. The very size of the area of impact should cause NRC to reconsider its conclusion that the impacts of groundwater withdrawal are small. In addition, the FEIS should consider impacts of LNP on wetlands, floodplains, special aquatic sites, other waters and other wildlife habitat and threatened and endangered species, over a much larger area.

Q.53 Do you swear in accordance with 28 U.S.C. § 1746, under penalty of perjury, that this testimony is true and correct?

A.53. Yes I do.

Executed in accord with 10 C.F.R. § 2.304(d)

Sydney T. Bacchus
Applied Environmental Services

P.O. Box 174
Athens, GA, 30603-0174

<u>CORRECTED JULY 6, 2012</u>

Relevant Publications*

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* List of peer-reviewed publications related to testimony does not include other referenced attachments that are **not** peer-reviewed publications.

** Not available in electronic format and out of print. Brook and Sun (1982), Fernald and Purdum (1998) and Popenoe et al. (1984) is referenced only as the original source of extracted figure on page 3 of that publication, which was later published in Bacchus (2005) in electronic format.