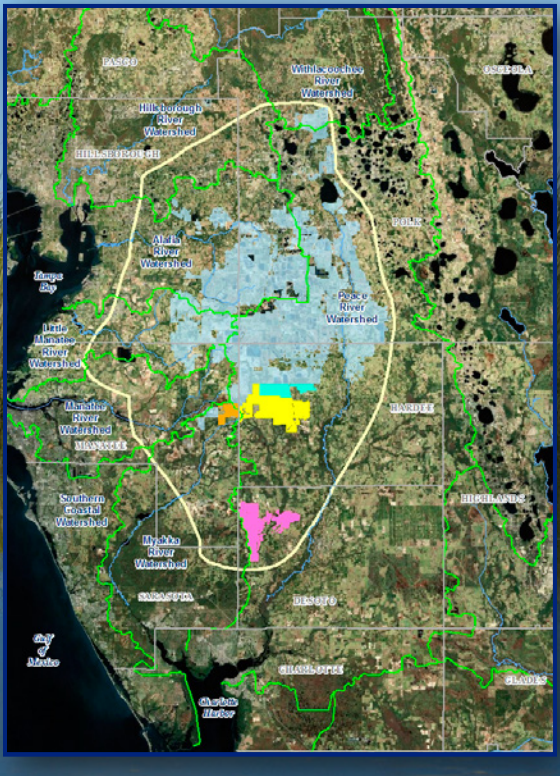
Appendix D
Surface Water Quality Evaluations for the Final AEIS on Phosphate Mining in the CFPD



Surface Water Quality Evaluations for the Final AEIS on Phosphate Mining in the CFPD

PREPARED FOR: U.S. Army Corps of Engineers, Jacksonville District

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Florida Department of Environmental Protection

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DATE: May 7, 2012; revision date March 1, 2013

PROJECT NUMBER: 418237.07.01

Contents

1.0 Introduction

Mosaic Fertilizer, LLC (Mosaic) and CF Industries, Inc. (CF Industries), collectively referred to as the Applicants, have applied for Clean Water Act Section 404 permits from the U.S. Army Corps of Engineers (USACE). The permits would authorize construction and operation of the Applicants' four proposed phosphate mines, Desoto (Alternative 2), Ona (Alternative 3), Wingate East (Alternative 4), and South Pasture Mine Extension (Alternative 5) in an area known as the Central Florida Phosphate District (CFPD). This review also includes information that applies to the four offsite alternatives, Pine Level/Keys (Alternative 6), Pioneer (Alternative 7), A-2 (Alternative 8) and W-2 (Alternative 9). Figure 1 and Figure 2 show the locations of these Applicants' Preferred Alternatives and the Offsite Alternatives in relation to their positions within watersheds in the CFPD.

The USACE is preparing an Areawide Environmental Impact Statement (AEIS) to evaluate the potential environmental consequences of federal authorization of these proposed mines. An important evaluation topic focuses on the direct and indirect impacts these phosphate mines could have on surface water quality of streams and rivers downstream of permitted discharges from active phosphate mines. This evaluation also considers the potential longer-term impacts on such water bodies if reclaimed mine lands should contribute elevated loads of pollutants, in addition to the discharges from past, current, or reasonably foreseeable future activities, which could degrade the quality of downstream reaches or other water bodies because of cumulative effects. This technical memorandum (TM) summarizes information compiled in support of water quality subsections of the AEIS, primarily in Section 4.4.

FIGURE 1
Location of the Three Applicants' Preferred Alternatives (Desoto, Ona, and South Pasture Mine Extension) and the Offsite Alternatives Pioneer Tract and Alternative A-2 in the Peace River Watershed
Central Florida Phosphate District, Florida

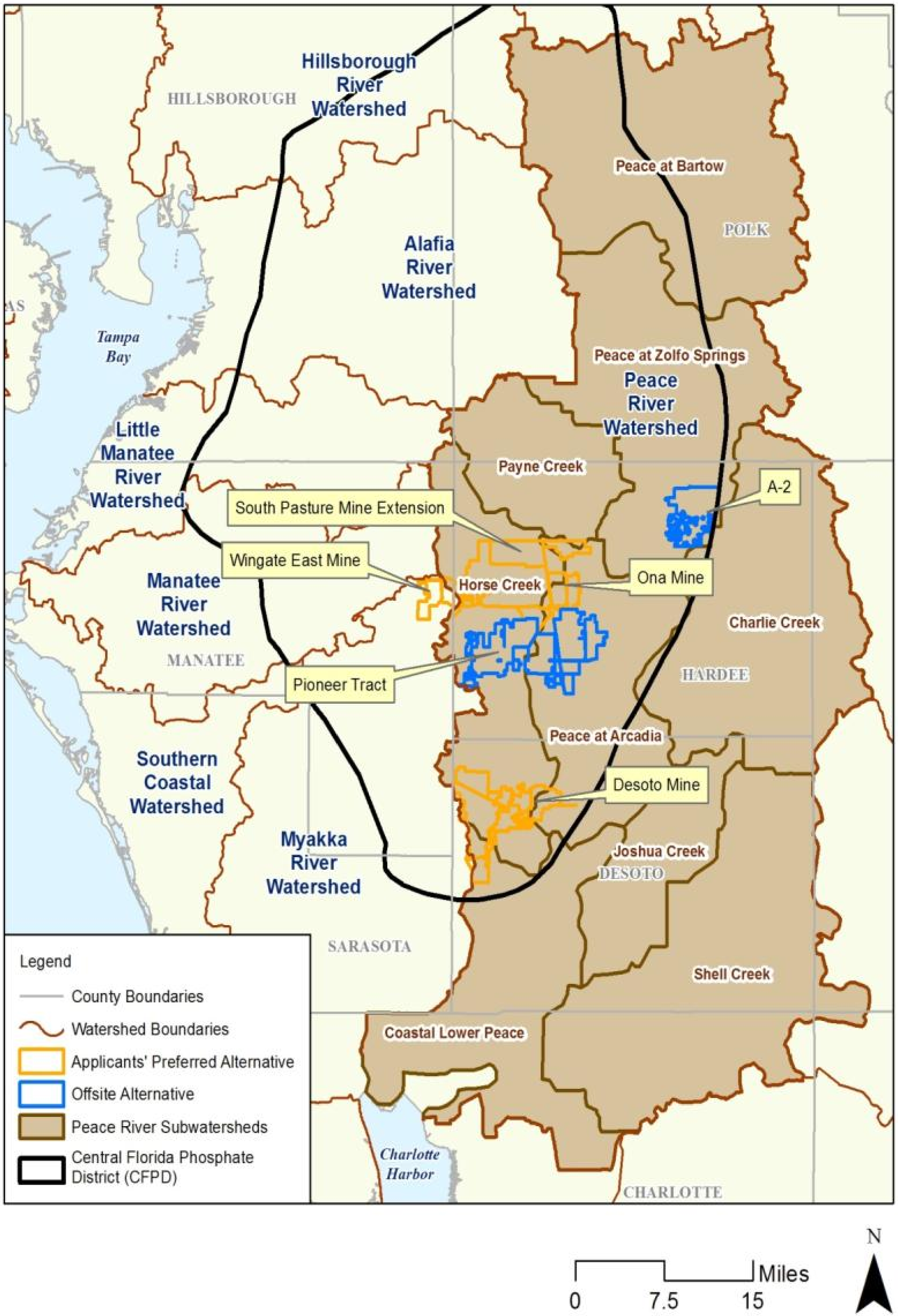
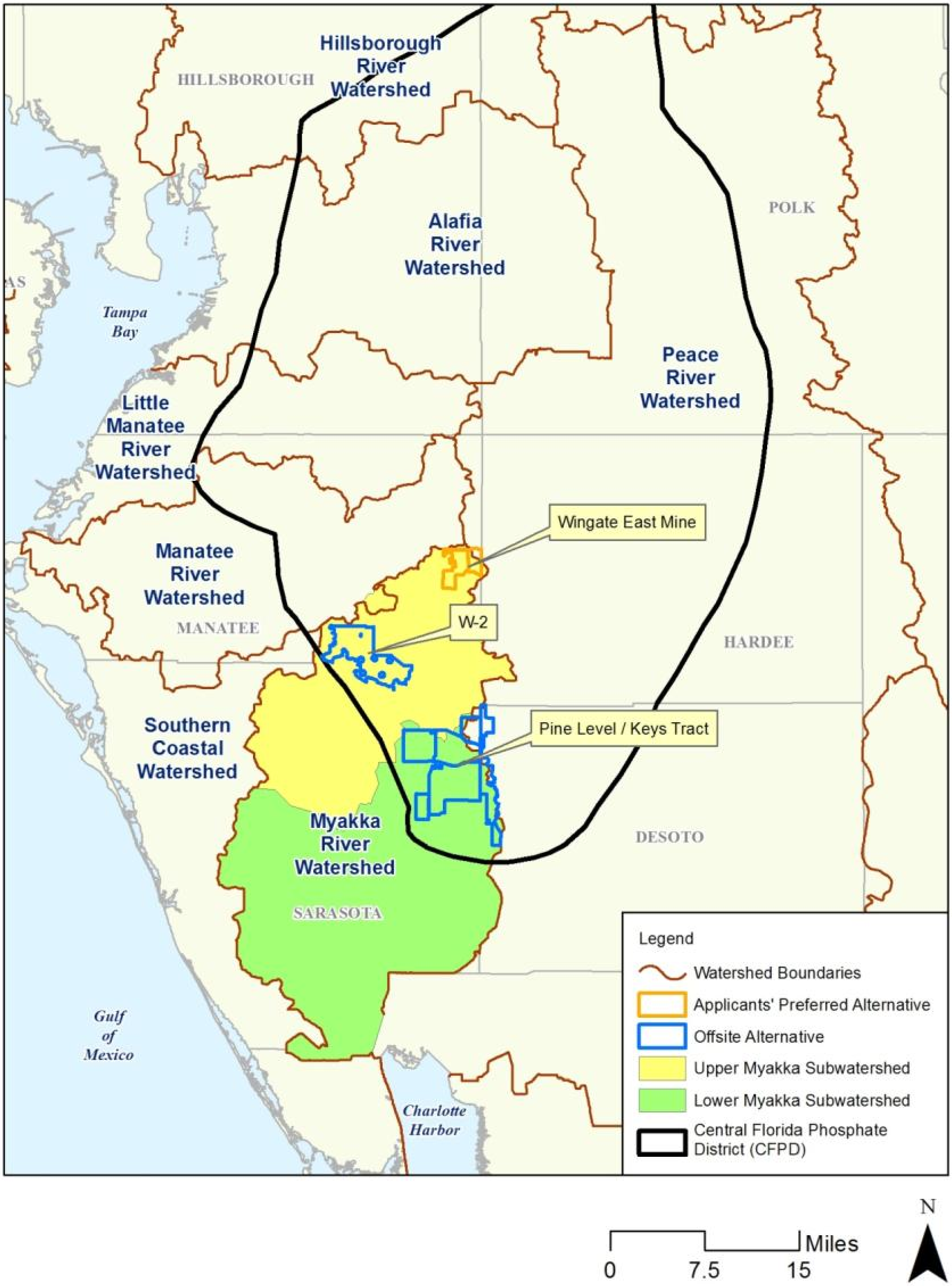


FIGURE 2

Location of the One Applicant Preferred Alternative (Wingate East) and Offsite Alternatives Pine Level/Keys Tract and W-2 in the Myakka River Watershed

Central Florida Phosphate District, Florida



2.0 Florida Surface Water Classifications and Water Quality Standards

Surface waters in Florida are classified in one of several "designated use" categories defined in Chapter 62-302, Florida Administrative Code (F.A.C.), and listed in Table 1. Each category has numerical and narrative criteria for physical, chemical, or biological parameters that are designed to protect the designated uses. These criteria, in conjunction with applicable implementation protocols allowed under the F.A.C., comprise the surface water standards used by the Florida Department of Environmental Protection (FDEP) to ensure that discharges from regulated facilities like phosphate mines do not cause or contribute to violations of applicable standards.

Certain water bodies receive a higher level of regulatory protection against water quality degradation. Chapter 62-302.700, F.A.C., identifies specific water bodies in the state designated as either Outstanding Florida Waters (OFWs) or Outstanding National Resource Waters. There are only two formally defined Outstanding National Resource Waters in Florida:

- Everglades National Park
- Biscayne National Park

TABLE 1
Surface Water Classifications in Florida per Chapter 62-302, F.A.C.

Category	Designated Uses
Class I	Potable Water Supply
Class II	Shellfish Propagation or Harvesting
Class III (Fresh Waters)	Fish Consumption; Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife
Class III (Marine Waters)	
Class III Limited	Fish Consumption; Recreation or Limited Recreation; and/or Propagation and Maintenance of a Limited Population of Fish and Wildlife
Class IV	Agricultural Water Supplies
Class V	Navigation, Utility, and Industrial Use

It is notable, however, that the National Estuary Program (NEP) was established in 1987 by an amendment to the Clean Water Act to protect and restore the water quality and ecological integrity of estuaries of national significance. There are now 28 "estuaries of national significance" in the NEP, and the CFPD river watersheds are tributary primarily to 2 of the 4 estuaries of national significance in Florida:

- In 1991, the Tampa Bay National Estuary Program (TBNEP) was established as a partnership of Hillsborough, Manatee and Pinellas counties; the Cities of Tampa, St. Petersburg, and Clearwater; the Southwest Florida Water Management District; the FDEP; and the U.S. Environmental Protection Agency (USEPA). The Hillsborough, Alafia, Little Manatee, and Manatee River watersheds are tributary to the TBNEP planning area.
- In 1995, Governor Lawton Chiles submitted an application to USEPA to designate the Charlotte Harbor estuary as an estuary of national significance under the NEP. The application was accepted by USEPA and the Charlotte Harbor NEP (CHNEP) was established. The Peace and Myakka River watersheds are two of the major tributaries contributing inflow to the CHNEP planning area.

Protection strategies for these estuaries include prevention of water quality degradation and, where applicable, measures to improve water quality conditions through pollutant load reductions from tributary basins. Sarasota Bay is also an NEP estuary, but the generally recognized CFPD boundary includes only a small area that would drain to this natural system.

Water bodies designated by the state as OFWs include national parks, wildlife refuges, and wilderness areas, waters in the state park system, many waters in areas acquired through the state's environmental land acquisition programs, rivers designated as wild and scenic, Florida's aquatic preserves, and other specially designated waters listed in Chapter 62-302, F.A.C. While all surface waters are regulated using standards defined in this chapter of the F.A.C., these specially designated waters are afforded extra protection under the antidegradation provisions of the rule. OFW antidegradation requirements state that the water quality shall not be degraded further after the date when the water body is designated an OFW, among other provisions. The following water bodies in the CFPD watersheds have been given additional protection through designation as OFWs:

- Hillsborough River State Park
- The Little Manatee River
- Lake Manatee State Recreation Area
- Paynes Creek State Historic Site
- The estuarine portion of the Peace River (downstream of U.S. Highway 41), designated as an OFW because of its location in the Charlotte Harbor Aquatic Preserve
- The entire portion of the Myakka River that flows through Sarasota County and the estuarine portions of the river, designated as an OFW because they lie, respectively, in a segment designated as a Wild and Scenic River and within the Gasparilla Sound–Charlotte Harbor Aquatic Preserve
- Becker Tract (Manatee County)
- Certain segments of Hillsborough River (Chapter 62-302.700(9)(i)4, F.A.C.)
- Certain segments of Myakka River (Chapter 62-302.700(9)(i)22, F.A.C.)
- Certain segments of Little Manatee River (Chapter 62-302.700(9)(i)20, F.A.C.)

Other than these designations, most of the streams, rivers, and associated water bodies within and downstream of the CFPD are designated Class III waters by default. Exceptions identified by FDEP in the *Tampa Bay Tributaries Water Quality Assessment Report* (FDEP, 2005) and the Sarasota Bay and Peace and Myakka Rivers Water Quality Assessment Report (FDEP, 2006a) include the following:

- The portion of the Hillsborough River between Flint Creek and the City of Tampa Dam, as well as Cow House Creek, is a Class I water.[1]
- Segments of the Manatee River above the Rye Road Bridge, including Lake Manatee, tributaries entering Lake Manatee, and tributaries entering the upstream reaches of the river are Class I because they supply drinking water for Manatee County.
- The Braden River, from the Bill Evers Reservoir upstream to State Road (S.R.) 675, and most of the length of all its tributaries entering the Manatee River above the reservoir dam, are also Class I waters.
- Portions of the Peace River watershed, including: the lower portion of Horse Creek from the northern border of Section 14, T38S, R23E, southward to the Peace River; the headwaters of Prairie Creek to the Charlotte County line; and the headwaters of Shell Creek to the Hendrickson Dam. These tributaries (or portions of them) serve as potable water supply sources for the cities of Punta Gorda and North Port, and several surrounding counties (Charlotte, Sarasota, and DeSoto).
- Portions of the Myakka River watershed, including the river reach that extends south from the Manatee County line through Upper and Lower Myakka Lakes to Manhattan Farms (north boundary of Section 6, T39S,

[1] Class I waters are designated as potable water supply sources. However, surface waters that may be used for water supply are not automatically designated a new classification, FDEP must make a rule change for a new classification.

R20E) and Big Slough Canal (headwaters to U.S. Highway 41) are Class I waters. Big Slough Canal/Myakkahatchee Creek is a potable water source for the city of North Port.

Additionally, estuarine portions of the river systems draining the CFPD designated as Class II waters include the following:

- The lowermost reach of the Peace River, extending from the Barron Collier Bridge (U.S. Highway 41) to the river mouth, falls within the Charlotte Harbor Aquatic Preserve and is designated as a shellfish propagation and harvesting area (Class II).
- The southernmost reaches of the Myakka River, extending south from the western boundary of Section 35, T39S, R20E in Sarasota County and all of the river in Charlotte County are designated as a shellfish propagation and harvesting area (Class II).

In assessing the potential for phosphate mining to affect the designated uses of these CFPD and downstream water bodies, compliance with applicable numeric standards is an important aspect to be included in the evaluations. The specific numeric criteria applicable to surface waters in Florida are detailed in Chapter 62-302, F.A.C. However, there are additional non-numeric (narrative) criteria and standards that may affect how water quality is assessed. These criteria are discussed in this TM, as appropriate.

3.0 State of Florida Assessments of Ambient Water Quality

Evaluation of a water body's compliance with the water quality standards is outlined in Florida's assessment methodology in Chapter 62-303, F.A.C. As required by the Clean Water Act, FDEP updates USEPA every 2 years concerning surface water body use attainment in its 305(b) report and 303(d) list of impaired waters. The primary purposes of 305(b) analyses are to determine the extent that waters are attaining water quality standards, to identify waters that are impaired and need to be added to the 303(d) list, and to identify waters that can be removed from the list because they are attaining standards. The biannual updates by the FDEP are report cards to the general public and USEPA, and as part of the assessment they identify water bodies with water quality impairment such that the applicable designated use is not met (those waters are included on the 303(d) list). Florida must develop a Total Maximum Daily Load (TMDL) for each of the impaired waters where the impairment results from abatable, human-induced causes. A TMDL is the maximum loading of a particular pollutant that can be discharged in a surface water and still allow it to meet its designated uses and applicable water quality standards. TMDL evaluations include parameter-specific analyses identifying the daily loads that should be used as pollutant limits for the water body, and set the stage for identifying Basin Management Action Plans (BMAPs) which will decrease excessive pollutant loads and return the water body to compliance with its designated use. Each assessment and TMDL is for a specific segment of a water body defined by FDEP with an identification code called its WBID (water body ID).

The 1998 impaired waters evaluations by FDEP led to identification of water body segments in the AEIS study area that the agency considered impaired, and also led to initial prioritization of whether such areas were considered high, medium, or low priority for completion of TMDL studies. Table 2 lists those water bodies in the AEIS study area for reference. For WBIDs in Table 2 that are noted to have "all parameters addressed," every listed parameter either had a TMDL developed or the parameter was determined not to be impaired after the 1998 list was developed.

The most recently approved Florida 303(d) list of impaired waters is for Reporting Year 2010, which was formally approved by USEPA on May 13, 2010. This is the current list of waters that are considered impaired and either needs a TMDL or for which a TMDL already has been completed. The list can be accessed on USEPA's website ().

TABLE 2
Central Florida Phosphate District Water Bodies Included on the 1998 Impaired Waters List

River Basin	WBID No.	Name	Parameters Listed	Priority Set by FDEP - Targeted Year	Special TMDL Status, or Other Notes
Hillsborough	1542A	Mill Creek	Dissolved Oxygen, Coliforms, Nutrients, Un-ionized Ammonia, Lead	Low - 2008	Completed for Coliforms
Hillsborough	1482	Blackwater Creek	Dissolved Oxygen, Coliforms, Nutrients, Turbidity, Biochemical Oxygen Demand	High - 2003	Completed for Coliforms
Hillsborough	1561	Sparkman Branch	Dissolved Oxygen, Coliforms, Nutrients, Turbidity, Total Suspended Solids	High - 2003	Completed for Coliforms
Hillsborough	1543	Lake Hunter Outlet	Nutrients	High - 2003	Completed for Coliforms
Alafia - North	1621E	North Prong of the Alafia River	Dissolved Oxygen, Nutrients, Coliforms	Low - 2009	Monitoring - Facility BMPs
Alafia - North	1578B	Turkey Creek Above Little Alafia River	Coliforms, Nutrients, Turbidity	Low - 2008	Completed for Coliforms
Alafia - North	1592C	English Creek	Coliforms, Nutrients	Low - 2008	Completed for Coliforms
Alafia - North	1583	Poley Creek	Coliforms, Nutrients, Turbidity	Low - 2008	Completed for Coliforms
Alafia - North	1639	Thirty Mile Creek	Dissolved Oxygen, Coliforms, Nutrients	High - 2003	Completed for Total Nitrogen
Alafia - South	1653	South Prong of the Alafia River	Coliforms, Nutrients	Low - 2008	
Alafia - South	1675	Owens Branch	Coliforms, Nutrients	Low - 2008	
Little Manatee	1790	So. Fork Little Manatee River	Dissolved Oxygen, Coliforms, Nutrients	Low - 2008	Completed for Coliforms
Little Manatee	1742A	Little Manatee River	Dissolved Oxygen, Coliforms, Nutrients	Low - 2008	Completed for Coliforms
Manatee	1840	Gilly Creek	Dissolved Oxygen, Coliforms, Nutrients	Low - 2008	Completed for Coliforms
Peace - Upper	1751	Whidden Creek	Nutrients, Turbidity, Total Suspended Solids, Dissolved Oxygen	High - 2004	FDEP WQ Study
Peace - Upper	1539	Peace Creek Canal	Dissolved Oxygen, Coliforms, Nutrients, Turbidity, Total Suspended Solids Biochemical Oxygen Demand, Mercury (Fish Consumption)	High - 2004	2011 for Mercury

TABLE 2
Central Florida Phosphate District Water Bodies Included on the 1998 Impaired Waters List

River Basin	WBID No.	Name	Parameters Listed	Priority Set by FDEP - Targeted Year	Special TMDL Status, or Other Notes
Peace - Upper	1580	Wahneta Farms Drainage Canal	Dissolved Oxygen, Coliforms, Nutrients, Turbidity	High - 2004	
Peace - Upper	1613	Peace Creek Tributary Canal	Dissolved Oxygen, Coliforms, Nutrients, Turbidity	High - 2004	Artificial canal through swamp.
Peace - Upper	1757A	Payne Creek - East	Dissolved Oxygen, Nutrients	Low - 2008	
Peace - Upper	1757B	Payne Creek - West	Coliforms, Nutrients	Low - 2008	
Peace - Upper	1774	Little Charlie Creek	Coliforms, Nutrients	Low - 2008	
Peace - Middle	1844	Thompson Branch	Coliforms, Nutrients	Low - 2008	
Peace - Middle	1871	Alligator Branch	Dissolved Oxygen, Coliforms, Nutrients	High - 2004	
Peace - Middle	1921	Limestone Creek	Dissolved Oxygen, Coliforms, Nutrients, Total Suspended Solids	High - 2004	
Peace - Middle	1939	Brandy Branch	Nutrients	High - 2004	
Peace - Middle	1948	Bear Branch	Dissolved Oxygen, Nutrients	Low - 2008	
Peace - Upper	1623J	Peace River - J (Above Bowlegs Creek)	Dissolved Oxygen, Coliforms, Nutrients, Turbidity, Total Suspended Solids Biochemical Oxygen Demand, Mercury (Fish Consumption)	High - 2004	2011 for Mercury; Completed for Coliforms
Peace - Upper	1623H	Peace River - H (Above Payne Creek)	Dissolved Oxygen, Coliforms, Nutrients, Mercury (Fish Consumption)	High - 2004	2011 for Mercury
Peace - Middle	1623E	Peace River - E (Above Oak Creek)	Nutrients, Turbidity, Total Suspended Solids, Mercury (Fish Consumption)	High - 2004	2011 for Mercury
Peace - Middle	1623D	Peace River - D (Above Charlie Creek)	Coliforms, Nutrients, Turbidity, Total Suspended Solids, Mercury (Fish Consumption)	High - 2004	2011 for Mercury
Peace - Middle	1623C	Peace River - C (Above Joshua Creek)	Dissolved Oxygen, Nutrients, Total Suspended Solids, Mercury (Fish Consumption)	High - 2004	2011 for Mercury

TABLE 2
Central Florida Phosphate District Water Bodies Included on the 1998 Impaired Waters List

River Basin	WBID No.	Name	Parameters Listed	Priority Set by FDEP - Targeted Year	Special TMDL Status, or Other Notes
Peace - Middle	1787A	Horse Creek	Dissolved Oxygen, Coliforms, Nutrients, Biochemical Oxygen Demand	Low - 2008	
Peace - Lower	1995	Myrtle Slough	Dissolved Oxygen, Nutrients, Biochemical Oxygen Demand, Coliforms	Low - 2008	
Peace - Lower	1997	Hawthorne Creek	Coliforms, Nutrients	Low - 2008	
Peace - Lower	1962	Prairie Creek	Dissolved Oxygen, Nutrients, Turbidity	Low - 2008	
Peace - Estuarine	2056A	Peace River - Lower Estuary	Dissolved Oxygen, Nutrients, Mercury (Fish Consumption)	Low - 2008	2011 for Mercury
Peace - Estuarine	2056B	Peace River - Mid Estuary	Dissolved Oxygen, Nutrients, Mercury (Fish Consumption)	Low - 2008	2011 for Mercury
Myakka - Upper	1933	Owen Creek	Dissolved Oxygen, Coliforms, Turbidity, Nutrients, Total Suspended Solids	High - 2001	all parameters addressed
Myakka - Upper	1981C	Upper Lake Myakka	Based on biological sampling		done (2001)
Myakka - Upper	1981B	Myakka River	Dissolved Oxygen, Coliforms, Nutrients, Total Suspended Solids	Low - 2001	all parameters addressed
Myakka - Lower	1958	Mud Lake Slough	Dissolved Oxygen, Coliforms, Nutrients, Turbidity, Total Suspended Solids	High - 2001	all parameters addressed
Myakka - Lower	1976	Big Slough Canal	Dissolved Oxygen, Coliforms, Nutrients	Low - 2001	all parameters addressed
Myakka - Lower	2014	Un-Named Ditch System (Northport)	Dissolved Oxygen, Nutrients, Biochemical Oxygen Demand	Low - 2001	all parameters addressed
2009 Amendments (Additions)					
Charlotte Harbor Proper	2065A	Upper Segment Charlotte Harbor Estuary	Nutrients	Medium	
Charlotte Harbor Proper	2071	North Prong - Alligator Creek	Coliforms	Low	
Charlotte Harbor Proper	2073	Mangrove Point Canal	Mercury (Fish Consumption)	High	
Charlotte Harbor Proper	2074	Alligator Creek	Dissolved Solids	Medium	

TABLE 2
Central Florida Phosphate District Water Bodies Included on the 1998 Impaired Waters List

River Basin	WBID No.	Name	Parameters Listed	Priority Set by FDEP - Targeted Year	Special TMDL Status, or Other Notes
Charlotte Harbor Proper	2087	Direct Runoff to Bay	Mercury (Fish Consumption)	High	
Charlotte Harbor Proper	2090	Direct Runoff to Bay	Mercury (Fish Consumption)	High	

Notes:
FDEP's determination of high-, low-, and medium-priority waters was based on the following criteria.

High-priority waters:
- Water body segments where the impairment poses a threat to potable water supplies or human health.
- Water body segments where the impairment is due to a pollutant regulated by the Clean Water Act and the pollutant has contributed to the decline or extirpation of a federally listed threatened or endangered species.
- Water body segments verified as impaired that are included on the USEPA's 1998 303(d) list as high priority.

Low-priority waters:
- Water body segments that were listed before 2010 because of fish consumption advisories for mercury.
- Canals, urban drainage ditches, artificial water body segments listed only due to exceedances of dissolved oxygen.
- Water body segments identified as impaired during Phase 2 and added to the Verified List.
- Additional water body segments identified by USEPA through its own methods.

Medium-priority waters:
All segments not designated high- or low-priority were designated in this list as medium-priority.

4.0 Total Maximum Daily Load Program Considerations

During the past 25 years, USEPA has defended numerous cases in which plaintiffs have alleged that USEPA has a mandatory duty to "backstop" state establishment of TMDLs under Clean Water Act section 303(d) (i.e., that USEPA has a duty to establish TMDLs in states that fail to do so). In 27 state cases, including Florida, USEPA was placed under a court order, or agreed in a consent decree, to establish TMDLs if the state failed to do so within a prescribed schedule.

In Florida, the backstop for TMDLs is for waters identified on the 1998 list, and the consent decree is due to be fulfilled in 2013 (ref: *Consent Decree entered in the case of Florida Wildlife Federation, et al. v. Carol Browner, et al.*). To assist in TMDL development, Florida is also implementing a “5-Year Rotating Basin Cycle” by analyzing each of the state’s major river basins over a 5-year period. The current list of Florida TMDLs proposed or finalized by USEPA (including Public Notices of Availability) can be accessed on USEPA’s website (http://www.epa.gov/region4/water/tmdl/florida/index.html).

This cycle of water quality assessment and regulation for the state’s major river basins is implemented continually by the following steps:

- Updating criteria with new scientific information
- Monitoring, reporting, and creating TMDLs for impaired waters
- Adjusting permit limits, as needed
- Using best management practices (BMPs) to restore waters

Fundamental to this process is Florida’s antidegradation policy, which protects existing water quality above the minimum criteria levels and requires that once uses are achieved, they must be maintained.

Table 3 lists the locations within the CFPD of study areas for TMDLs completed by FDEP, along with the specific applicable water quality parameters of concern. Figure 3 reflects the locations of these TMDL study areas in the CFPD (see Attachment A for FDEP’s larger-scale maps of the water bodies), and specifically in relation to the four Applicants’ Preferred Alternatives and two of the offsite alternatives, Pine Level/Keys and Pioneer Tracts, also considered as reasonably foreseeable future mines for purposes of cumulative impact assessment. Sites A-2 and

W-2 are at the headwaters of rural streams without impairments and are not shown in Figure 3. Of the 18 TMDLs in the table and the figure, only one (for Thirty Mile Creek) has a parameter associated specifically with phosphate mining and is within a subwatershed dominated by phosphate mining (about 61 percent is extractive land use; FDEP, 2004).

The TMDL Report for Thirty Mile Creek (FDEP, 2004) concluded that total nitrogen was the limiting nutrient for algal growth in the creek, and that decreasing total nitrogen concentrations and loads would result in increased dissolved oxygen levels and compliance with the dissolved oxygen criterion. The study also characterized seasonal variations in total nitrogen, total phosphorus, and chlorophyll *a* based on monitoring results from 1998 through 2003. Average total phosphorus concentrations were highest in summer and average total nitrogen concentrations were highest during spring. Average chlorophyll *a* values were lowest during winter and spring, and highest in summer. The seasonal average chlorophyll *a* values based on data collected between 1998 and 2003 were all less than the screening value of 20 micrograms per liter (μg/L) used to identify impaired waters. One annual average value for 2002 was 28.3 μg/L because of several high values during that year, but those values did not cause the overall seasonal averages to exceed 20 μg/L. The annual average values of the nutrients in the report did not appear to be geometric means, which is the basis for evaluating compliance with the forthcoming numeric nutrient criteria (NNC), but all of the annual average total phosphorus and nitrogen values exceeded the baseline NNC limits that will apply to streams in the CFPD (see Section 7 for additional discussion of NNC).

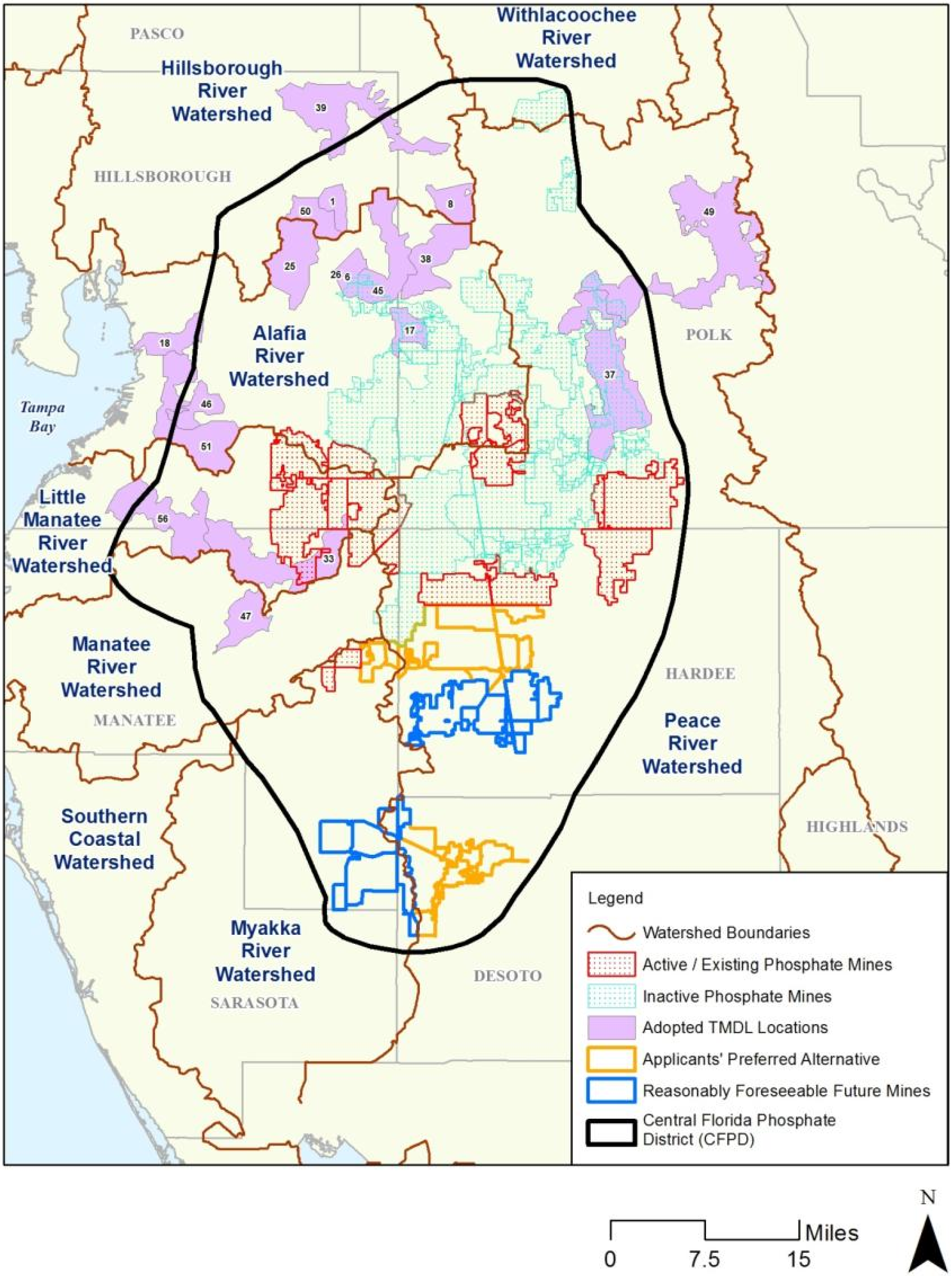
IMC operated the Kingsford Mine Complex in the Thirty Mile Creek watershed at the time of the TMDL study. Three permitted mine outfalls discharged to an unnamed tributary to Thirty Mile Creek, Guy Branch, and George Allen Creek. The wasteload allocation associated with the TMDL required outfalls that discharge from the IMC mine to the affected portion of Thirty Mile Creek to limit total nitrogen concentrations to a maximum of 3.0 milligrams per liter (mg/L) as a monthly average. Kingsford Mine is being completed (still in reclamation phase) and this TMDL-derived provision is being enforced through the National Pollutant Discharge Elimination System (NPDES) permit.

TABLE 3
Summary of Completed TMDLs for Water Body Segments within the CFPD as of 2010

Map ID No.	Water Body Name	Water Body Type	Pollutant of Concern	TMDL Status
1	Mill Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL
25	Turkey Creek Above Little Alafia River	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
26	Mustang Ranch Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
33	Little Manatee River (South Fork)	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
37	Peace River Above Bowlegs Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
38	Poley Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
39	Blackwater Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
45	English Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
46	Little Bullfrog Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
47	Gilly Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
49	Peace Creek Drainage Canal	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
50	Spartman Branch	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
51	Bullfrog Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
56	Little Manatee River	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
17	Thirty Mile Creek	Stream	Total Nitrogen	Adopted TMDL and USEPA Approved
6	Mustang Ranch Creek	Stream	Total Nitrogen and Total Phosphorus	Adopted TMDL and USEPA Approved
8	Lake Hunter Outlet	Stream	Total Nitrogen and Total Phosphorus	Adopted TMDL and USEPA Approved
18	Alafia River Above Hillsborough Bay	Estuary	Total Nitrogen	Adopted TMDL and USEPA Approved

Source: FDEP, 2013d

FIGURE 3
Locations of Completed TMDL Studies within the CFPD
Central Florida Phosphate District, Florida



Source: FDEP TMDL list and Florida Geographic Data Library for WBID shapefiles, 2012

5.0 Phosphate Mine Monitoring Programs

Projection of the environmental consequences of authorization of the Applicants' Preferred Alternatives and offsite alternatives on surface water quality is best supported by review of such effects documented for recent or ongoing phosphate mines. In terms of the Applicants' Preferred Alternatives under USACE review, two are extensions of existing mines. Accordingly, review of mine water quality monitoring records for the Wingate Creek Mine and South Pasture Mine was particularly relevant because the Wingate East Mine (Alternative 4) and South Pasture Mine Extension (Alternative 5) would have recirculation systems integrated with the existing mines. Therefore, future offsite discharges through the applicable NPDES-permitted outfalls would be reasonably expected to reflect the same or similar water quality characteristics. The direct and indirect effects of these two alternatives on the applicable receiving water bodies are reviewed in this section. Effects from these extensions of existing mines would be expected to be similar to those effects demonstrated through ongoing monitoring records.

For the Ona Mine (Alternative 3), predictions on water quality impacts must rely on characterization of typical conditions documented at nearby "reference mines," which reasonably could include both the Wingate Creek and South Pasture Mines because they are adjacent to the Ona Mine site. In contrast, the Desoto Mine site (Alternative 2) is south of any existing phosphate mines in the CFPD. Despite this geographic separation, there still is justification for using a "reference mines" approach to this projection of potential environmental consequences since the proposed mine operation is similar to those of the existing mines. The Desoto Mine's discharges offsite would primarily have the potential to affect Horse Creek, with only a small portion of its drainage area discharging east to the Peace River at Arcadia subwatershed. Pine Level/Keys Tract (Alternative 6) is mostly in the lower Myakka River subwatershed, specifically in the Big Slough Basin. The Pioneer Tract (Alternative 7) is between the Desoto and Ona Alternative mine sites, with about half of it in Horse Creek and the other half in the Peace River at Arcadia subwatershed. Site A-2 (Alternative 8) is in the Peace River at Zolfo Springs subwatershed. Site W-2 (Alternative 9) is in the upper Myakka River subwatershed. Again, these four offsite alternatives should have similar discharge characteristics because of the types of soils, streams, and likely mining operations to be conducted in these areas.

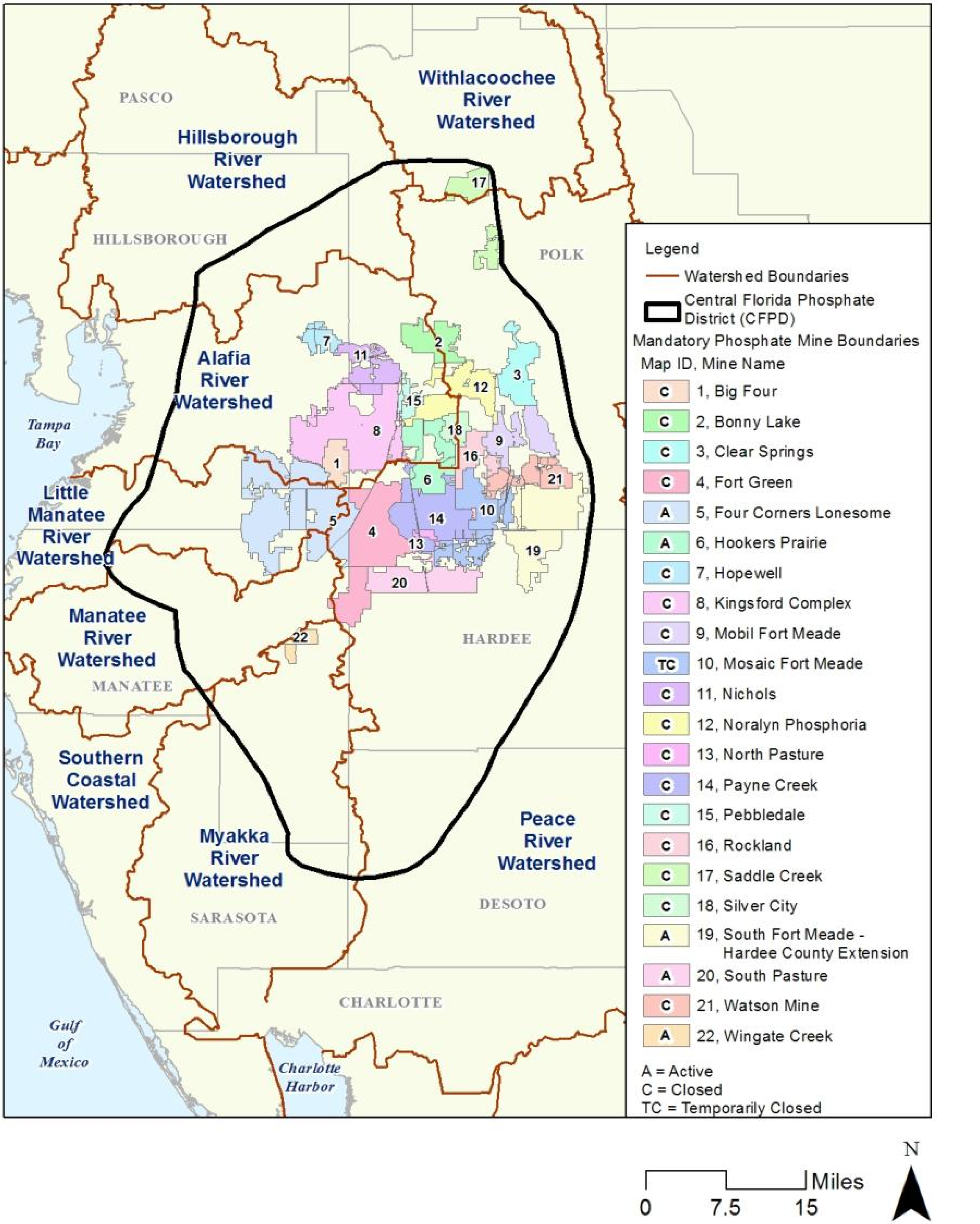
Mosaic's proposed mining technologies and BMPs for water quality-based impact avoidance and minimization for these new mines are essentially the same as those proposed for existing mines. To broaden the geographic extent of the mines included in the "reference mines" comparison, data were summarized for a total of six mines; four of these are actively involved in phosphate rock production, beneficiation, and reclamation; the other two are inactive in terms of phosphate rock production and beneficiation, but are still engaged in reclamation. A total of 11 mines were reviewed with 31 permitted outfalls; however, 13 of those outfalls were at two mines (Kingsford and Fort Green Complex) and some outfalls did not have a lot of data for analysis because there was limited discharges and sampling normally is only required when discharge occurs. The reference mines used in this TM are identified as follows:

- Active mines: Four Corners/Lonesome, South Fort Meade, Wingate Creek, and South Pasture
- Inactive mines: Fort Green Complex and Kingsford

Discharges from these mines were considered most relevant to the AEIS surface water quality evaluation because these NPDES discharge locations were related solely to mine operations, whereas some outfalls from other mines in the study area discharge stormwater and wastewater from facilities that include chemical manufacturing sites. Locations of these reference mines are shown in Figure 4.

Reference is made to the applicable outfalls from mines in the following descriptions of potential environmental effects of mining on surface water quality of offsite discharges. The primary focus is on assessment of the potential direct impacts as reflected by water quality characteristics in offsite discharges. However, the potential for indirect effects also is addressed in terms of any indications of aquatic biological community response to offsite discharges.

FIGURE 4
Locations of Historical and Existing Phosphate Mines in the CFPD, Including Reference Mines Used in the AEIS Surface Water Quality Review
Central Florida Phosphate District, Florida



5.1 NPDES Discharge Data

Operating permits issued by FDEP for phosphate mines contain specific conditions that include requirements for hydrologic isolation of a mine's water management system from Waters of the State, with all discharges from the water management system limited to those passing through specific permitted outfalls defined in the permits. Typically, water quality monitoring is required for any month during which a discharge occurs. While the analytical parameters called for in the various permits reviewed were not always consistent, they often included most of the following:

- pH
- Specific conductance
- Temperature
- Turbidity
- Dissolved oxygen
- Total suspended solids
- Fixed suspended solids
- Total phosphorus
- Total nitrogen
- Fluoride
- Sulfate
- Chlorophyll *a*
- Total radium
- Gross alpha

Discharge compliance with the applicable surface water quality standards is required by these FDEP-specified permit conditions.

The NPDES outfall monitoring data for 2005 through 2010 were summarized for example discharges from five outfalls at active Mosaic phosphate mines: the Four Corners Mine (two outfalls), Wingate Creek Mine (two outfalls), and South Fort Meade Mine (one outfall). Monitoring data for discharges from the two permitted outfalls at the CF Industries South Pasture Mine were also summarized for the same period of record. Parameter averages for 2005 through 2010 summarized in Table 4 indicate that the various mine discharges generally have similar water quality and that on average the discharges comply with the applicable Class III surface water quality criteria.

Comparable records were compiled for two inactive Mosaic mines that remain engaged in reclamation only (no active phosphate rock extraction or beneficiation); these mean values are summarized in Table 5. For nearly all parameters, the values shown for the inactive mines were comparable to those for the active mines. Sulfate mean values were substantively lower for the inactive mine outfalls.

To support further evaluation of the relative influence of phosphate mining on ambient water quality conditions, scatter plots of the monitoring records supporting the long-term averages summarized in Tables 4 and 5 were prepared. Figures 5 through 11 compare discharge and background records for the following parameters, respectively:

- Specific conductance (Conductivity)
- Total suspended solids
- Total phosphorus
- Total nitrogen
- Sulfate
- Fluoride
- Chlorophyll *a*

These figures reflect the high level of variability in the datasets for the background as well as the NPDES discharge data groups, and are instructive in that the values reflect substantive overlap in values from mine to mine as well as across the various reference ambient locations from multiple CFPD subwatersheds.

TABLE 4
Phosphate Mine Discharge Mean Water Quality Values for Selected Active Mosaic and CF Industries Mine NPDES Outfalls (Averages for Period of Record 2005 – 2010)

			Outfall						
Parameter	**Units**	**Class III Criteria**	**FCO D001**	**FCO D002**	**WIN D001**	**WIN D002**	**SFM D001**	**SP D004**	**SP D005**
pH	SU	6.0 - 8.5	7.2	7.4	6.6	7.0	7.6	7.5	7.4
Specific Conductance	µmho/cm	1275	569	653	408	600	782	781	651
Temperature	°C	--	26.9	23.4	27.9	35.2	24.9	23.1	27.5
Turbidity	NTU	Bkgd + 29	15.7	7.0	5.1	6.2	5.6	6.7	8.1
Dissolved Oxygen	mg/L	5.0	6.0	7.8	6.9	8.0	7.7	7.5	6.9
Total Suspended Solids	mg/L	--	11.8	5.0	3.6	4.7	5.1	6.5	6.6
Fixed Suspended Solids	mg/L	--	7.2	2.3	2.2	2.4	1.8	3.2	3.5
Total Phosphorus	mg/L	--	1.10	1.23	1.00	1.51	1.44	1.13	0.87
Total Nitrogen	mg/L	--	0.88	0.93	0.95	0.99	0.97	0.98	1.23
Fluoride	mg/L	10.0	1.4	1.7	ND	0.88	2.1	2.1	2.4
Sulfate	mg/L	--	98	204	204	273	278	222	204
Chlorophyll *a*	µg/L	--	6.7	14.8	5.8	13.2	13.5	15.3	10.0
Total Radium	pCi/L	5	2.93	2.20	1.52	1.57	ND	ND	ND
Gross Alpha	pCi/L	15	10.30	9.50	2.22	3.22	ND	11.60	12.27

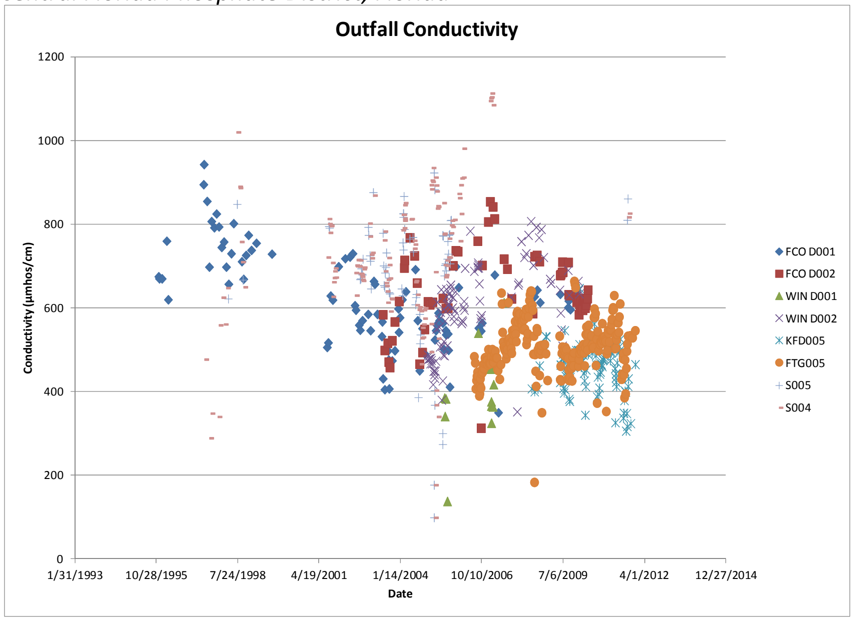
Notes:
FCO = Mosaic Four Corners Outfall
WIN = Mosaic Wingate Creek Outfall
SFM = Mosaic South Fort Meade Outfall
SP = CF Industries South Pasture Outfall

TABLE 5
Phosphate Mine Discharge Mean Water Quality Values for Selected Inactive Mosaic NPDES Outfalls

			Outfall	
Parameter	**Units**	**Class III Criteria**	**Fort Green 005**	**Kingsford 005**
pH	**SU**	**6.0 - 8.5**	**7.2**	**7.8**
Specific Conductance	**µmho/cm**	**1275**	**508**	**465**
Temperature	**°C**	**--**	**23.2**	**25.1**
Turbidity	**NTU**	**Bkgd + 29**	**5.5**	**7.6**
Dissolved Oxygen	**mg/L**	**5**	**--**	**7.8**
Total Suspended Solids	**mg/L**	**--**	**7.7**	**9.7**
Fixed Suspended Solids	**mg/L**	**--**	**0.9**	**2.9**
Total Phosphorus	**mg/L**	**--**	**1.03**	**0.72**
Total Nitrogen	**mg/L**	**--**	**1.60**	**1.43**
Fluoride	**mg/L**	**10**	**1.32**	**1.44**
Sulfate	**mg/L**	**--**	**62**	**42**
Chlorophyll-a	**µg/L**	**--**	**12.6**	**38.4**
Total Radium	**pCi/L**	**5**	**--**	**--**
Gross Alpha	**pCi/L**	**15**	**--**	**3.01**

Fort Green (2006-2011)
Kingsford (2008-2011)

FIGURE 5
Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Conductivity
Central Florida Phosphate District, Florida



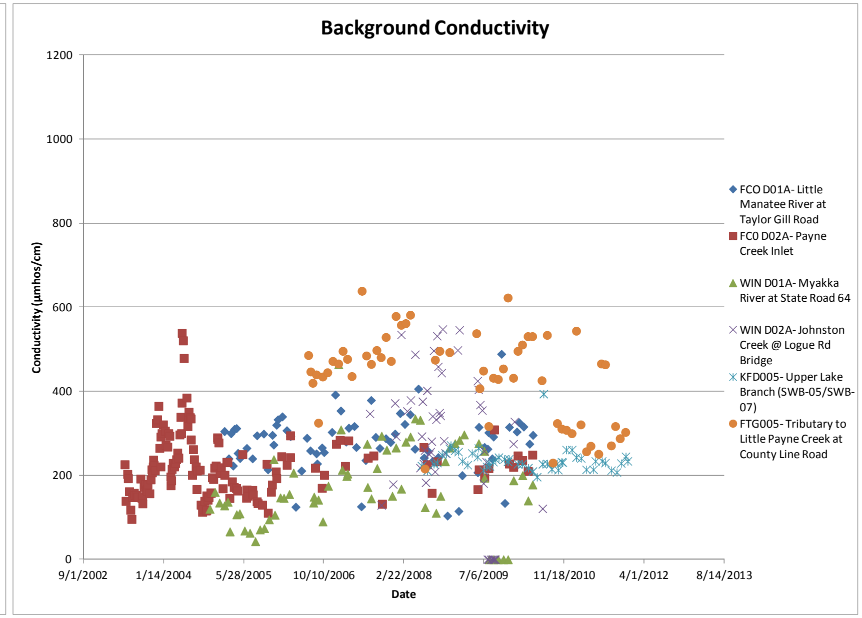
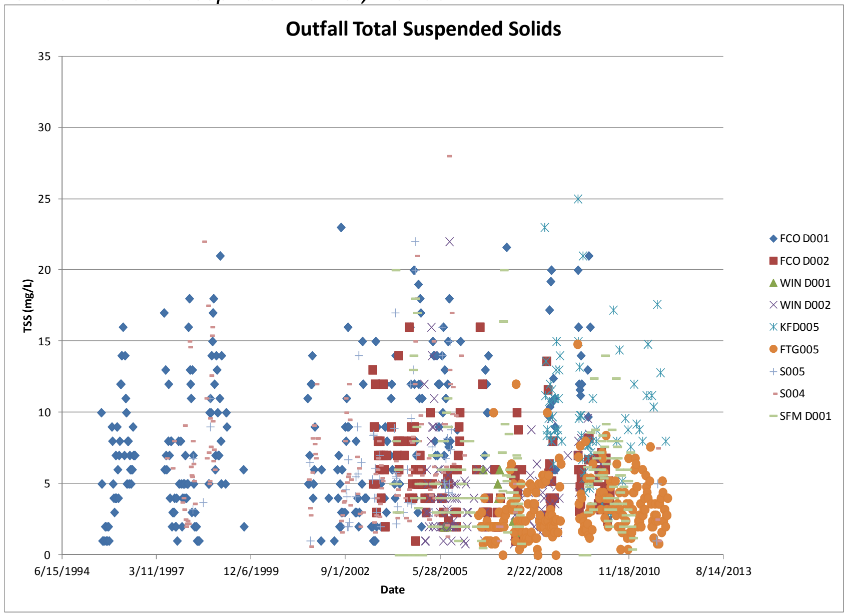


FIGURE 6

Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Total Suspended Solids

Central Florida Phosphate District, Florida



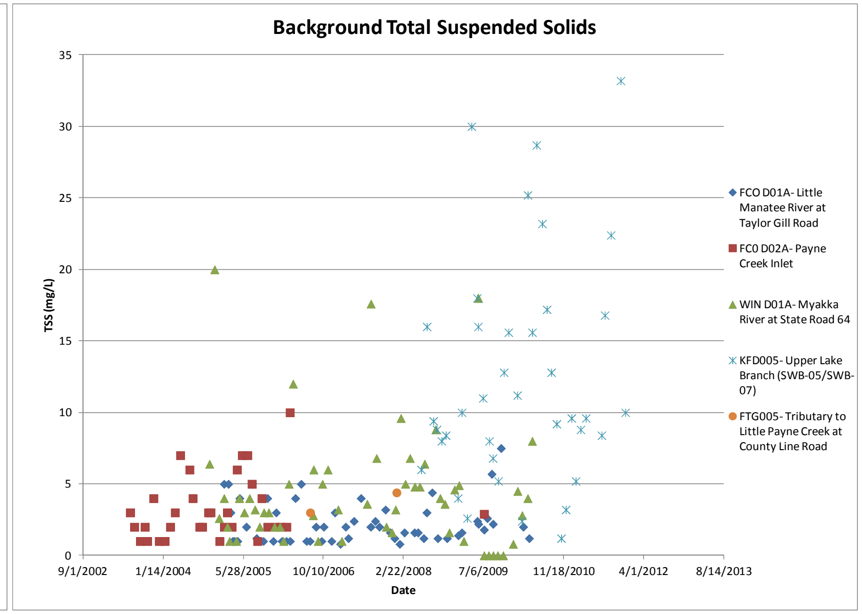
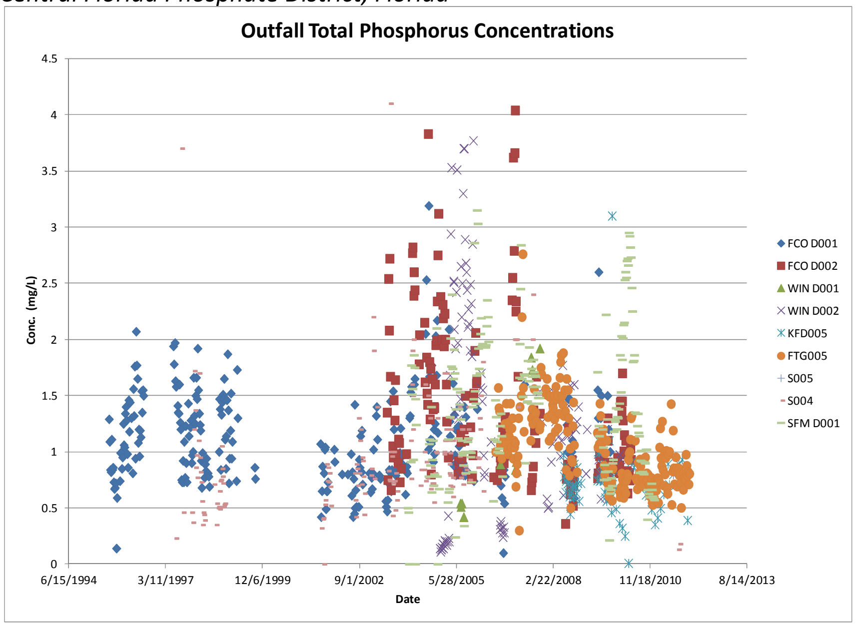


FIGURE 7
Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Total Phosphorus
Central Florida Phosphate District, Florida



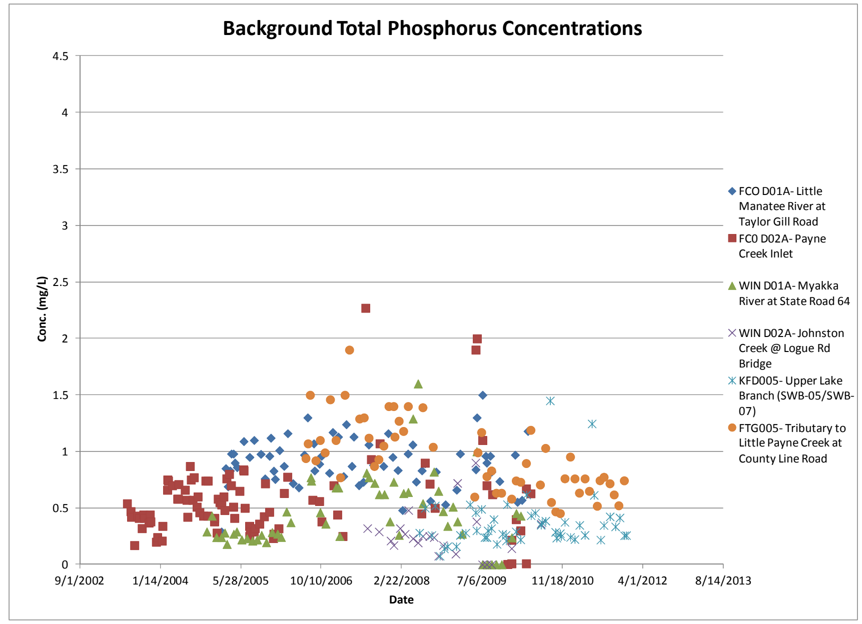
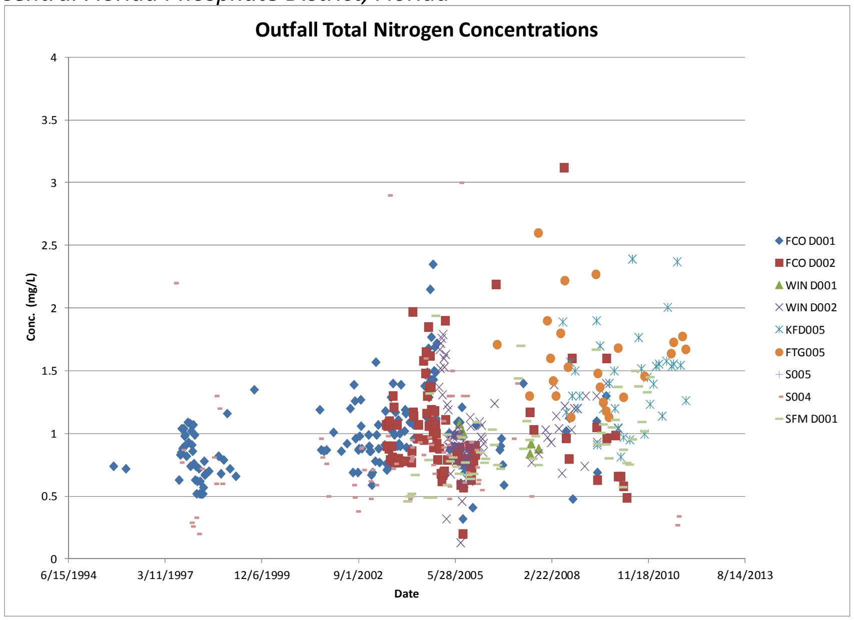


FIGURE 8
Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Total Nitrogen
Central Florida Phosphate District, Florida



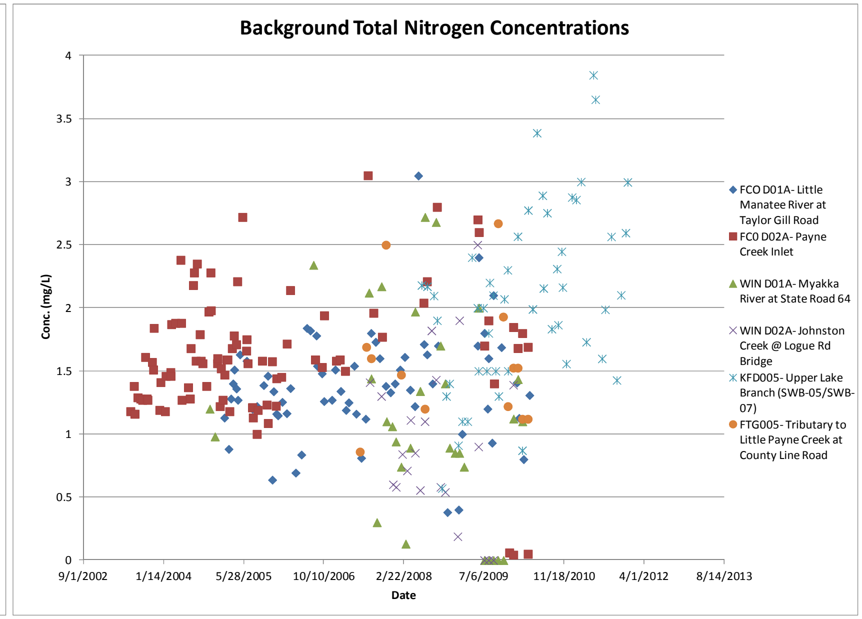
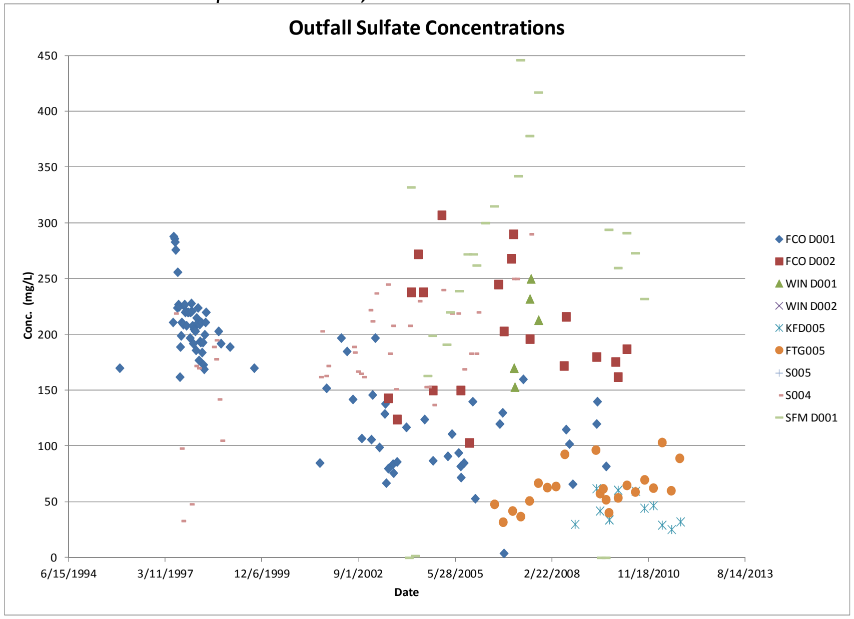


FIGURE 9

Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Sulfate

Central Florida Phosphate District, Florida



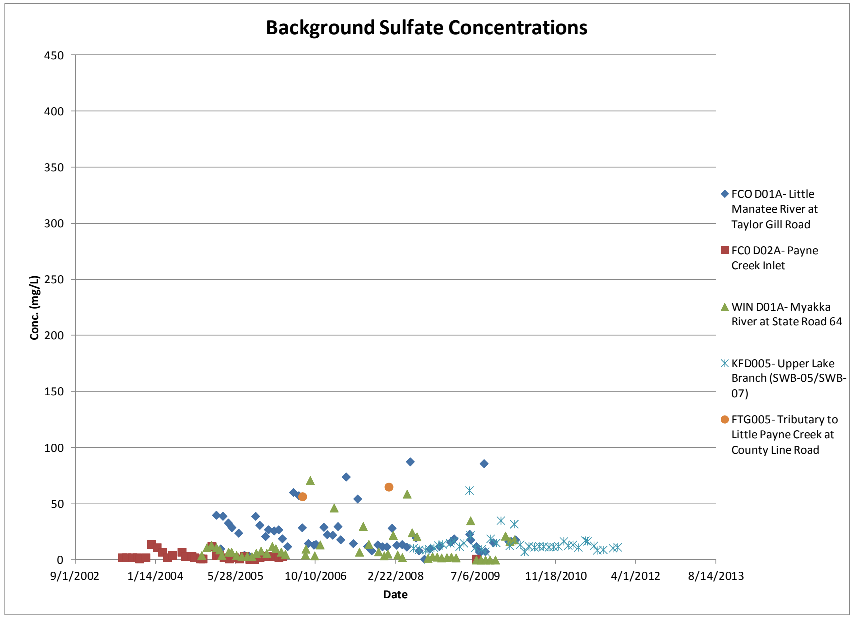
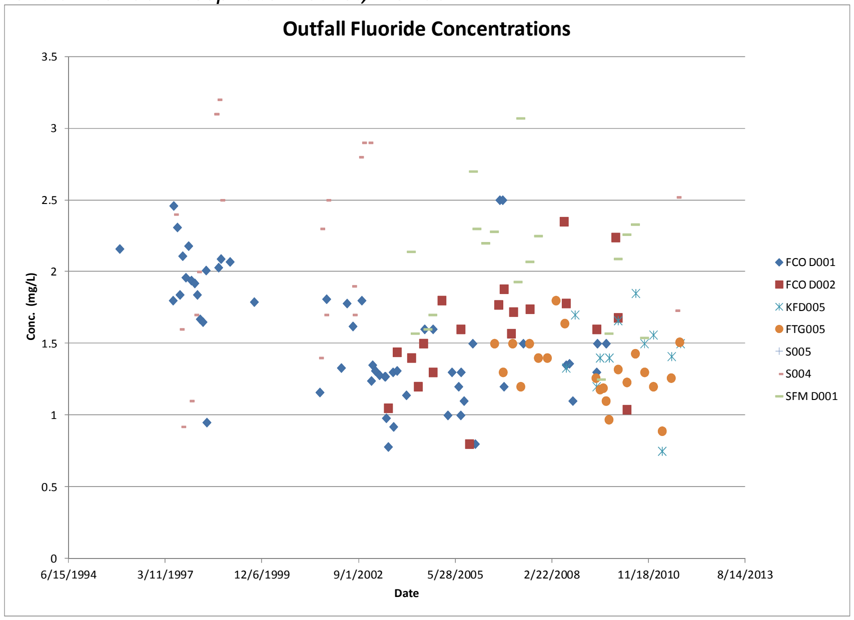


FIGURE 10

Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Fluoride

Central Florida Phosphate District, Florida



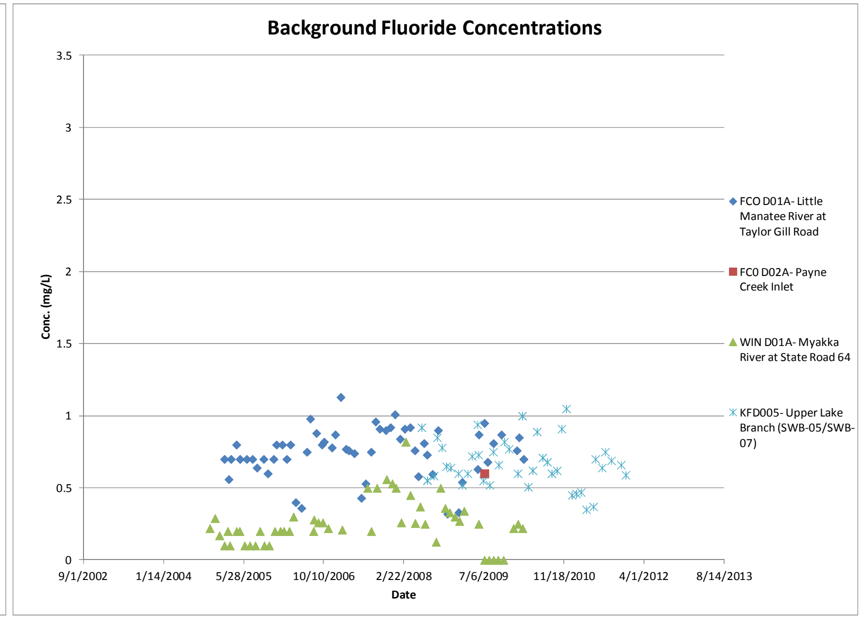
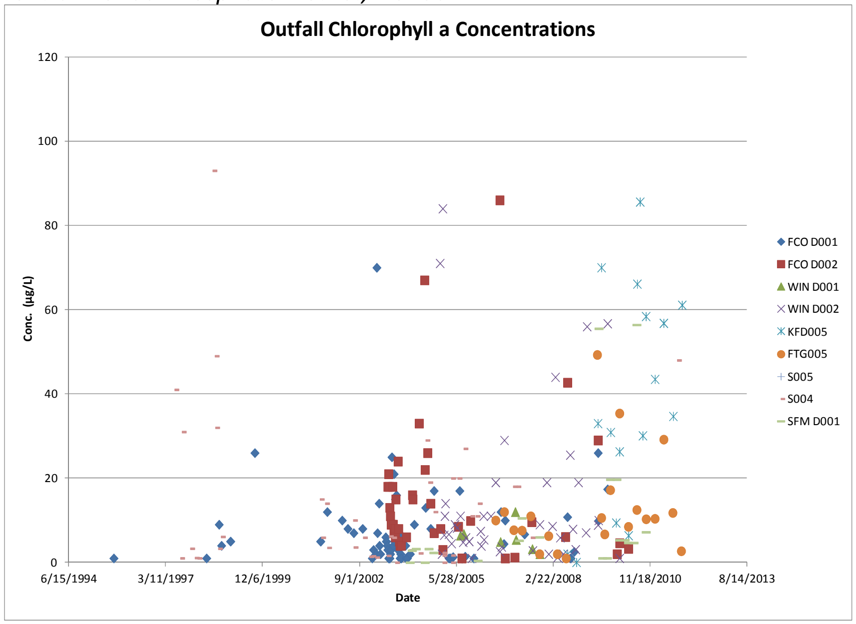
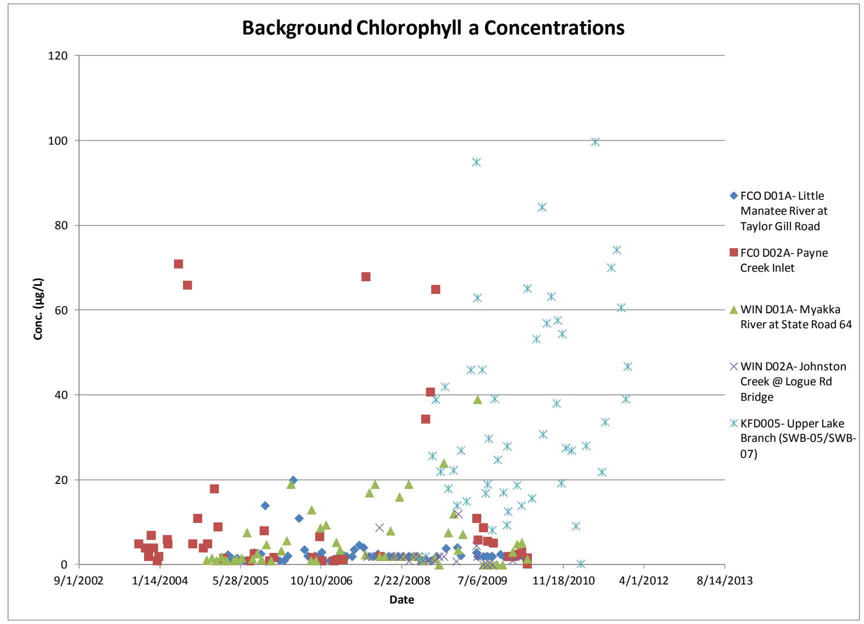


FIGURE 11

Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Chlorophyll *a*

Central Florida Phosphate District, Florida





5.2 Upstream and Downstream Monitoring Records

The Mosaic outfall monitoring program requirements for the Four Corners and Wingate Creek mines included monitoring of receiving water locations upstream (background) and downstream of each NPDES point of discharge for a subset of the water quality parameters monitored in the discharge samples. Comparable monitoring requirements exist for the Fort Green Complex and Kingsford Mine. Table 6 summarizes the averages and number of observations for the background, outfall, and downstream stations for Four Corners Outfall D-001. Table 7 provides the corresponding summary for Four Corners Outfall D-002. Figure 12 shows the locations of the two Four Corners Mines outfalls and the corresponding background and downstream sampling stations. Tables 8 and 9 summarize the averages and number of observations for background, outfall, and downstream stations for Wingate Creek Mine Outfalls D-001 and D-002, and Figure 13 shows the locations of the stations. Tables 10 and 11 summarize parameter averages for background, outfall, and downstream stations for the Fort Green Complex Outfall 005 and Kingsford Outfall 005, respectively. Figures 14 (Fort Green Complex) and 15 (Kingsford Mine) illustrate the outfalls and sampling station locations at these mines.

TABLE 6

Mean Water Quality Monitoring Data for Four Corners Mine; Background, Outfall 001 and Downstream Locations, 2005 - 2010

		Background		Outfall		Downstream	
Parameter	Units	Value	N	Value	N	Value	N
pH	SU	6.78	21	7.26	21	7.18	21
Specific Conductance	µmho/cm	268	21	584	21	556	21
Turbidity	NTU	2.97	17	16.15	17	5.86	17
DO	mg/L	5.03	21	6.29	21	6.62	21
Total P	mg/L	0.91	20	1.22	20	0.68	20
Total Nitrogen	mg/L	1.46	20	0.87	20	1.12	20
Chlorophyll-a	µg/L	1.89	16	6.70	16	4.89	16

Background Station: Little Manatee River at Taylor Gill Rd.
Effluent Station: FCO D001
Downstream Station: Alderman Creek at Taylor Gill Rd.

TABLE 7

Mean Water Quality Monitoring Data for Four Corners Mine; Background, Outfall 002 and Downstream Locations, 2005 – 2010

		Background		Outfall		Downstream	
Parameter	Units	Value	N	Value	N	Value	N
pH	SU	6.68	31	7.48	31	6.85	31
Specific Conductance	µmho/cm	217	30	870	30	643	30
Turbidity	NTU	1.68	9	5.29	9	3.36	9
DO	mg/L	3.31	30	7.50	30	5.78	30
Total P	mg/L	0.87	28	1.23	28	0.98	28
Total Nitrogen	mg/L	1.70	19	1.03	19	1.03	19
Chlorophyll-a	µg/L	11.83	12	18.46	12	8.90	12

Background Station: Payne Creek inlet
Effluent Station: FCO D002
Downstream Station: Payne Creek at pipe crossing in Section 49

TABLE 8

Mean Water Quality Monitoring Data for Wingate Creek Mine; Background, Outfall 001 and Downstream Locations, 2005 - 2010

		Background		Outfall		Downstream	
Parameter	Units	Value	N	Value	N	Value	N
pH	SU	6.7	9	6.9	9	6.7	9
Specific Conductance	µmho/cm	258	5	481	5	375	5
Turbidity	NTU	4.2	6	4.7	6	1.9	6
DO	mg/L	6.9	3	7.3	3	7.2	3
Total P	mg/L	0.47	2	0.88	2	0.29	2
Total Nitrogen	mg/L	2.15	2	0.90	2	1.02	2
Chlorophyll-a	µg/L	2.75	2	3.70	2	3.70	2

Background Station: Myakka River at State Road 64
Effluent Station: WIN D-001
Downstream Station: Wingate Creek @ State Route 64

TABLE 9

Mean Water Quality Monitoring Data for Wingate Creek Mine; Background, Outfall 002 and Downstream Locations, 2005 - 2010

		Background		Outfall		Downstream	
Parameter	**Units**	**Value**	**N**	**Value**	**N**	**Value**	**N**
pH	SU	6.9	61	7.3	61	7.2	61
Specific Conductance	µmho/cm	323	24	671	24	612	24
Turbidity	NTU	5.7	33	6.2	33	6.0	33
DO	mg/L	5.7	15	8.2	15	7.5	15
Total P	mg/L	0.31	18	1.41	18	1.23	18
Total Nitrogen	mg/L	1.09	20	1.07	20	1.33	20
Chlorophyll-a	µg/L	2.69	20	14.53	20	11.37	20
Background Station: Upstream/Johnston Creek @ Logue Rd Bridge							
Effluent Station: WIN D-002							
Downstream Station: Downstream/Johnston Creek @ 64							

TABLE 10

Mean Water Quality Monitoring Data for the Fort Green Mine Complex; Background, Outfall 005 and Downstream Locations, 2006 - 2011

			Station		
Parameter	**Units**	**Class III Criteria**	**Upstream**	**Ft. Green**	**Downstream**
pH	**SU**	**6.0 - 8.5**	**7.4**	**7.2**	**7.6**
Specific Conductance	**µmho/cm**	**1275**	**442**	**508**	**445**
Turbidity	**NTU**	**Bkgd + 29**	**5.9**	**5.5**	**4.6**
Dissolved Oxygen	**mg/L**	**5**	**6.47**	**--**	**7.10**
Total Phosphorus	**mg/L**	**--**	**0.95**	**1.03**	**0.82**
Total Nitrogen	**mg/L**	**--**	**1.57**	**1.60**	**1.45**
Chlorophyll-a	**µg/L**	**--**	**--**	**12.58**	**--**
Fort Green (2006-2011)					

TABLE 11

Mean Water Quality Monitoring Data for Kingsford Mine; Background, Outfall 005 and Downstream Locations, 2008 - 2010

			Station		
Parameter	**Units**	**Class III Criteria**	**Upstream**	**Kingsford**	**Downstream**
pH	**SU**	**6.0 - 8.5**	**7.2**	**7.8**	**7.5**
Specific Conductance	**µmho/cm**	**1275**	**236**	**465**	**361**
Turbidity	**NTU**	**Bkgd + 29**	**13.7**	**7.6**	**7.6**
Dissolved Oxygen	**mg/L**	**5**	**6.05**	**7.77**	**5.27**
Total Phosphorus	**mg/L**	**--**	**0.36**	**0.72**	**0.53**
Total Nitrogen	**mg/L**	**--**	**2.13**	**1.43**	**1.88**
Chlorophyll-a	**µg/L**	**--**	**37.2**	**38.4**	**28.6**
Kingsford (2008-2011)					

FIGURE 12

Location of NPDES Discharge and Ambient Water Quality Stations Evaluated at Four Corners Mine

Central Florida Phosphate District, Florida

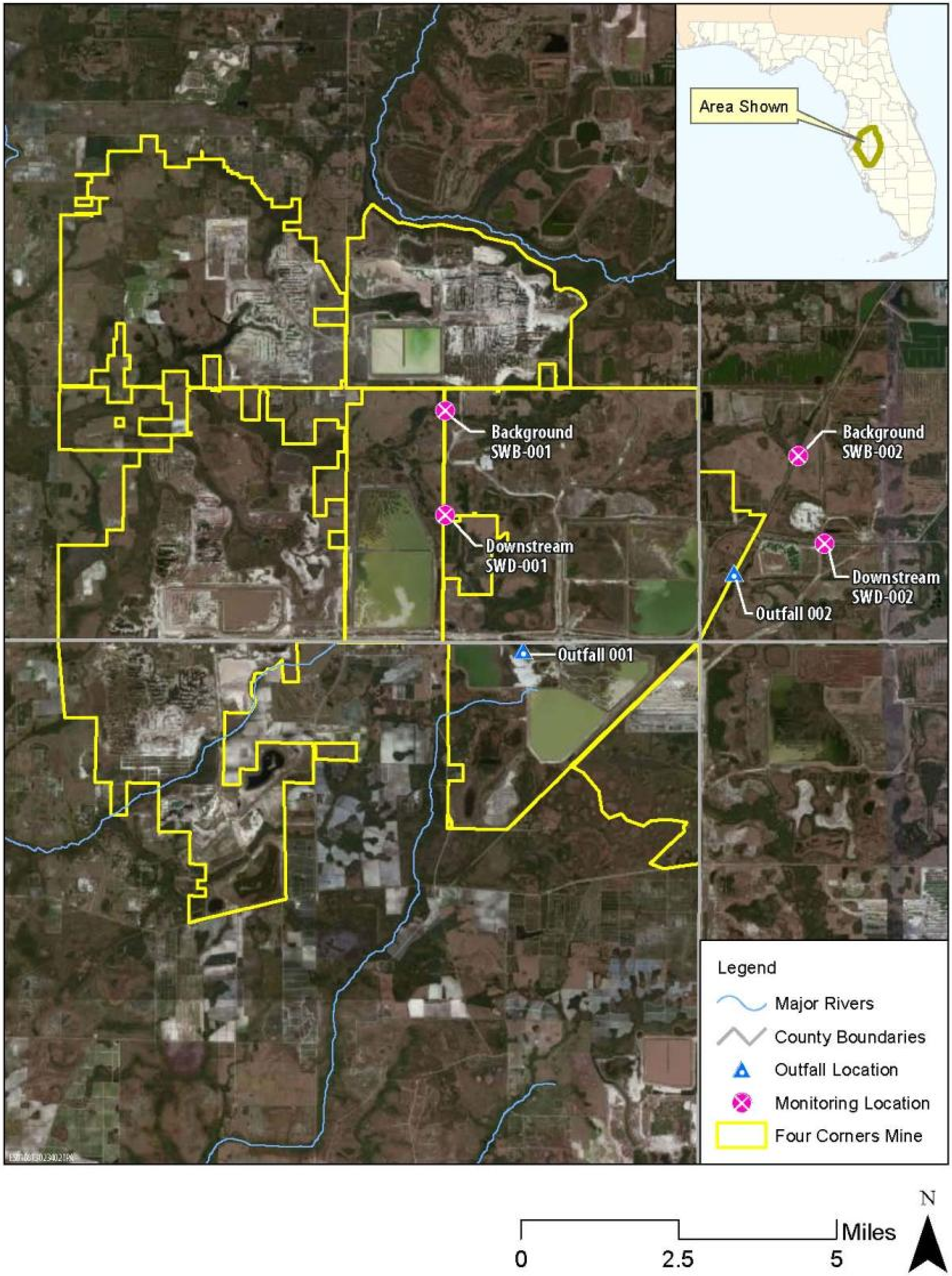


FIGURE 13
Location of NPDES Discharge and Ambient Water Quality Stations Evaluated at Wingate East Mine
Central Florida Phosphate District, Florida

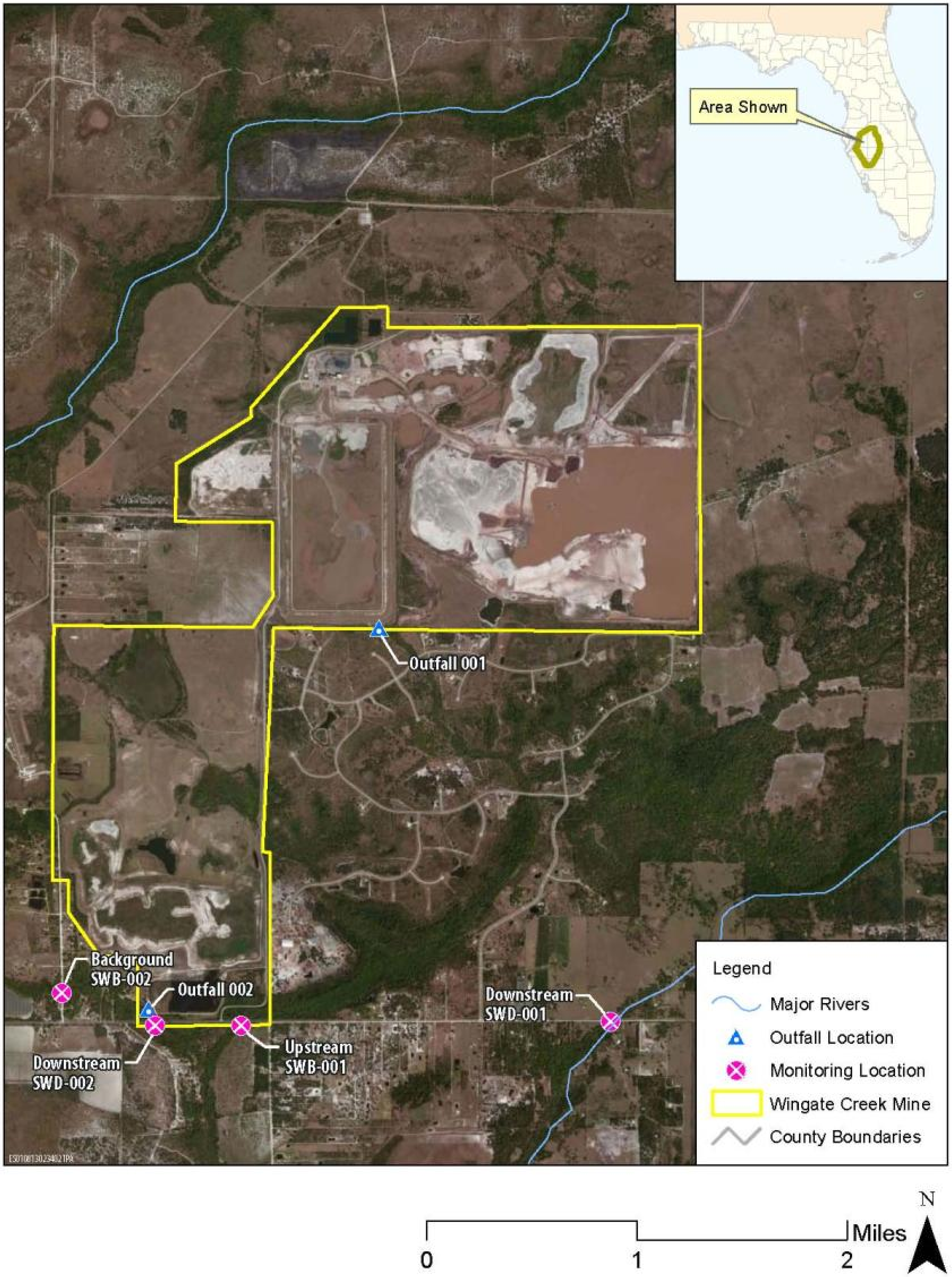


FIGURE 14
Location of NPDES Discharge and Ambient Water Quality Stations Evaluated at Fort Green Mine Complex
Central Florida Phosphate District, Florida

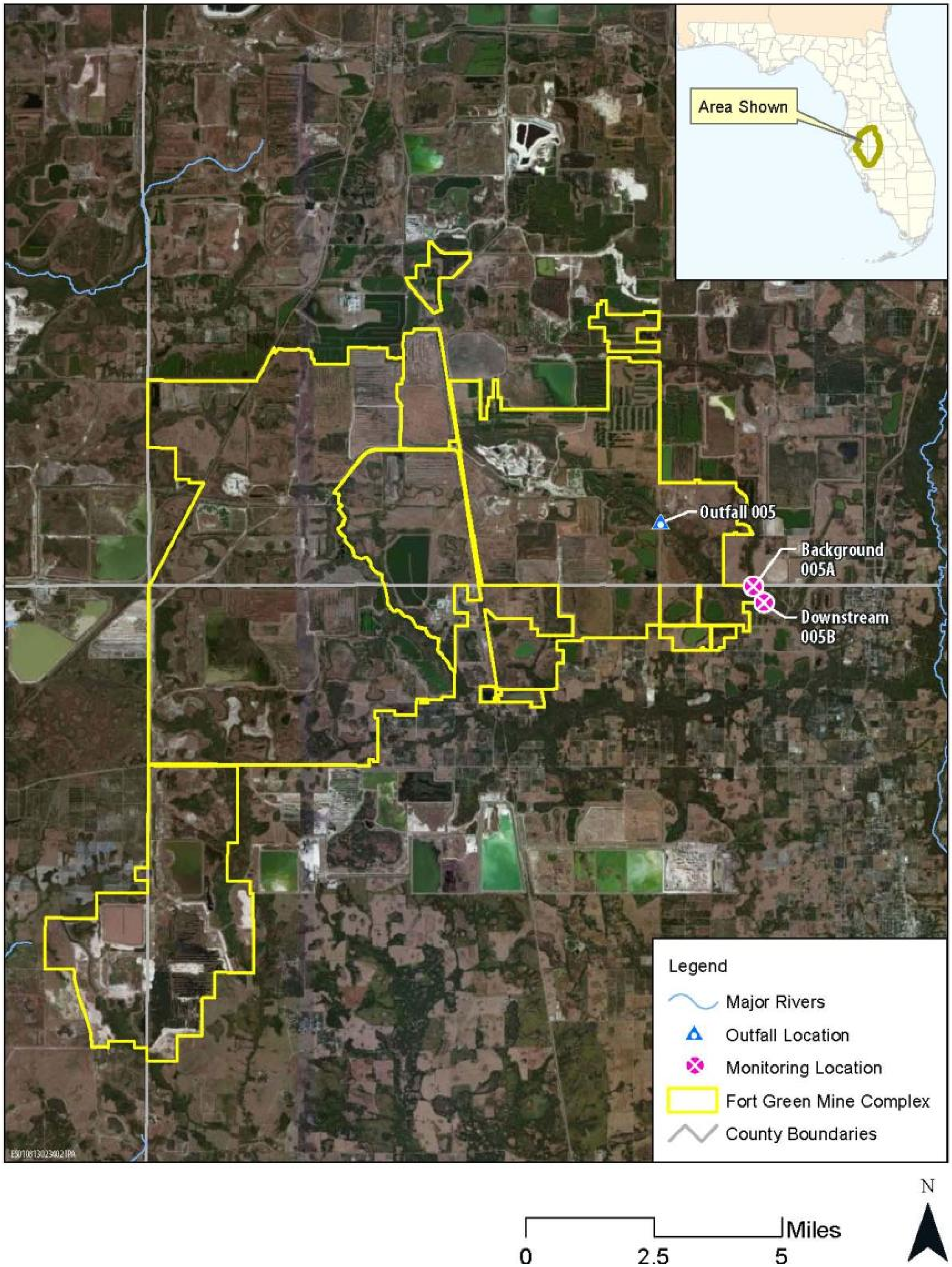
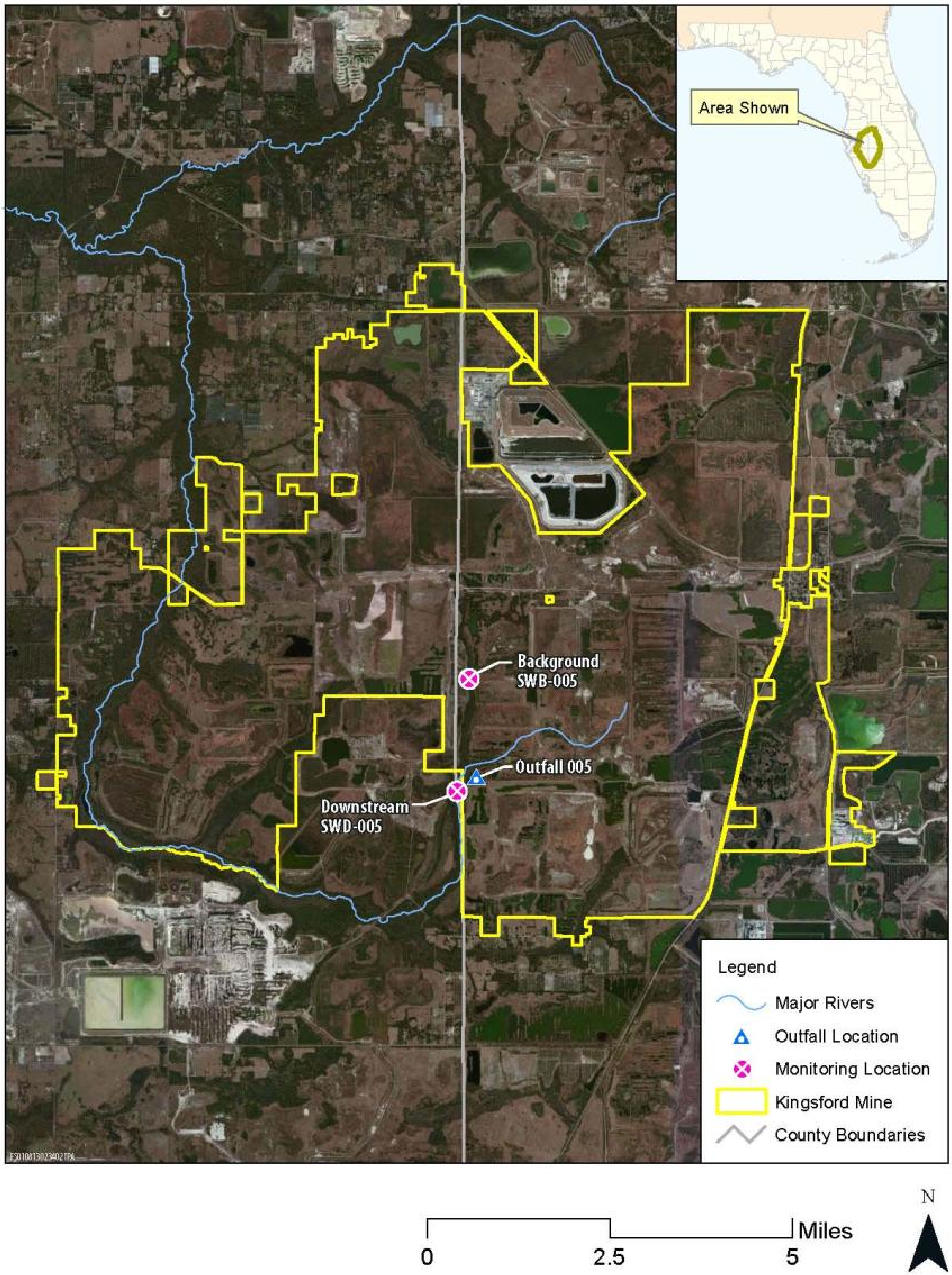


FIGURE 15
Location of NPDES Discharge and Ambient Water Quality Stations Evaluated at Kingsford Mine
Central Florida Phosphate District, Florida



Additional analyses of the NPDES monitoring results were performed to compare water quality at mine outfall stations with corresponding upstream and downstream stations and compliance with applicable surface water quality criteria. These included box and whisker plots and paired comparison tests, as described in the following paragraphs.

Box and whisker plots display information on the central tendency, variability, and skewness of sample data sets by sketching the middle 50 percentile values of the data with a box, and using whiskers to show the tail regions of the distribution; Figure 16 presents an example. A description of box and whisker plot construction follows:

- The height of the box represents the interquartile range (the distance between the 25th and 75th percentiles).
- The horizontal line in the box represents the median.
- The vertical whiskers extend to the minimum and maximum measured values, provided the minimum and maximum values do not extend more than 1.5 times the inter-quartile range beyond the box.
- Individual data symbols represent data points that exceed the whiskers (outliers).

Figures 17 through 23 are box and whisker plots for the parameters listed below for upstream, outfall, and downstream stations at several active and closed mines, and South Pasture outfalls 4 and 5:

- Conductivity
- pH
- Dissolved oxygen
- Turbidity
- Total phosphorus
- Total nitrogen
- Chlorophyll *a*

The plots also provide the number of data points for each station and the number of values that exceeded criteria for conductivity, pH, dissolved oxygen, and turbidity. The conductivity data (Figure 17) are consistent with observations from many of the studies referenced above; conductivity tends to be higher at mine outfalls and downstream locations than at the respective upstream locations. However, all of the conductivity values are less than the criterion of 1,275 micromhos per centimeter (µmhos/cm). The criteria range for pH includes a minimum value of 6.0 and a maximum of 8.5. Most of the values are within that range (Figure 18), except for two upstream values and one outfall value that were less than 6.0, and one outfall and one downstream value that were greater than 8.5. No consistent pattern is apparent between the outfall and upstream locations.

Many dissolved oxygen values were less than the minimum criterion of 5.0 mg/L (Figure 19). The low values generally were observed more frequently at upstream locations than at the corresponding outfalls and downstream stations. No dissolved oxygen exceedances were reported for the four outfalls at the Wingate Creek and Four Corners mines or at South Pasture Outfall 4. Dissolved oxygen showed different trends at the two outfalls associated with closed mines. Dissolved oxygen values at the Kingsford outfall were higher than at the corresponding upstream and downstream stations, while the Fort Green upstream values were lower than at the upstream station. The NPDES permit for the Fort Green outfall does not require dissolved oxygen monitoring at the outfall station.

The turbidity criterion prohibits values greater than 29 nephelometric turbidity units (NTU) above background. The plot of turbidity data used 29 NTU as a very conservative evaluation of compliance with the criterion at upstream, outfall, and downstream locations (Figure 20). Nearly all of the turbidity values were less than 29 NTU, with very infrequent exceedances noted at some upstream, outfall, and downstream stations.

The median total phosphorus values were consistently higher for outfall stations than for upstream or downstream stations (Figure 21). Nevertheless, median total phosphorus values at several downstream locations were lower than total phosphorus values at the corresponding upstream locations. In addition, the total phosphorus inter-quartile ranges for downstream stations generally overlapped the inter-quartile ranges for the upstream stations, including most cases where the downstream median was greater than the upstream median.

This means that there was not a regular increase in concentration downstream that could be statistically discerned given the variability in the monitoring data.

Outfall total nitrogen median values were generally lower than the corresponding upstream and downstream total nitrogen values (Figure 22). The inter-quartile ranges tended to be greater at the upstream stations than at the outfall stations. This suggests much less variability in total nitrogen concentrations for the outfall discharges than at the upstream locations.

The distribution of chlorophyll *a* values was similar for the upstream, outfall, and downstream stations at the Four Corners and Wingate Creek mines (Figure 23). Outfall monitoring at the closed Fort Green and Kingsford mines did not include chlorophyll *a* measurements for the upstream stations. However, the Kingsford outfall and Fort Green downstream stations appeared to have higher chlorophyll *a* values than at the other stations.

FIGURE 16
Example Box and Whisker Plots
Central Florida Phosphate District, Florida

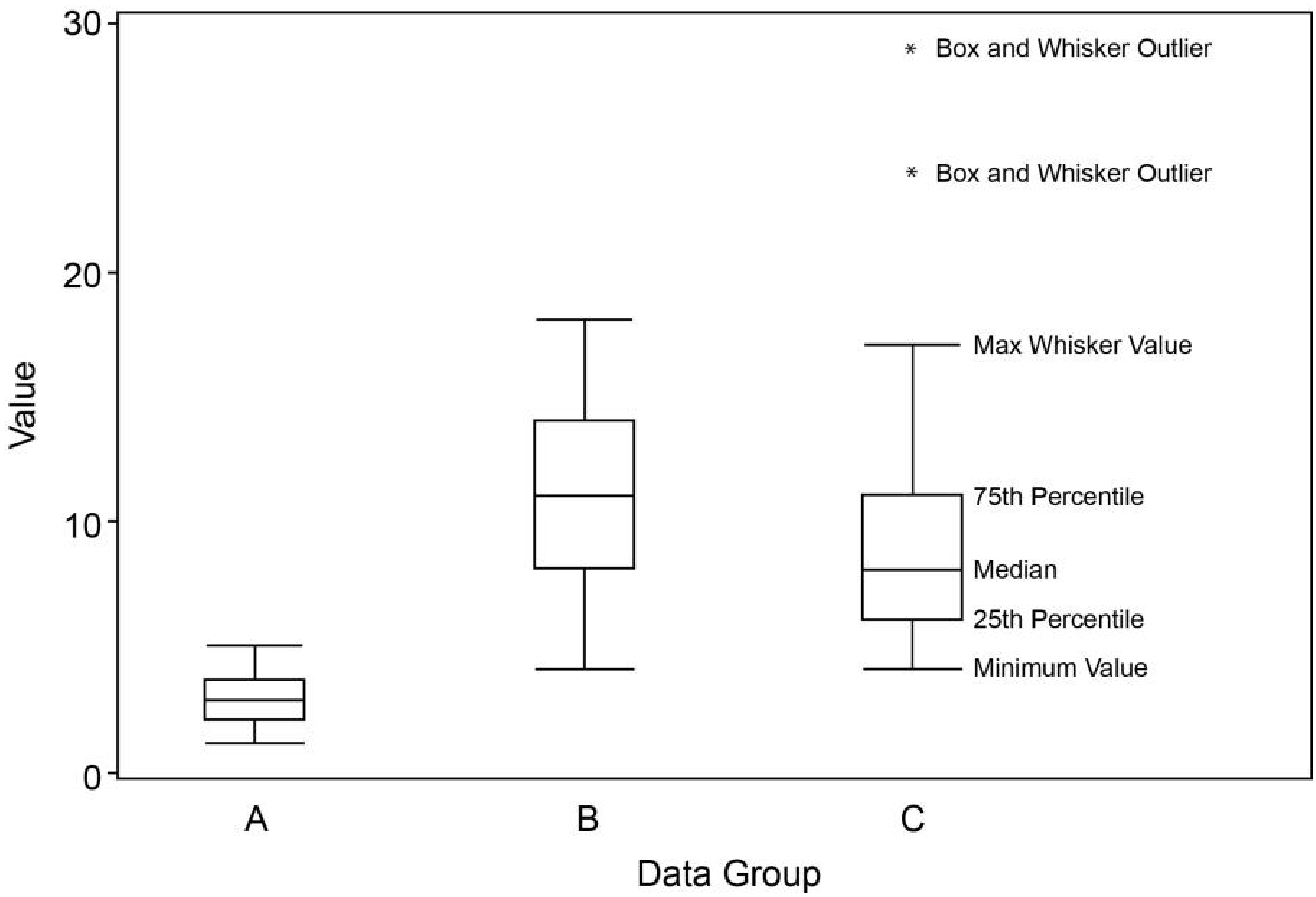
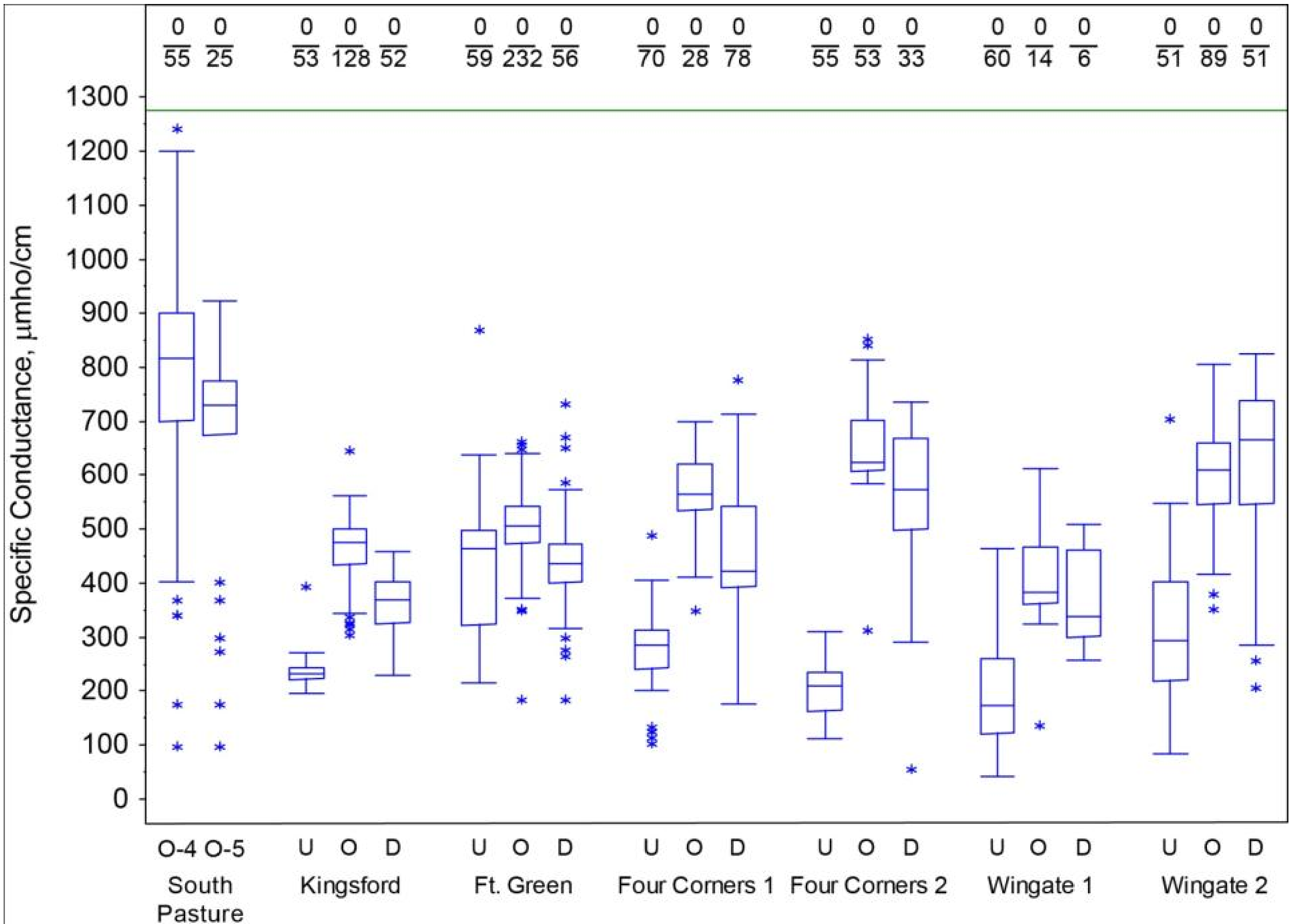


FIGURE 17

Specific Conductance Monitoring Data for Mine Outfalls and Upstream and Downstream Locations

Central Florida Phosphate District, Florida



U = Upstream; O = Outfall; D = Downstream

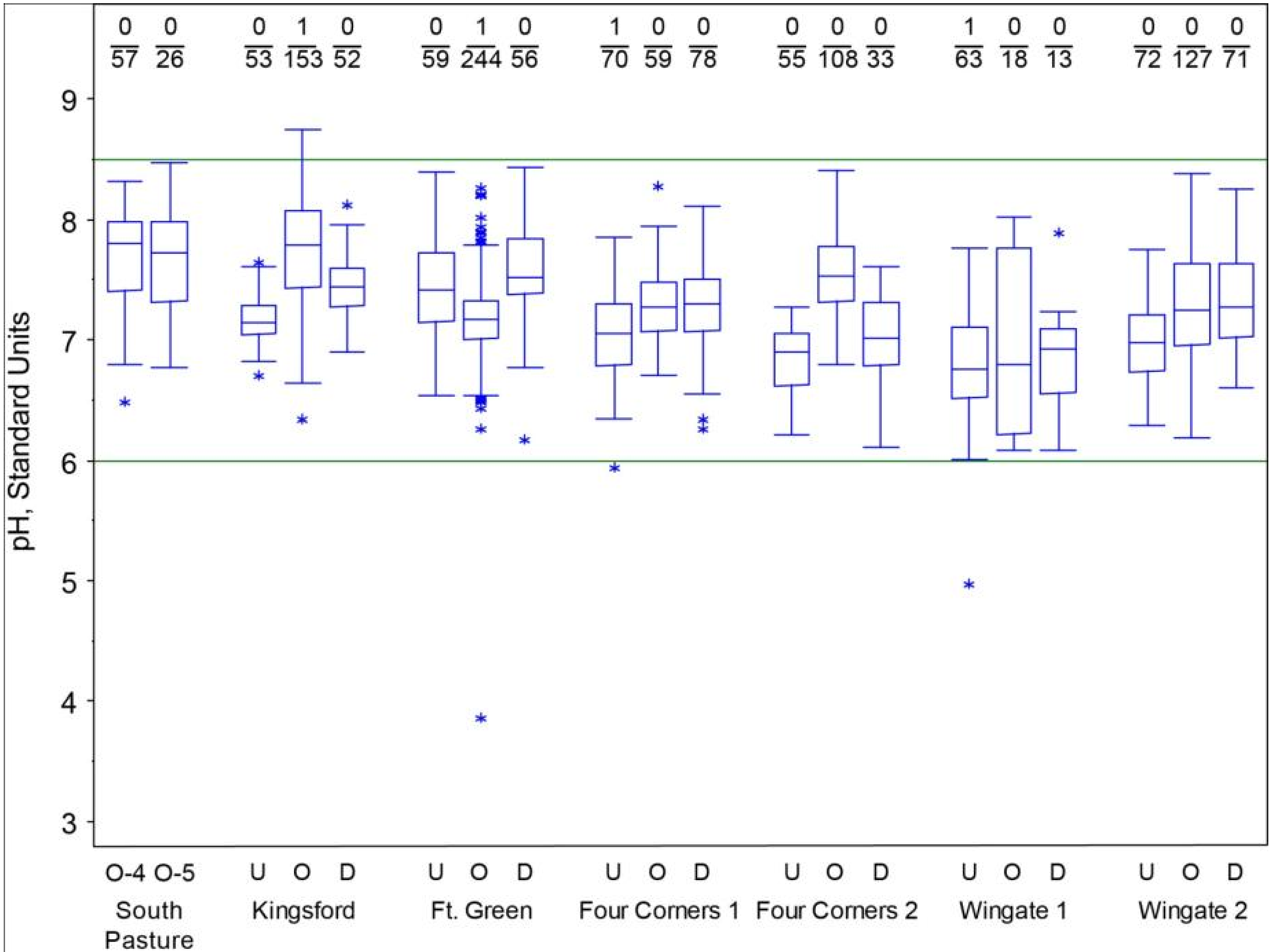
Frequency of SWQ Criteria Exceedances Listed at the Top of Each Plot

Green Horizontal Line at SWQ Criteria

FIGURE 18

pH Monitoring Data for Mine Outfalls and Upstream and Downstream Locations

Central Florida Phosphate District, Florida



U = Upstream; O = Outfall; D = Downstream

Frequency of SWQ Criteria Exceedances Listed at the Top of Each Plot

Green Horizontal Line at SWQ Criteria

FIGURE 19

Dissolved Oxygen Monitoring Data for Mine Outfalls and Upstream and Downstream Locations

Central Florida Phosphate District, Florida

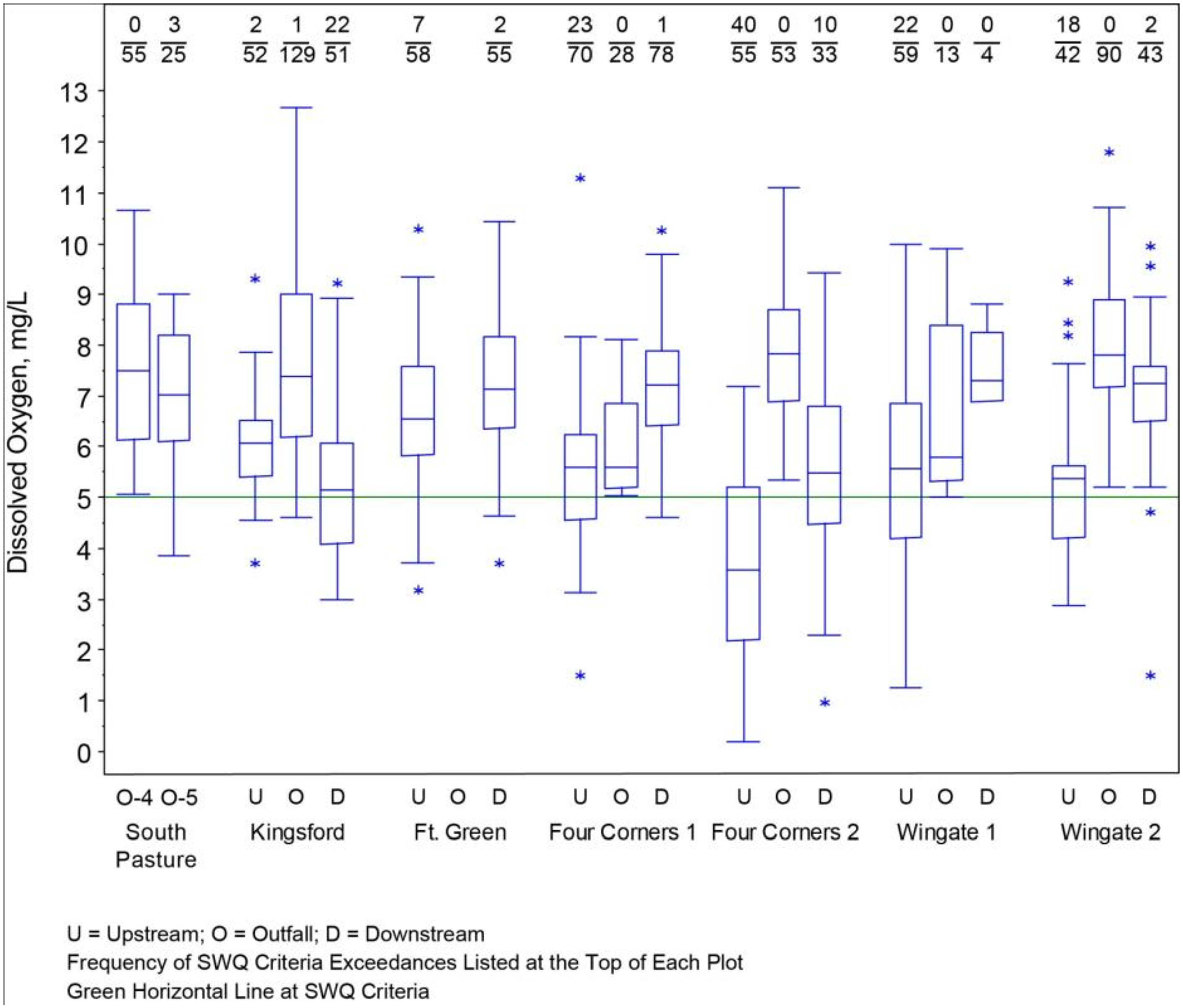
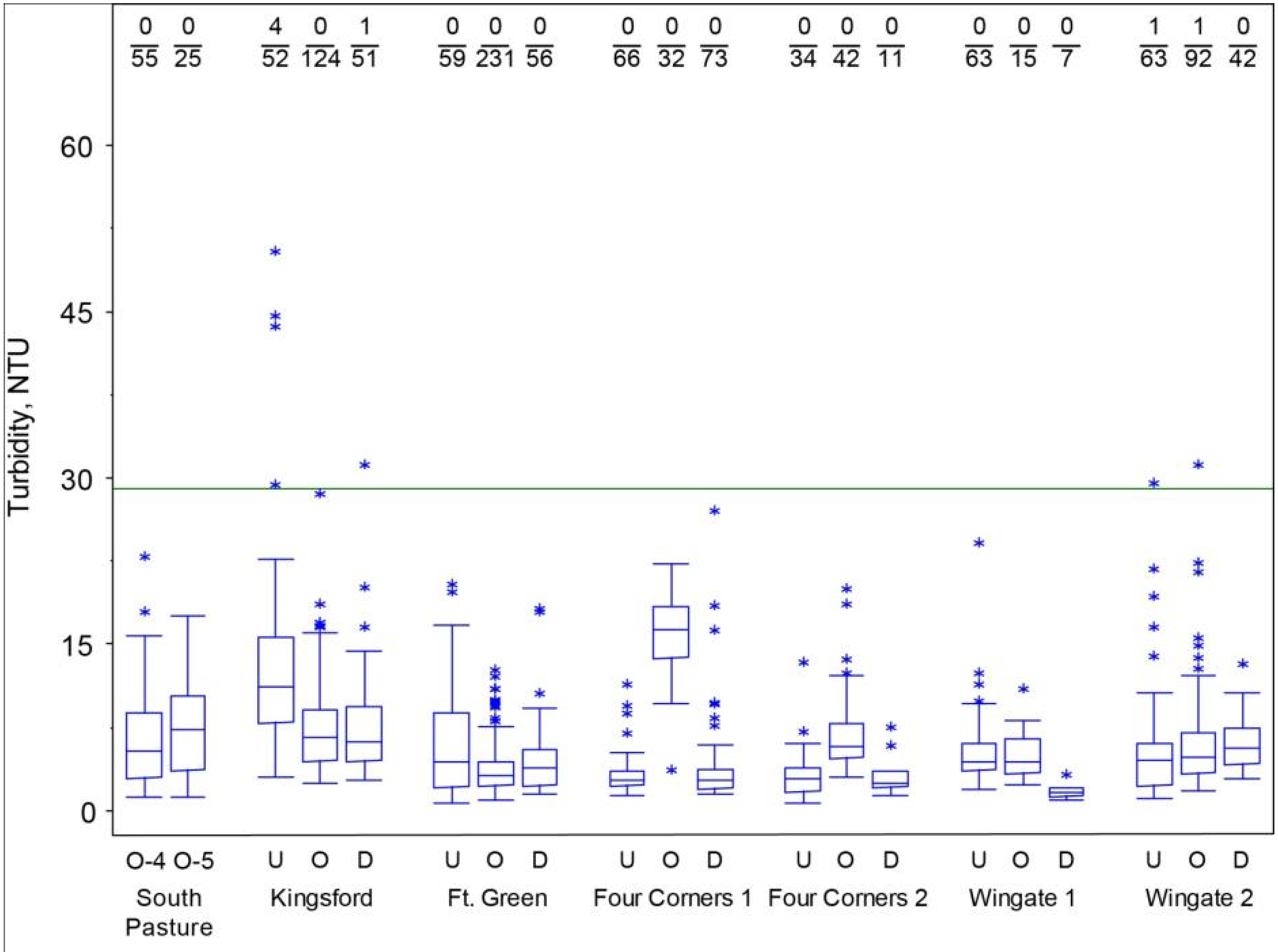
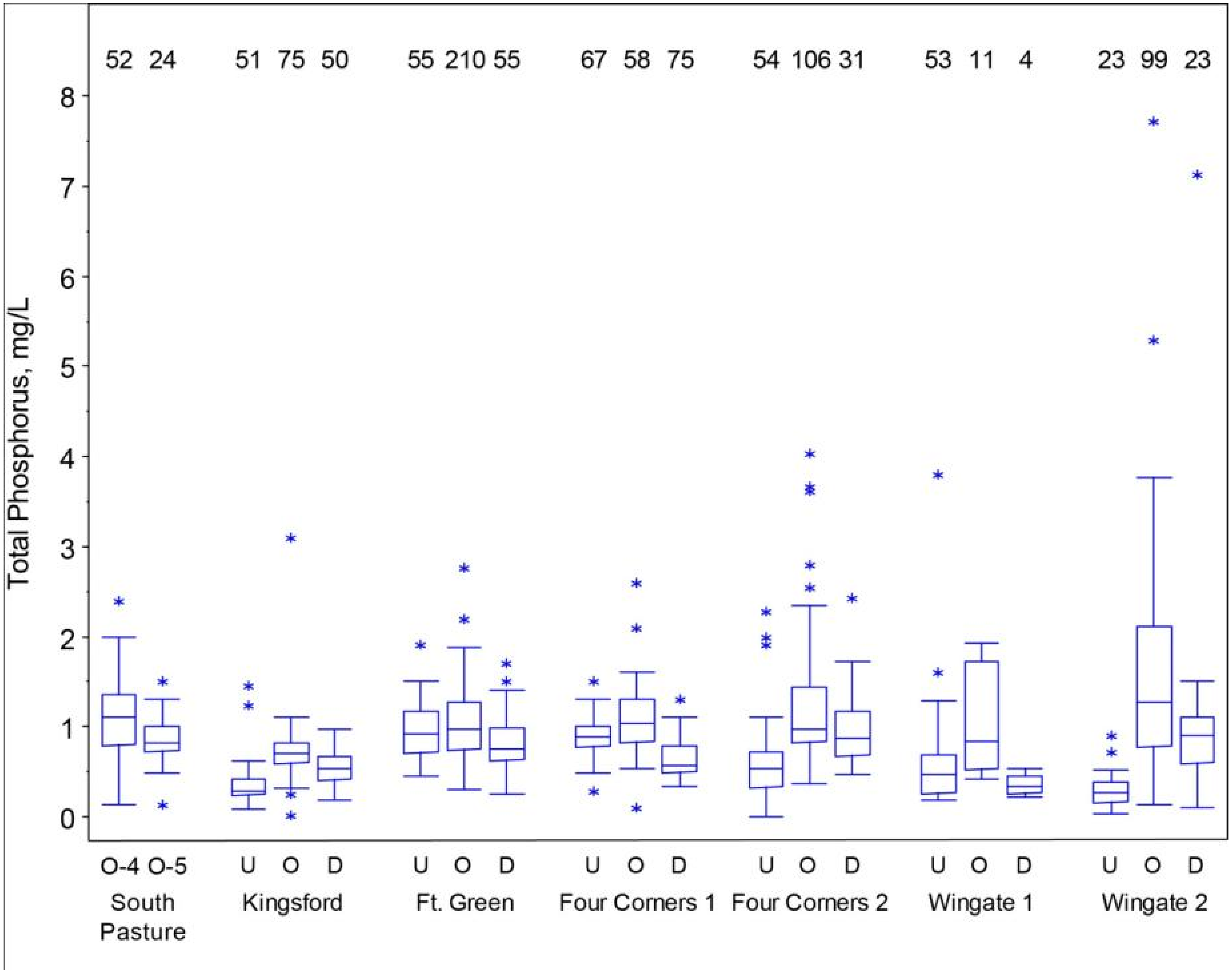


FIGURE 20
Turbidity Monitoring Data for Mine Outfalls and Upstream and Downstream Locations
Central Florida Phosphate District, Florida



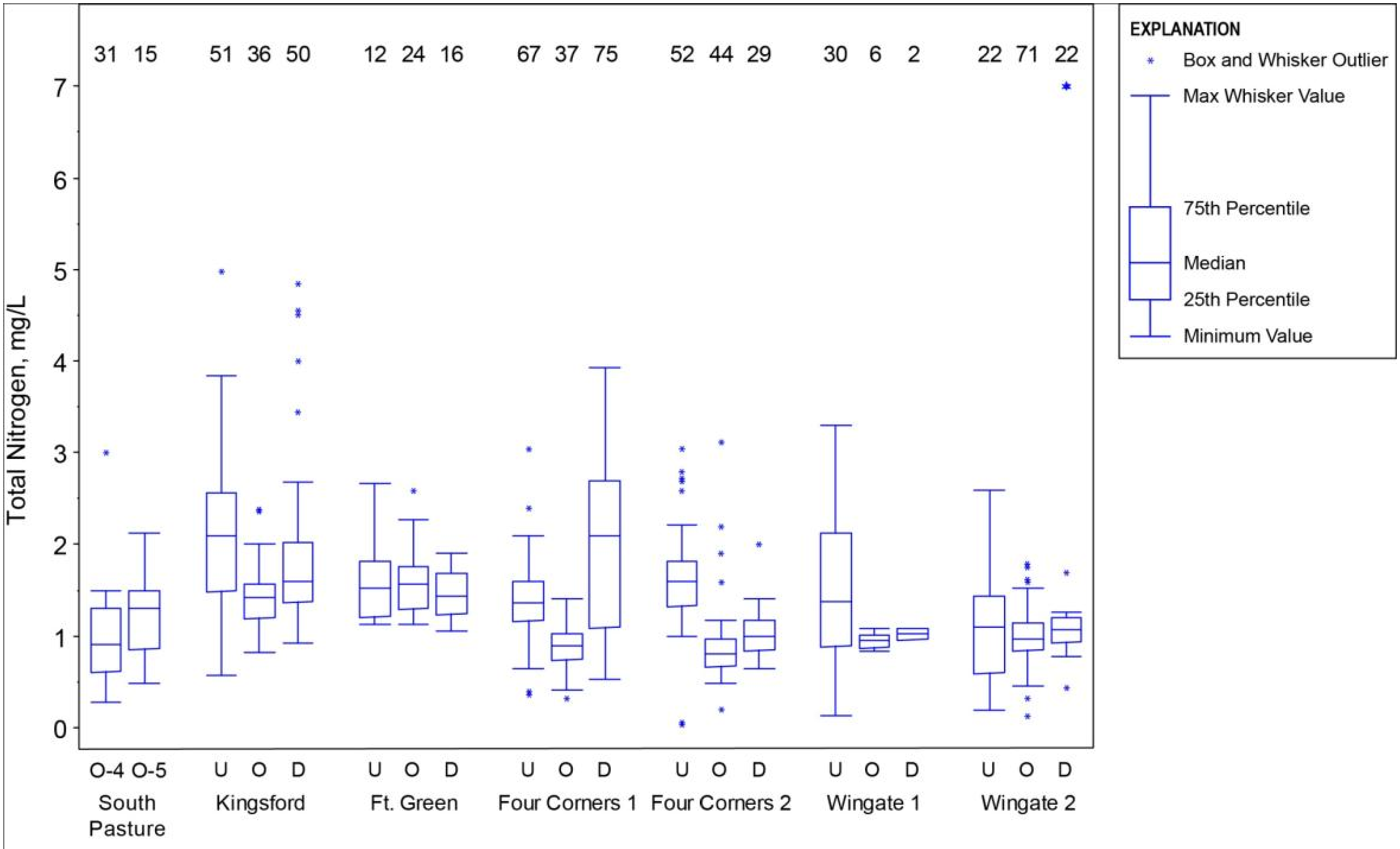
U = Upstream; O = Outfall; D = Downstream
Frequency of SWQ Criteria Exceedances Listed at the Top of Each Plot
Green Horizontal Line at SWQ Criteria

FIGURE 21
Total Phosphorus Monitoring Data for Mine Outfalls and Upstream and Downstream Locations
Central Florida Phosphate District, Florida



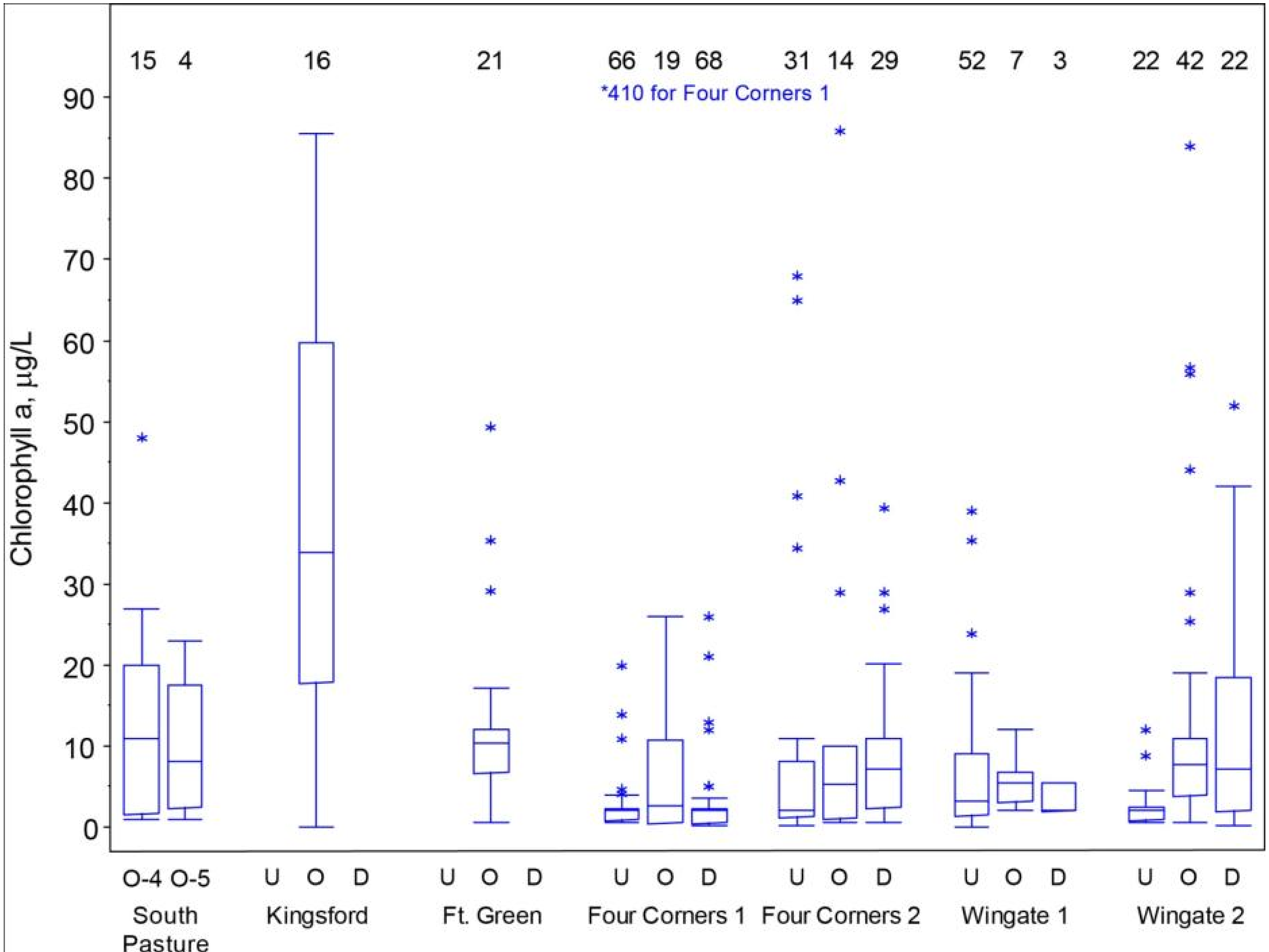
U = Upstream; O = Outfall; D = Downstream
Number of Results Listed at the Top of Each Plot

FIGURE 22
Total Nitrogen Monitoring Data for Mine Outfalls and Upstream and Downstream Locations
Central Florida Phosphate District, Florida



U = Upstream; O = Outfall; D = Downstream
Number of Results Listed at the Top of Each Plot

FIGURE 23
Chlorophyll *a* Monitoring Data for Mine Outfalls and Upstream and Downstream Locations
Central Florida Phosphate District, Florida



U = Upstream; O = Outfall; D = Downstream
Number of Results Listed at the Top of Each Plot

The time series plots and box and whisker plots display all the data available for each station.[2] However, not all groups of stations (upstream, outfall, and downstream) had the same numbers of observations. A statistical analysis was performed with the Wilcoxon Signed Rank test to evaluate the relationship between surface water quality conditions at upstream locations and the corresponding outfall and downstream stations using only data from dates when all three locations in a group were sampled. This is a non-parametric test that evaluates data for individual pairs of stations to determine whether there is a significant difference between the two for a particular parameter; it is valid whether the data are normally distributed or not.

Table 12 summarizes the Wilcoxon Signed Rank test results for the same parameters plotted in the box and whisker diagrams by listing which station in a pair has significantly higher values, or if there is not a significant difference. The test uses the signs and magnitudes of differences between data pairs collected on the same dates. No comparison was made if there were less than 10 pairs of data points for a pair of stations. This is consistent with the FDEP procedure for evaluating potentially impaired water body segments for the 303(d) planning list, which also requires a minimum of 10 data points (Chapter 62-303, F.A.C.).

The paired specific conductance data showed trends that were similar to the overall datasets; specific conductance values at outfall and downstream stations were greater than values at upstream stations. Dissolved oxygen values were higher at outfall and downstream stations than at the corresponding upstream stations. Paired pH data were higher at the outfall and downstream stations than at the upstream locations except at the Fort Green Mine, where pH was higher at the upstream station than at the outfall. Turbidity was higher at the outfalls than at the upstream locations for the two active mines with at least 10 upstream-outfall data pairs (Four Corners Outfall 1, and Wingate Outfall 2). The opposite was true for the closed mines (Fort Green and Kingsford), where turbidity was higher at the upstream stations than at the outfalls. There was not a significant difference between turbidity values at most of the upstream-downstream station pairs. The paired total phosphorus trends were also generally consistent with the overall datasets. Total phosphorus was higher at outfalls than at corresponding upstream stations, although two upstream stations had higher total phosphorus values than the downstream stations. Total nitrogen was generally higher at the upstream stations than at the outfalls and downstream stations. Only 3 of the 6 mines had at least 10 chlorophyll *a* data pairs. Chlorophyll *a* was higher at the outfalls than at the upstream stations for Four Corners Outfall 1 and Wingate Outfall 2, but there was not a significant difference between the Four Corners Outfall 2 station and the corresponding upstream station. Two of the three upstream-downstream station pairs with 10 or more chlorophyll *a* data points had no significant difference, while chlorophyll *a* was higher at the Wingate Outfall 2 downstream station than at the upstream station.

These data summaries document that for these example discharges from ongoing phosphate mines, some of the mine discharges showed elevated specific conductance, total phosphorus, turbidity, and chlorophyll *a* values compared to the corresponding background locations. In some, but not all, cases downstream values were correspondingly higher than the background levels, reflecting an in-stream influence of the discharge. For three of the outfall monitoring locations, average total nitrogen concentrations were lower for the mine discharges than at the background stations. These observations must be tempered by the high variability in the number of samples included in these average values, and the relatively low number of values. As documented elsewhere in the AEIS, the mines only discharge when their respective recirculation systems exceed their cumulative storage capacities. The low number of monitoring values is reflective of the low number of discharge events for this period of record.

[2] The NPDES permits require monthly monitoring, but only when discharges occur, so there are months without data because there were no discharges and this varied by mine.

TABLE 12
Water Quality Comparisons for Outfall, Upstream, and Downstream Stations at Mine NPDES Outfalls
Table indicates which station in pair has significantly higher values based on Wilcoxon Signed Rank Test (α = 0.05)

Station Pairs	Specific Conductance	Dissolved Oxygen	pH	Turbidity	Total Phosphorus	Total Nitrogen	Chlorophyll *a*
Four Corners Mine Outfall 1							
Upstream vs. Outfall	Outfall	Outfall	Outfall	Outfall	Outfall	Upstream	Outfall
Upstream vs. Downstream	Downstream	Downstream	Downstream	NSD	Upstream	Downstream	NSD
Four Corners Mine Outfall 2							
Upstream vs. Outfall	Outfall	Outfall	Outfall	—	Outfall	Upstream	NSD
Upstream vs. Downstream	Downstream	Downstream	Downstream	NSD	Downstream	Upstream	NSD
Wingate Mine Outfall 1							
Upstream vs. Outfall	—	—	NSD	NSD	—	—	—
Upstream vs. Downstream	—	—	NSD	—	—	—	—
Wingate Mine Outfall 2							
Upstream vs. Outfall	Outfall	Outfall	Outfall	Outfall	Outfall	NSD	Outfall
Upstream vs. Downstream	Downstream	Downstream	Downstream	NSD	Downstream	NSD	Downstream
Fort Green Mine							
Upstream vs. Outfall	Outfall	–	Upstream	Upstream	Outfall	—	—
Upstream vs. Downstream	NSD	—	Downstream	NSD	Upstream	Upstream	—
Kingsford Mine							
Upstream vs. Outfall	Outfall	Outfall	Outfall	Upstream	Outfall	Upstream	—
Upstream vs. Downstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	—

Wilcoxon Signed Rank Test used only data from dates when all three stations (outfall, upstream, and downstream) were sampled.
NSD = No significant difference
— = Less than 10 data pairs, no statistical analysis

5.3 Indirect Effects Monitoring

Indirect effects of phosphate mine discharges on downstream reaches of the receiving water body may be difficult to detect solely through water quality monitoring because of low frequency of mine discharges and the variable nature of stream flow. Discharges generally only occur when rainfall accumulations lead to the recirculation systems being full because of seasonal accumulations or because of extended durations and/or multiple large storm events. Thus, mine discharges are most likely to occur when stream base flows are elevated because of the same drivers – large storms, extended durations of rainfall, or gradual seasonal buildup of watershed storage and base flow. Under such scenarios, water quality effects of mine discharges may be quickly diluted by stream base flow, making them difficult to document. However, these same conditions may make it less likely that the discharges would have an effect on the aquatic biological communities associated with the water body.

For these reasons, aquatic biological monitoring is often used to provide an indirect measure of potential water quality effects of a discharge on the receiving stream. The results of two examples of such monitoring activities are described below.

5.3.1 Horse Creek Stewardship Program Aquatic Biological Studies

Of the widely varied studies of fish and macroinvertebrate communities in the AEIS study area pertinent to review of phosphate mining effects, one of the most relevant is the long-term monitoring of these communities conducted under the Horse Creek Stewardship Program (HCSP). This environmental monitoring program was established through the collaborative efforts of Mosaic and the Peace River-Manasota Regional Water Supply Authority (PRMRWSA) to monitor for potential mining-related effects on Horse Creek that could affect PRMRWSA's withdrawal of raw water for potable water supply purposes.

Under this program, monitoring of fish and macroinvertebrate communities at fixed locations in Horse Creek has been conducted since 2003. The monitoring program includes assessments of fish and macroinvertebrate communities three times per year (March-April, July-September, and October-December) at the four sites shown in Figure 24, all of which are along the main stem of Horse Creek (Entrix, 2010a). The upstream station (HCSW1) is slightly less than 8 miles downstream of the nearest phosphate mine outfall. Monitoring of macroinvertebrates is conducted in accordance with FDEP-approved procedures for stream condition index (SCI) analyses. Figure 25 summarizes SCI scores for each of the four stations for monitoring years 2003 through 2008. SCI scores for the upstream station remained in the "healthy" range for this entire study period as did those for the most downstream station. Station HCSW2 consistently was characterized as "impaired" based on its low SCI scores; these were attributed to the influence of a large wetland system adjacent to this monitoring location, which influenced the prevailing flow and water quality conditions. The third monitoring location, HSCW3, variably reflected SCI scores in either the impaired or healthy range. For all four stations, considerable season-to-season and year-to-year variability was evident. None of these patterns appear related to phosphate mining discharges from the two outfalls from the Fort Green Mine in the upper portion of the Horse Creek watershed.

Biological Research Associates (BRA) presented an overview of historical macroinvertebrate monitoring data in the Horse Creek watershed (BRA, 2006b), including data collected prior to HCSP sampling. On the basis of that review, BRA concluded that macroinvertebrate abundance and richness in this creek were greater during the dry season than during the wet season. The lower abundance and richness during the wet season were attributed to macroinvertebrates being flushed out and/or being diluted by greater stream flows during the wet season (BRA, 2006b). These relationships may be relevant as future mining effects are evaluated for individual mines and/or for combinations of mines which may have overlapping operational periods affecting lands in the Horse Creek watershed.

Monitoring of fish species present at these same four stations from 2003 through 2008 produced the species richness (number of species per station) information summarized in Figure 26 (Entrix, 2010a). Through 2008, a total of 41 fish species was collected from these four sampling sites. The number of fish species found at the upstream locations was generally lower than at the locations further downstream, perhaps reflecting the increased opportunity for fish movements up into the watershed from the lower reaches of the system as well as increased habitat diversity in higher order stream reaches. Entrix (2010a) indicated that prior to 2004 when Hurricane Charley caused substantial impacts across this watershed, species richness and diversity were lowest at the upstream site and highest at the location furthest downstream in the study area, and stated that "this pattern of longitudinal zonation of increasing species diversity with increasing stream order is typical of stream systems (Harrel et al., 1967; Whiteside and McNatt, 1972; Sheldon, 1988)." Fish community species richness and diversity were not viewed as related to mining activities in the uppermost reaches of the creek watershed during this period of monitoring. Recovery from Hurricane Charley effects has been suggested by the more recent years of monitoring. In light of the locations of the Applicants' Preferred Alternatives, this background information regarding long- term fish community composition and structure will be of value in assessing the potential for phosphate mining effects on the Horse Creek watershed in the future.

5.3.2 Wingate Creek Mine Discharge Monitoring for Effects on Macroinvertebrates

The existing Wingate Creek Mine's industrial operations permit issued by FDEP is unique in that it includes a requirement for an annual wet season evaluation of macroinvertebrate communities upstream and downstream from each of the two NPDES permit-authorized outfalls from this mine. The permit conditions call for monitoring if any outflow through the specific outfall occurs within the 12 months prior to that year's wet season (August - October); monitoring is conducted following FDEP's standard operating procedure (SOP; DEP-SOP-001/01 FS 7420, *Stream Condition Index (D-Frame Dipnet) Sampling.*) The permit conditions stipulate that, "At the time of sampling, the appropriate outfall shall be discharging effluent to the receiving stream."

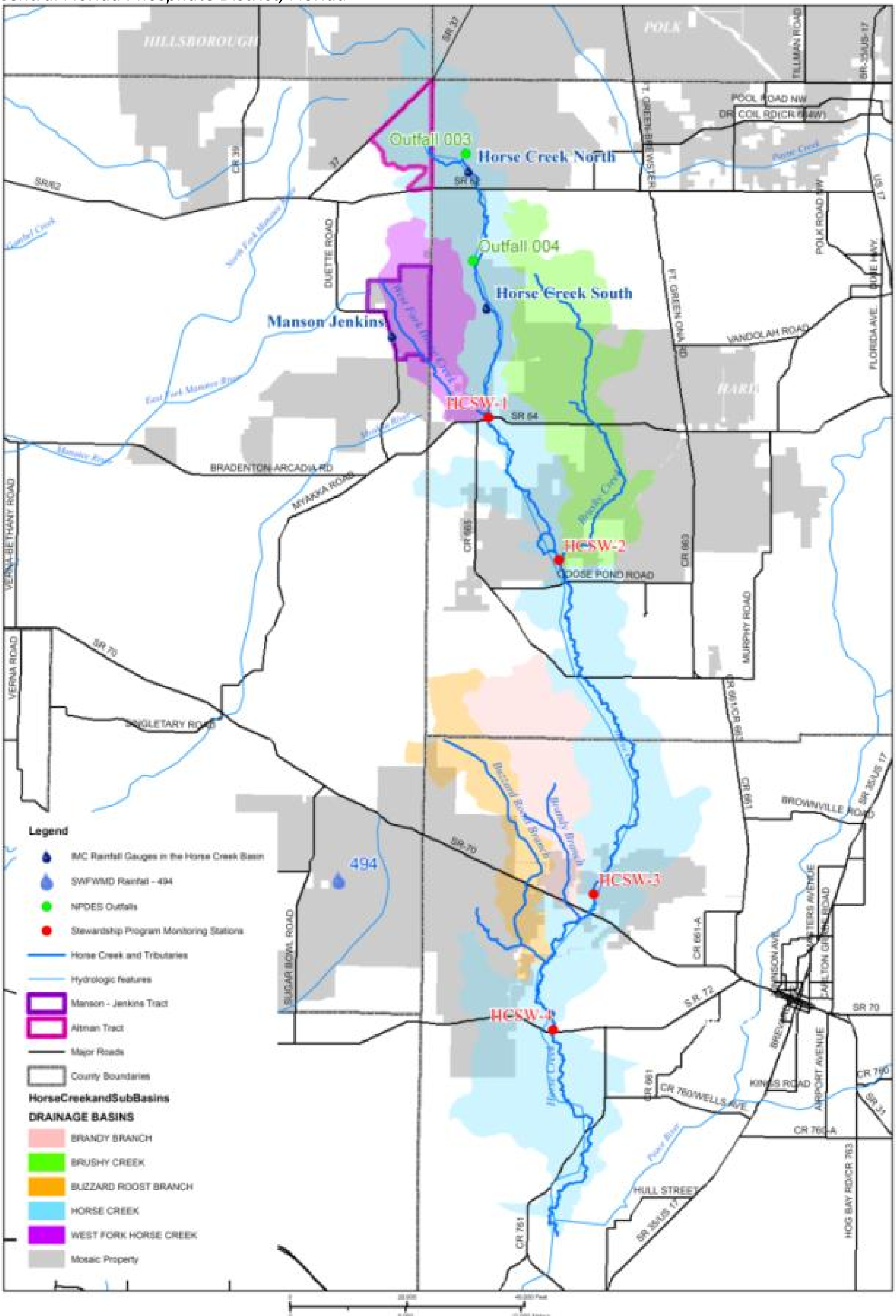
The two permitted Outfalls (D-001 and D-002) discharge to Wingate Creek and Johnson Creek, respectively; these creeks are tributaries of the Myakka River. For Outfall D-002, the upstream and downstream reaches monitored are in Johnson Creek, with each reach defined as a 100-meter length of the creek. Outfall D001 discharges to Wingate Creek and the downstream station is just upstream of the confluence of Wingate Creek with Johnson Creek. No upstream portion of Wingate Creek was suitable as an upstream reference site; therefore, the background monitoring station is in the Myakka River at a location considered as comparable in habitat characteristics as possible to the downstream monitoring station in Wingate Creek. Each monitoring location also is represented by a 100-meter length of the applicable water body. The station locations are shown in Figure 27.

The monitoring records available for 2008, 2009, and 2010 are summarized in Table 13. No discharges from Outfall D-001 occurred during this 3-year period; thus, the limited data reported relevant to this site may be useful for future reference, but cannot be interpreted in terms of assessing potential effects of mine-related discharges. For Outfall D-002, discharges did occur during each of the 3 years, with discharge rates ranging from near zero to a peak rate of up to approximately 19 million gallons per day (mgd). Macroinvertebrate monitoring only occurred during an actual period of discharge for the first year (2008). For both 2009 and 2010, the macroinvertebrate surveys were conducted during periods when no effluent was being released; in both years the most recent discharge had occurred several weeks prior to the stream monitoring effort.

In 2009, both upstream and downstream SCI scores relevant to Outfall D-002 suggested an impaired stream condition. This was in contrast to the 2010 results, which suggested a healthy stream condition. The 2008 monitoring results (healthy upstream but impaired downstream conditions) may indicate a short-term invertebrate community response to high rates of mine discharge. Where such communities are numerically dominated by insect larval forms with short-duration reproductive strategies, recolonization rates may be high enough to result in a rapid recovery to community characteristics similar to those of upstream reference habitats. What may be most relevant is that during both 2009 and 2010, the upstream and downstream values were comparable, suggesting no substantive differences in the macroinvertebrate communities approximately 3 weeks after the last mine discharge from Outfall D-002. If there were short-term effects on the macroinvertebrate communities, recovery occurred within a very short time.

On the basis of these monitoring records, there were no definitive indications of phosphate mine-related indirect water quality impacts on the aquatic communities monitored downstream of the Wingate Creek Mine and Fort Green Mine discharges.

FIGURE 24
Aquatic Biological Monitoring Stations in Horse Creek, Horse Creek Stewardship Program
Central Florida Phosphate District, Florida

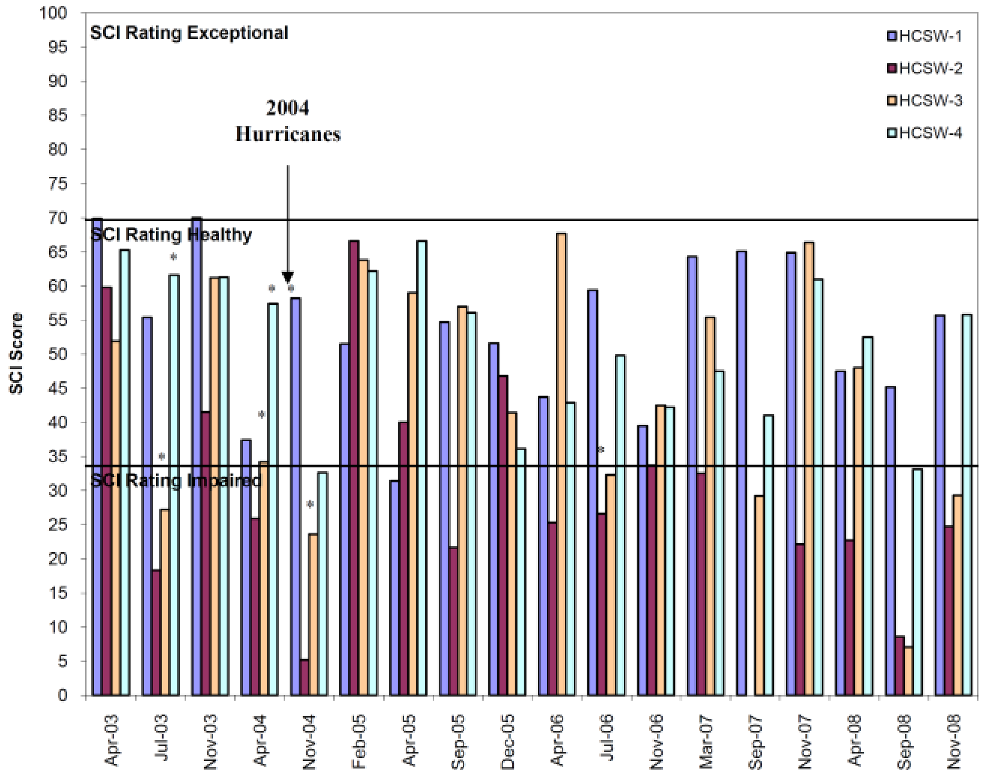


Source: Entrix, 2010a

FIGURE 25

Macroinvertebrate Community Assessment Results (SCI Scores), 2003 - 2008, Horse Creek Stewardship Program

Central Florida Phosphate District, Florida

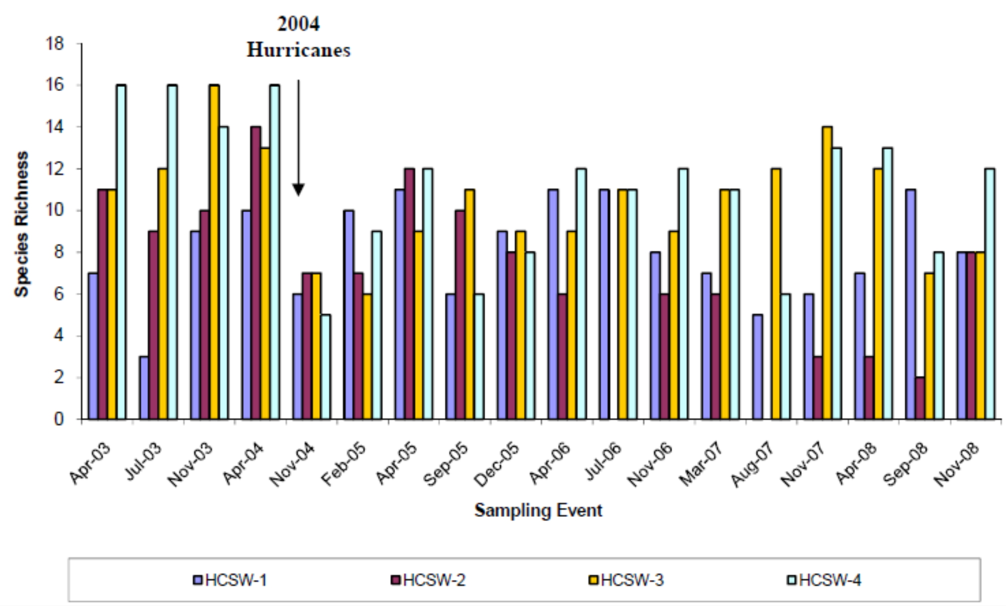


Source: Entrix, 2010a

FIGURE 26

Fish Community Assessment Results (Species Richness), 2003 - 2008, Horse Creek Stewardship Program

Central Florida Phosphate District, Florida

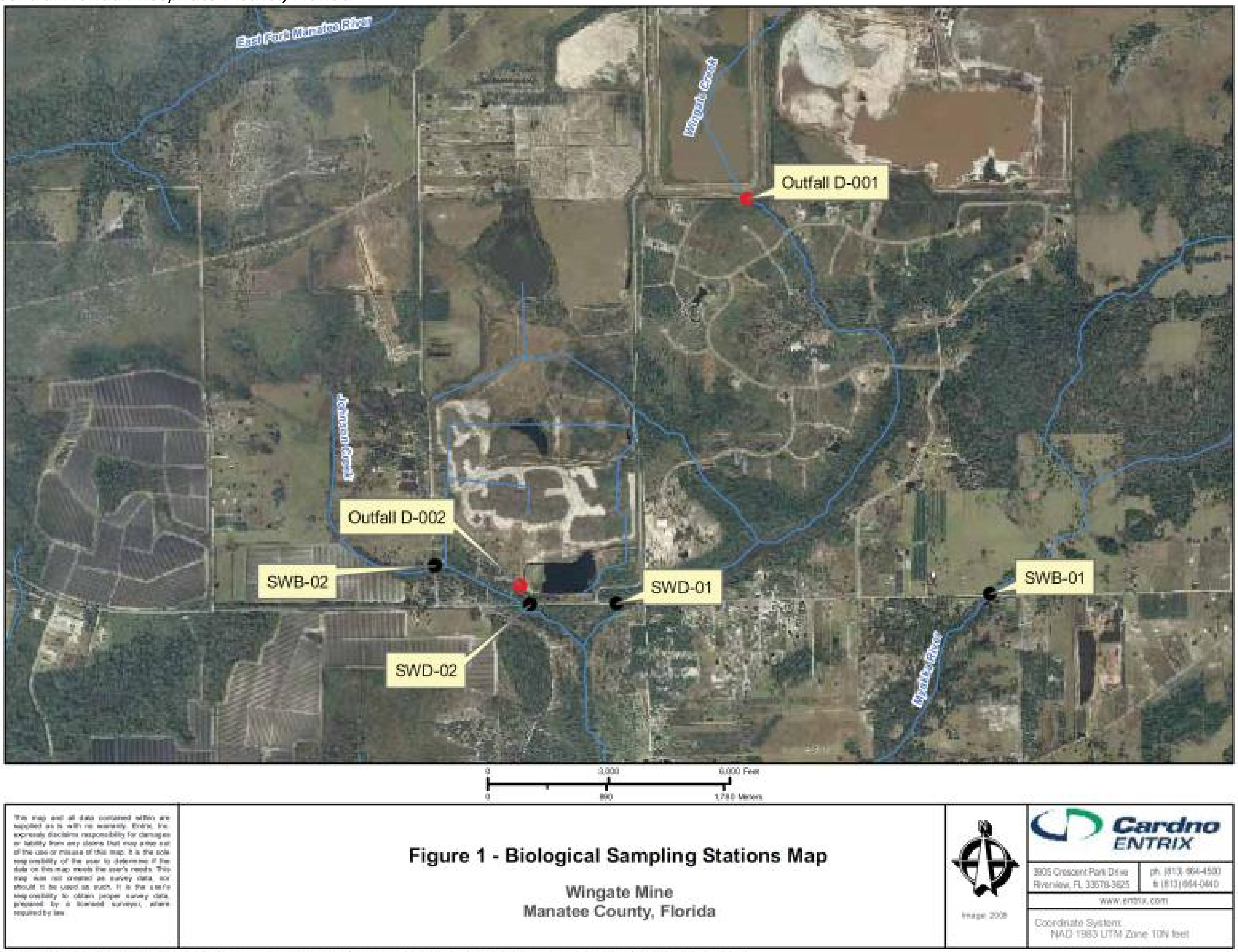


Source: Entrix, 2010a

FIGURE 27

Macroinvertebrate Monitoring Stations for the Wingate Creek Mine (NPDES Permit No. FL0032522)

Central Florida Phosphate District, Florida



(Source: Entrix, 2010a).

TABLE 13
Stream Condition Index Scores for Wingate Creek Mine's Outfalls D-001 and D-002

		Outfall D-001		Outfall D-002	
Year		**Reference**	**Downstream**	**Upstream**	**Downstream**
2008	Flow Condition	No Discharge in Prior Year; No monitoring		High rate of effluent flow (>10 mgd)	
	SCI Score	NA	NA	50	32
2009	Flow Condition	No Discharge in Prior Year; Monitored Per Permit Condition		No Effluent Flow During Sampling, but Monitored	
	SCI Score	Inadequate Flow; No Sampling	46	29	28
2010	Flow Condition	No Discharge in Prior Year; No monitoring		No Effluent Flow During Sampling, but Monitored	
	SCI Score	NA	NA	36	42

Notes.
For these scores, evaluations were as follows per the FDEP SOP specifications: SCI scores of 71-100 = Exceptional; SCI scores of 35-70 = Healthy; SCI scores of 0-34 = Impaired. FDEP has recommended using an SCI score threshold of 40 to differentiate healthy vs. impaired stream habitats.
(Source: BRA, 2008; Entrix, 2010a; Entrix, 2010e; Cardno ENTRIX, 2011b)

5.4 Storage Reservoir Spills

Historically, there have been a number of spills from clay settling areas (CSAs) associated with the mining process and gypsum stacks associated with the chemical plant facilities that have had a direct effect on the adjacent stream at the time of occurrence. At the chemical plants, phosphorus (or phosphoric acid) is extracted from the phosphate rock; the solid waste by-product of the process is calcium sulfate, also called phosphogypsum or just gypsum. Phosphogypsum is stored in large mounds commonly called "stacks." The chemical plants' water containing the phosphogypsum is pumped to ponds on top of the stacks where the phosphogypsum is settled out and the process water returned to the chemical plant (USEPA, 2012c). The mining process includes the beneficiation of the matrix (ore) where the sand tailings and phosphatic clays are separated from the phosphate rock. The phosphatic clays are pumped from the beneficiation plant to the CSAs where the clays settle out by gravity and the water is returned to the mine recirculation system. Table 14 lists, in reverse chronological order, some notable spills from phosphate mines and chemical plants in recent history. These spills include breaches from both chemical plants (i.e., gypsum stacks) and CSAs. Included also are large releases from tanks and pipelines operated by phosphate companies.

TABLE 14
Historical Spills from Stacks and CSAs in the CFPD

Date	Source	Description
May 2011	Mine	About 170 million gallons of dredged material from pipeline leaks were released into Bishop Harbor.
September 2004	Chemical Plant	A dike at the top of a gypsum stack in Riverview, Florida, broke after Hurricane Frances. 60 million gallons of acidic wastewater discharged into Archie Creek, a tributary of the Hillsborough River.
December 1997	Chemical Plant	Large release of phosphogypsum process water related to a dam break from the Mulberry phosphate facility as a result of a hurricane. Estimated 50 million gallons of acidic water released into the Alafia River.
November 1994	Mine	A dam failure at the IMC-Agrico Company Hopewell Mine in Hillsborough County caused about 482 million gallons of water to spill from a CSA. The water spilled into nearby mine cuts and thereafter drained to wetlands and the North Prong of the Alafia River.

TABLE 14
Historical Spills from Stacks and CSAs in the CFPD

Date	Source	Description
October 1994	Mine	An internal CSA dam in IMC-Agrico Company's (IMC) Payne Creek Mine failed. This resulted in a release of 1.8 billion gallons of wastewater onto CF Industries Hardee Mine property, most of which was contained in mine cuts. About 127 million gallons were discharged into Hickey Branch which flows into Payne Creek and then into the Peace River.
June 1994	Chemical Plant	A sinkhole opened up within the gypsum stack releasing gypsum and water into groundwater at the IMC-Agrico New Wales chemical plant
October 1993	Chemical Plant	A spill of undisclosed amount of acidic water into Archie Creek from the Cargill facility East Tampa Plant near Gibsonton.
May 1988	Chemical Plant	Release of about 40,000 gallons of acidic waste from a storage tank into the Alafia River.
December 1971	Mine	A clay settling area owned by Cities Service Company near Fort Meade spilled about 1 billion gallons of clay laden water into Whidden Creek and eventually into the Peace River. The clay laden water caused extensive damage to fish and wildlife down to Charlotte Harbor (USEPA, 1974).
March 1967	Mine	A rupture of a retention dike near Fort Meade, Florida, released 2 million gallons of clay-laden water into the Peace River. The accident killed a million fish and its effects did not subside until 2 years later.

Sources: Alvarez, 2011, personal communication; ManaSota-88, 2008

No new gypsum stacks are proposed for the future mining in the southern portions of the CFPD addressed in the AEIS. One facility with a gypsum stack that drains into the Peace River Basin on Whidden Creek, which is between Fort Meade and Bowling Green, closed and since 2006 most of the water stored within its stack has been treated and discharged under the authority of an NPDES permit (although a small volume of treated discharge will continue for years into the future, currently about 0.6 cubic foot per second on average). Consequently, water quality effects from chemical plants and gypsum stacks are not relevant to the present applications and offsite alternatives.

The effects of a spill from CSAs may entail both flooding- and sediment-related impacts to the downstream environments. The earthen dikes that form the CSAs are regulated primarily under Chapter 62-672, F.A.C. While biological effects occurring after a spill could be devastating to biota, natural systems do tend to recover over time. The historical catastrophic CSA dam failure events are not known to have caused injury or death to humans.

In general, after the advent of new regulations and oversight that began in the mid-1970s, the occurrence of dam failures has decreased substantially. Spills are highly disruptive to mining operations, as well as the environment and all parties (owners and regulators) try to design and maintain facilities that do not fail. However, it is impossible to guarantee that there would not be a combination of events that could occur in the future, causing an accidental dam failure. If a failure were to occur, the responsible owners must remediate and take emergency actions to contain, repair, and mitigate the damage. The risk of such occurrences is viewed as minimal with proper implementation of the current rules regarding earthen dam design and construction.

6.0 Effects of Phosphate Mine Reclamation on Surface Water Quality

Lewelling and Wylie (1993) evaluated hydrology, groundwater quality, and surface water quality for the U.S. Geological Survey (USGS) and the Florida Industrial and Phosphate Research Institute (FIPR Institute) in several small drainage basins in the "four corners area" of west-central Florida, where the applicable boundaries of Hillsborough, Polk, Manatee, and Hardee Counties meet. The surface water evaluation included 3 unmined basins that ranged from 90 to 420 acres in size, and 4 basins ranging in area from 47 to 250 acres that had been mined for phosphate rock and subsequently reclaimed using several different methods. Two of the former phosphate mining areas were reclaimed by backfilling with clay, one was backfilled with sand tailings and capped with overburden, and one was backfilled solely with overburden.

Surface water samples were collected during an initial reconnaissance evaluation and also during routine sampling that occurred during base flow and high flow conditions in most of the basins from November 1988 through October 1990. Two basins that were reclaimed using clay only had sufficient water for sampling during 2 routine sampling events. The number of samples collected from the 3 unmined basins and the other 2 mined and subsequently reclaimed basins ranged from 11 to 16 at each site. Reconnaissance samples were analyzed for nutrients, major ions, trace metals, and radionuclides. Routine samples were analyzed for alkalinity, chloride, sulfate, specific conductance, pH, orthophosphorus, dissolved solids, and suspended solids. USGS observations included the following:

- The major constituents in water from the streams in the study basins were the cations calcium, magnesium, sodium, and potassium; and the anions sulfate, chloride, fluoride, nitrate, and carbonate and bicarbonate.
- Parameters for which there were no observed differences between the reclaimed and unmined basins included color, nitrate/nitrite, sulfate, sodium, fluoride, potassium, and total dissolved solids.
- Analysis of water samples collected from streams during base flow and high flow conditions indicated that the water chemistry of surface waters in the unmined and reclaimed basins generally was similar. Higher concentrations of magnesium, orthophosphorus, alkalinity, and calcium were detected in water from streams at some of the reclaimed basins.
- Radiological evaluations included gross-alpha and radium-226. Gross alpha activity levels in water samples from streams in unmined basins ranged between 0.34 and 3.54 picocuries per liter (pCi/L), compared to 0.34 to 10.2 pCi/L from streams in mined basins. All values were less than the Florida surface water standard of 15 pCi/L. All measurements of radium-226 activity levels were below the Florida surface water standard of 5 pCi/L.
- The hydrologic characteristics and surface and groundwater quality of two reclaimed basins where overburden was used to either fill the mine cuts or cap sand tailings used to fill mine cuts were similar to those of the unmined basins.
- In contrast, the hydrologic characteristics and surface and groundwater quality of two reclaimed basins where either clay or a clay/sand mix was used to support reclamation differed somewhat from the unmined basins in exhibiting reduced runoff because of additional surface storage; increased uranium-234 activity levels at one recently reclaimed site; and more rapid runoff response to rainfall, reduced flow rates, greater depths to the water table, and a more gradual water table response to recharge at a more mature reclaimed site[3].

Overall, the surface water quality data gathered by USGS over this 2-year study period indicated that all the basins were in compliance with the surface water quality standards applicable at the time of the study (Lewelling and Wylie, 1993).

7.0 Effects of Evolving Numeric Nutrient Criteria on CFPD Phosphate Mining

Nutrient pollution is one of America’s most widespread, costly, and challenging environmental problems. Phosphorus is one of the primary nutrients that regulates algal and macrophyte growth in natural waters, particularly in freshwater. Phosphate, the form in which almost all phosphorus is found in the water column, can enter the aquatic environment in several ways. Natural processes transport phosphate to water through atmospheric deposition, groundwater percolation, and terrestrial runoff. Municipal treatment plants, industries, agriculture, and domestic activities can also contribute to phosphate loading through direct discharge and natural transport mechanisms.

Similar to phosphorus, nitrogen is ubiquitous and naturally present in the environment. Like phosphorus, it is a nutrient essential for normal plant and animal growth. At elevated concentrations, however, nitrogen has been

[3] The four Application mines are not proposing to use the clay/sand mix in reclamation. Future reclamation will utilize overburden.

shown to contribute to accelerated and enhanced algal and macrophyte growth patterns that can lead to water body eutrophication. Traditionally, nitrogen has been considered the limiting nutrient in estuarine and marine water systems, while phosphorus has been considered the limiting nutrient in freshwater systems. In transitional environments, both of these nutrients can be limiting factors under different ambient conditions. Even within a single water body, nutrient limitation can shift spatially (different limiting nutrients in different segments) and temporally (different limiting nutrients during different seasons). Equally important, if only phosphorus is limited in upstream freshwaters, high nitrogen loads may be delivered downstream to estuarine and marine environments, potentially eliminating nitrogen limitation in those waters and causing algal blooms, which can result in decreased dissolved oxygen levels and algal turbidity. Thus, both USEPA and FDEP have adopted the position that development of numeric nutrient criteria (NNC) is needed for both parameters in fresh and estuarine/coastal waters.

Both FDEP and the USEPA are working to develop water quality standards to prevent nutrient pollution in Florida rivers, perennial streams, lakes, and estuaries from Tampa Bay to Biscayne Bay, including Charlotte Harbor. These NNC establish levels for nitrogen, phosphorus, and chlorophyll *a*. FDEP's standards also include biological conditions that must be met to protect healthy waterways.

The USEPA's criteria development follows its January 2009 Clean Water Act determination that NNCs are necessary in Florida – whether adopted by the state or USEPA. Following that determination, USEPA entered into a Consent Decree with Florida Wildlife Federation and several other groups in August 2009. Under the Consent Decree, USEPA committed to a schedule to propose and finalize nutrient pollution rules covering Florida's inland and coastal waters if the state did not act first. The Consent Decree has since been revised, and some deadlines have been extended.

Pursuant to the Consent Decree, USEPA finalized its Inland Rule in December 2010, promulgating NNC for lakes, springs and flowing waters in Florida. In February 2012, a federal district court upheld part of the Inland Rule against various challenges and sent part of the Rule back to USEPA for further clarification.

In June 2012, the state submitted its own rule to USEPA for review pursuant to section 303(c) of the CWA. The state rule covered many of the same waters addressed by USEPA's Inland Rule as well as some estuaries. USEPA approved Florida's rule on November 30, 2012, but that rule is not yet effective under state law. Under the Consent Decree, USEPA was still required to move forward with its federal rules for the waters not covered by the state's rule. On November 30, 2012, USEPA proposed NNC for Florida's estuaries and coastal waters and also proposed a new rule covering those parts of the Inland Rule that were remanded by the court. Pursuant to the Consent Decree, USEPA must finalize the new Inland Remand Rule and the Coastal Rule by August and September of 2013, respectively. However, the agency is prepared to not move forward with – or withdraw– its rules for any waters that become covered by state law that meets the requirements of the Clean Water Act.

The only NNC that have taken full effect are those portions of USEPA's Inland Rule applicable to lakes and springs and FDEP's estuary criteria, which cover some state estuaries. The estuary criteria are set out in Section 62-302.532, F.A.C. For flowing waters and the remainder of the state's marine waters, the applicable water quality standards remain the state narrative criteria set out in subsection 62-302.530(47), F.A.C., as well as any established restoration goals in the form of TMDLs.

Tables 16, 17, and 18 summarize the results of sampling for total phosphorus, total nitrogen, and chlorophyll *a* for several mine outfalls, plus upstream and downstream locations, from 2001 through 2011. It is important to note that these data are provided for informational purposes only. The sampling procedures used to produce this data, and the sampling procedures that may be required to determine NNC compliance, may differ. The NNC limits for total phosphorus and total nitrogen shown are taken from Section 62-302.532, F.A.C.; the standard described in that statute allows for no more than one exceedance in any three calendar year period. The chlorophyll *a* limit shown is not in the NNC rule; rather it is the value FDEP uses to assess impairment.

TABLE 16
Total Phosphorus Annual Geometric Mean Values (mg/L) for Mine Outfall, Upstream and Downstream Stations

Mine/Station	Year										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
South Pasture											
Outfall 4	0.52	0.79	0.93	1.02	0.98	1.22	1.95	—	—	—	—
Outfall 5	—	0.62	0.77	1.01	0.88	—	—	—	—	—	—
Kingsford (inactive)											
Upstream	—	—	—	—	—	—	—	0.23	0.30	0.37	0.35
Outfall	—	—	—	—	—	—	—	0.69	0.77	0.40	0.62
Downstream	—	—	—	—	—	—	—	0.52	0.52	0.46	0.59
Fort Green (inactive)											
Upstream	—	—	—	—	—	1.12	1.17	1.25	0.78	0.71	0.69
Outfall	—	—	—	—	—	1.18	1.24	1.27	0.89	0.77	0.82
Downstream	—	—	—	—	—	0.91	1.04	0.94	0.66	0.69	0.62
Four Corners 1											
Upstream	—	—	—	—	0.85	0.94	0.94	0.75	0.94	0.78	—
Outfall	0.77	0.74	0.86	1.43	1.11	0.57		0.95	1.38	—	—
Downstream	—	—	—	—	0.56	0.55	0.65	0.65	0.71	0.47	—
Four Corners 2											
Upstream	—	—	0.36	0.54	0.47	0.54	0.76	0.62	0.41	0.13	—
Outfall	—	—	1.20	1.92	1.31	1.10	1.56	0.74	0.89	1.05	—
Downstream	—	—	0.67	1.26	0.98	1.03	1.19	0.57	0.90	0.80	—
Wingate 1											
Upstream	—	—	—	—	0.24	0.43	0.70	0.64	0.59	—	—
Outfall	—	—	—	—	0.50	—	1.25	—	—	—	—
Downstream	—	—	—	—	—	—	0.34	—	—	—	—
Wingate 2											
Upstream	—	—	—	—	—	—	—	0.19	0.39	—	—
Outfall	—	—	—	0.13	1.30	0.62	1.69	1.17	0.90	—	—
Downstream	—	—	—	—	—	—	—	0.91	0.58	—	—

Note: — indicates less than four data points for that year.
NNC limit for TP = 0.49 mg/L

TABLE 17
Total Nitrogen Annual Geometric Mean Values (mg/L) for Mine Outfall, Upstream and Downstream Stations

	Year										
Mine/Station	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
South Pasture											
Outfall 4	0.74	0.61	0.93	0.85	0.99	—	—	—	—	—	—
Outfall 5		0.64	0.47	0.85	1.08	—	—	—	—	—	—
Kingsford											
Upstream	—	—	—	—	—	—	—	1.53	1.75	2.16	2.45
Outfall	—	—	—	—	—	—	—	1.40	1.36	1.25	1.56
Downstream	—	—	—	—	—	—	—	2.76	1.41	1.63	1.90
Fort Green											
Upstream	—	—	—	—	—	—	—	—	—	1.31	—
Outfall	—	—	—	—	—	—	—	1.58	1.40	—	—
Downstream	—	—	—	—	—	—	—	—	—	1.48	1.26
Four Corners 1											
Upstream	—	—	—	—	1.24	1.32	1.33	1.41	1.34	1.13	—
Outfall	0.95	0.96	0.94	1.32	0.82	0.80	—	—	—	—	—
Downstream	—	—	—	—	1.24	1.83	2.33	1.93	1.65	2.76	—
Four Corners 2											
Upstream	—	—	1.36	1.68	1.46	1.69	1.91	—	1.11	0.52	—
Outfall	—	—	0.91	1.13	0.76	—	—	1.40	1.00	0.59	—
Downstream	—	—	1.20	1.43	0.97	1.06	1.01	—	1.21	0.72	—
Wingate 1											
Upstream	—	—	—	—	—	—	1.15	1.11	1.54	—	—
Outfall	—	—	—	—	—	—	—	—	—	—	—
Downstream	—	—	—	—	—	—	—	—	—	—	—
Wingate 2											
Upstream	—	—	—	—	—	—	—	0.85	1.24	—	—
Outfall	—	—	—	1.56	0.89	0.99	—	1.07	1.10	—	—
Downstream	—	—	—	—	—	—	—	1.04	1.39	—	—

Note: — indicates less than four data points for that year.
NNC limit for TN = 1.65 mg/L

TABLE 18
Chlorophyll *a* Annual Geometric Mean Values (µg/L) for Mine Outfall, Upstream and Downstream Stations

	Year										
Mine/Station	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
South Pasture											
Outfall 4	8.1	4.2	2.2	8.4	4.9	—	—	—	—	—	—
Outfall 5	—	—	1.9	14.7	—	—	—	—	—	—	—
Kingsford											
Upstream	—	—	—	—	—	—	—	—	—	—	—
Outfall	—	—	—	—	—	—	—	—	28.6	34.4	47.8
Downstream	—	—	—	—	—	—	—	—	—	—	—
Fort Green											
Upstream	—	—	—	—	—	—	—	—	—	—	—
Outfall	—	—	—	—	—	—	5.0	—	15.7	14.0	9.9
Downstream	—	—	—	—	—	—	—	—	—	—	—
Four Corners 1											
Upstream	—	—	—	—	1.1	1.9	3.4	1.4	1.6	—	—
Outfall	—	8.2	3.8	5.6	0.9	—	—	—	—	—	—
Downstream	—	—	—	—	0.9	2.0	1.8	1.6	1.7	—	—
Four Corners 2											
Upstream	—	—	3.2	9.4	2.0	1.3	3.9	14.6	5.7	1.5	—
Outfall	—	—	9.8	18.4	3.4	—	—	—	—	—	—
Downstream	—	—	7.5	16.2	4.3	3.9	4.4	2.2	14.5	5.7	—
Wingate 1											
Upstream	—	—	—	—	1.5	4.2	5.1	2.0	9.0	3.2	—
Outfall	—	—	—	—	—	—	4.5	—	—	—	—
Downstream	—	—	—	—	—	—	—	—	—	—	—
Wingate 2											
Upstream	—	—	—	—	—	—	—	1.2	2.8	—	—
Outfall	—	—	—	—	7.2	7.7	—	5.5	18.2	—	—
Downstream	—	—	—	—	—	—	—	3.2	10.6	—	—

Note: — indicates less than four data points for that year.
Impairment screening value for chlorophyll *a* = 20 µg/L

8.0 Conclusions

Agency reports and literature reviewed and summarized in this TM and Chapters 3 and 4 of the Final AEIS identified that the potential exists for phosphate mining to affect surface water quality as well as groundwater quality because of localized elevated concentrations of parameters influenced by the intensive interaction of water and soil media associated with mining and conveyance of matrix, sand tailings, and clay in mine site pipelines and other elements of the recirculation system. Most of the studies on groundwater quality indicate no substantive effects of mining operations on water quality in the surficial aquifer with the exception of potential localized effects near CSAs as suggested by some monitoring records. Periodic screenings for beneficiation-related chemicals have indicated compliance with primary and secondary drinking water standards. Annual screenings of water used to transport sand tailings for mining-related parameters also show levels that comply with applicable criteria. FDEP continues to monitor such records to ensure that the mining operations are not causing contaminant entry at levels exceeding the applicable standards or reference values.

More rigorous monitoring of mining effects on surface waters is conducted through FDEP's inclusion of NPDES discharge monitoring conditions in the state-issued mine operating permits. The monitoring records reviewed included recent discharge monitoring records for multiple example mines, some of which are active and some of which are primarily only engaged in reclamation. Post-reclamation water quality records viewed as of particular relevance were embodied in USGS's 2-year study of unmined and mined/reclaimed basins in the general vicinity of the Four Corners area in the CFPD. In the aggregate, these monitoring records confirmed that offsite discharges from phosphate mines occurred primarily when wet season accumulations, large tropical storm events, or similar large rainfall events contribute to recirculation system storage to such an extent that water must be released to protect the physical integrity of the associated infrastructure. Discharges were not continuous or year-round because mines are operated to maximize reuse and conservation of water. Monitoring records identified several parameters typically present at elevated concentrations compared to ambient background levels, and these are detailed in this TM. Instream monitoring upstream and downstream of NPDES discharge locations, where practicable, has suggested some increase in downstream concentrations within approximately 100 meters of the discharge location. Aquatic biological community monitoring results at these upstream and downstream locations have not been conclusive in defining the nature of the biological response to the NPDES-permitted discharges, and long-term monitoring of stream reaches in Horse Creek downstream of the Fort Green Mine's NPDES outfalls has not identified indirect effects of mine-related discharges.

Geographically, the following is a list of the watersheds and subwatersheds that would be primarily impacted by the Action Alternatives:

- Desoto: Peace River – Horse Creek and Peace River at Arcadia
- Ona: Peace River – Horse Creek and Peace River at Arcadia
- Wingate East: Myakka River – Upper Myakka River
- South Pasture Extension: Peace River – Horse Creek and Peace River at Arcadia
- Pine Level/Keys Tract: Myakka River – Big Slough; Peace River – Horse Creek
- Pioneer Tract: Peace River – Horse Creek and Peace River at Arcadia
- Site A-2: Peace River – Peace River at Zolfo Springs
- Site W-2: Myakka River – Upper Myakka River

The No Action Alternative - Upland Only scenario includes future mining in upland areas of the Applicants' Preferred Alternatives (Desoto, Ona, Wingate East, and South Pasture Extension), plus Pine Level/Keys Tract and Pioneer Tract. Mining under the Upland Only scenario would primarily affect the same watersheds and subwatersheds as those alternatives.

On the basis of the information reviewed for the AEIS, it appears that phosphate mining does have some impacts on receiving waters in the form of elevated concentrations of selected constituents, but that the impacts are localized and relatively short-term in duration, with the potential exception of nutrients. Discharge volumes are relatively small in scale compared to the flows of overall subwatersheds that may be influenced by mine discharges. The measurable effects on water quality in receiving waters are difficult to quantify because of the complex relationships between rainfall seasonality, mine water supply strategies focused on storage rather than drainage, and the capture area temporal relationships over the course of a given mine's life cycle. These observations suggest that with proper attention to stormwater quality-based BMPs, mining operations can minimize their water quality impacts on areas beyond their mine recirculation system boundaries (inside the limits of the ditch and berm system). As described in detail in Chapter 4, the Applicants' Preferred Alternatives or any of the offsite alternatives are expected to have only minor to moderate impacts on downstream water quality based on a review of recent reference mine data.

Changes in the applicable surface water quality standards are imminent. Most notable are the NNC, which will be applicable within the reasonably foreseeable future after USEPA completes rulemaking to repeal the federal NNC for Florida and determine whether Florida's rule addresses the January 2009 determination that NNC are needed in Florida. Evaluation of compliance with NNC for specific streams will require performing biological assessments in addition to obtaining total nitrogen and total phosphorus data. Stream segments in the AEIS study area that are determined to be noncompliant with the NNC will require developing and implementing basin management regulatory strategies, which will likely include state-of-the-art nutrient removal technologies designed to contribute to nutrient load reductions. These nutrient load reductions could be translated to reductions in long-term average total nitrogen and total phosphorus concentrations in waters delivered to downstream water bodies like the Charlotte Harbor estuary.

9.0 References

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Attachment A
1998 303(d) Listed Water Bodies in AEIS Study Area Counties

- Charlotte
- DeSoto
- Hardee
- Hillsborough
- Lee
- Manatee
- Polk
- Sarasota

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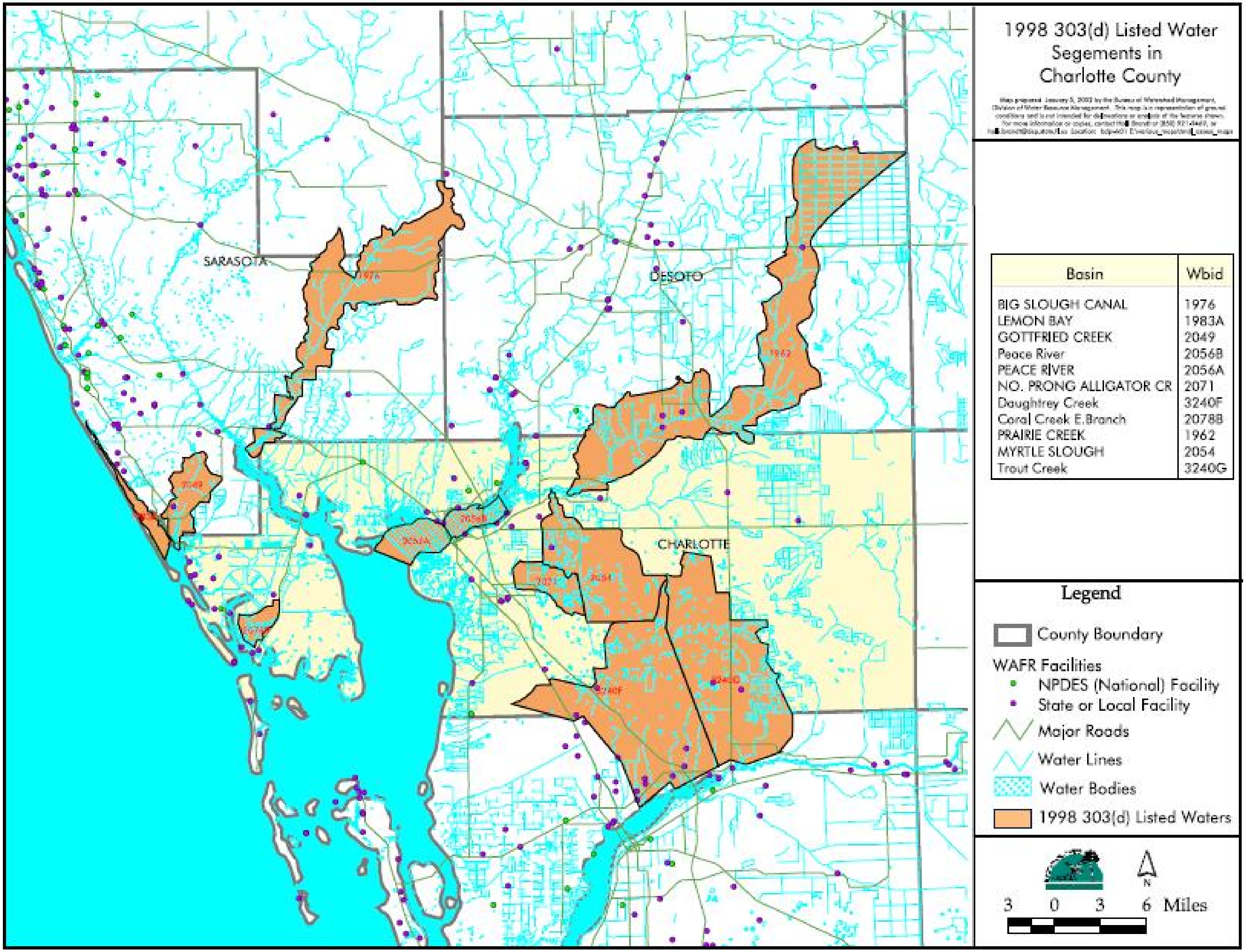
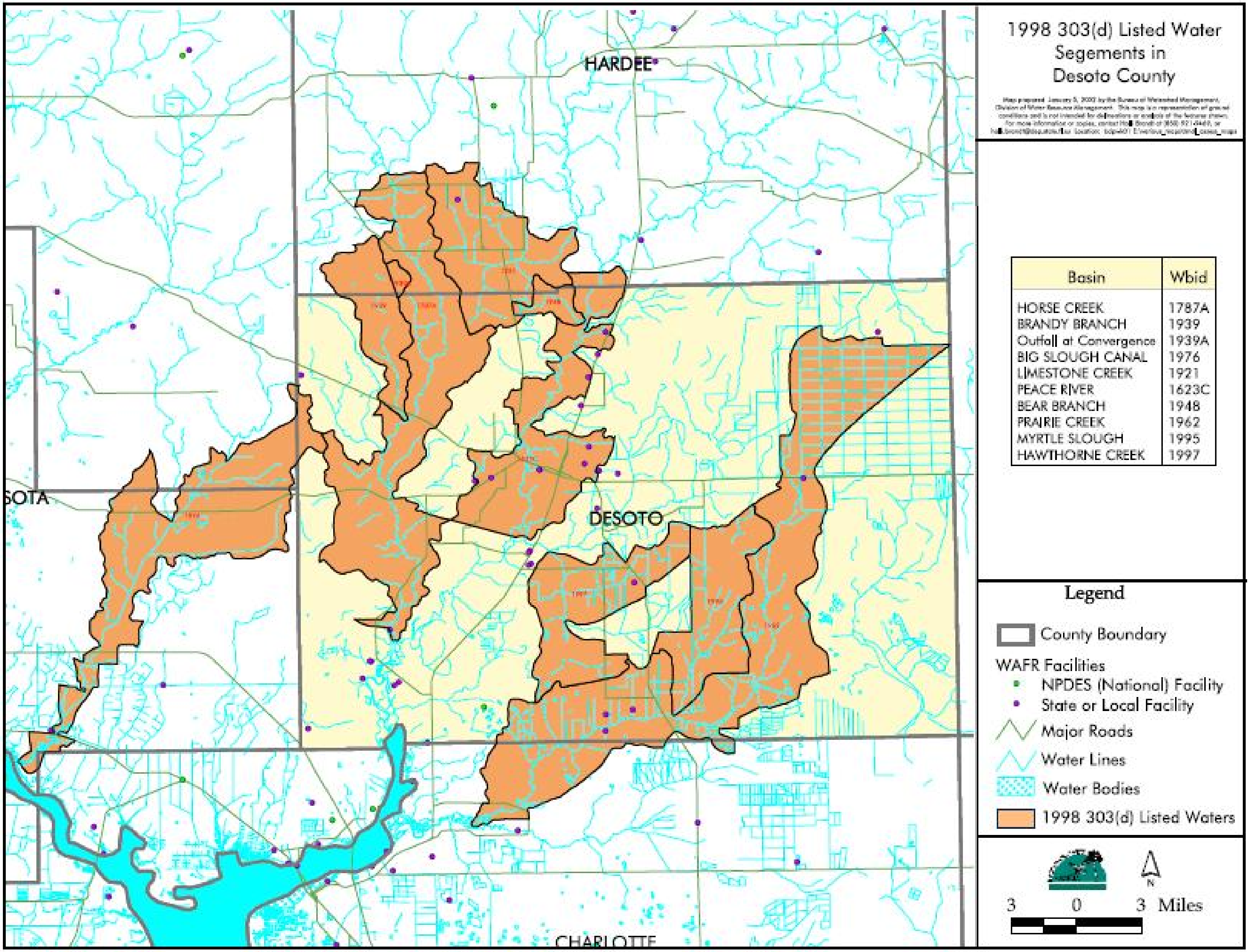
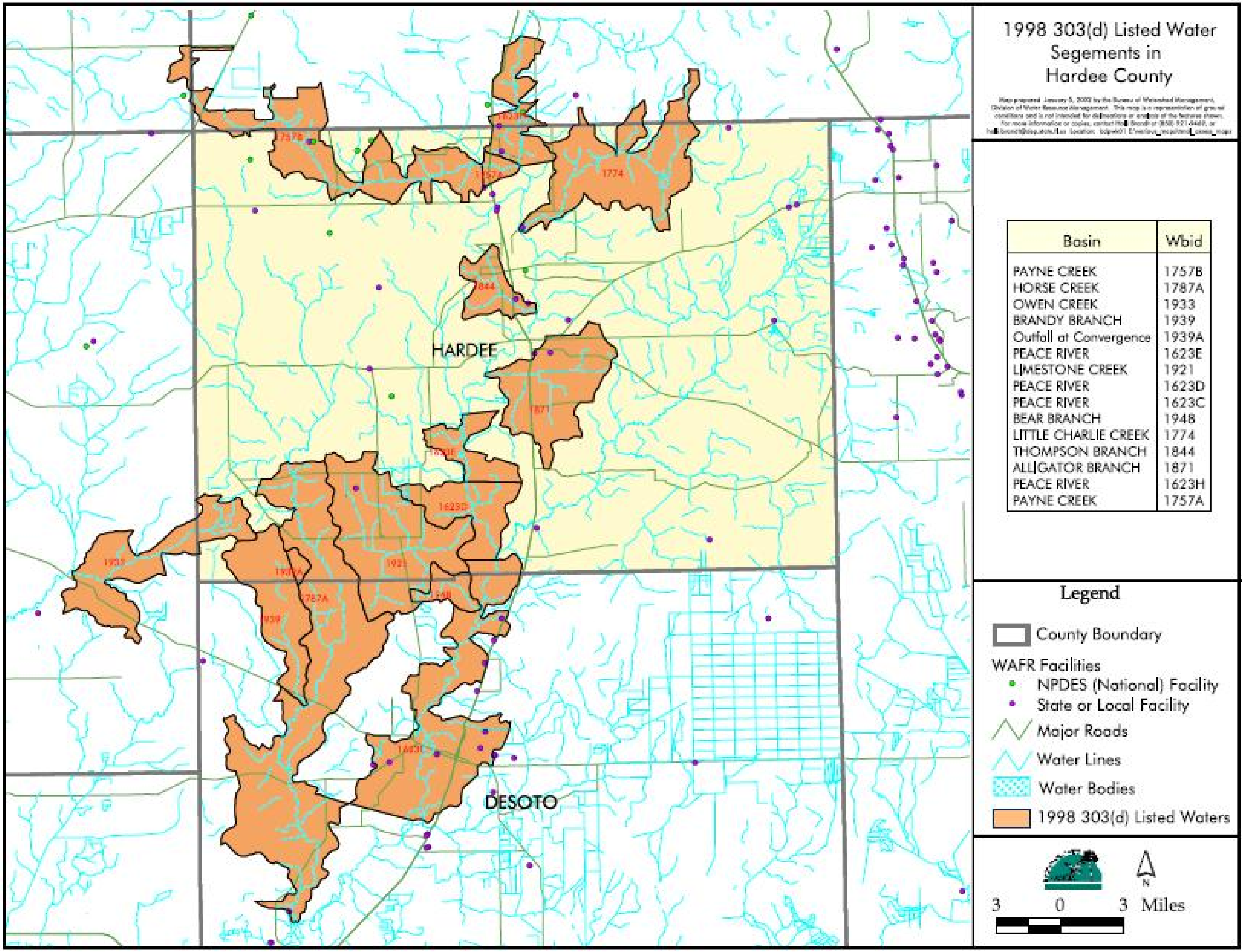
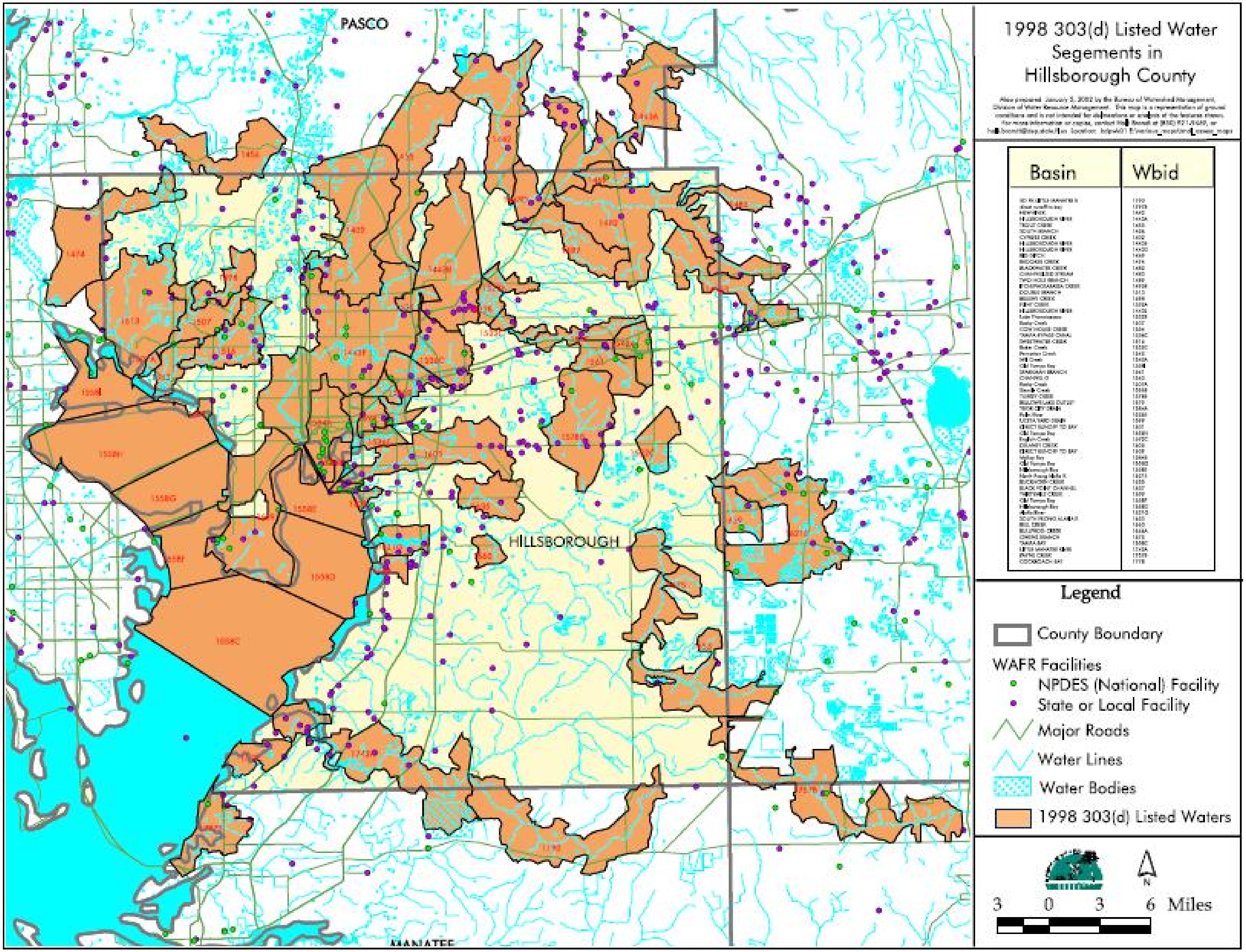
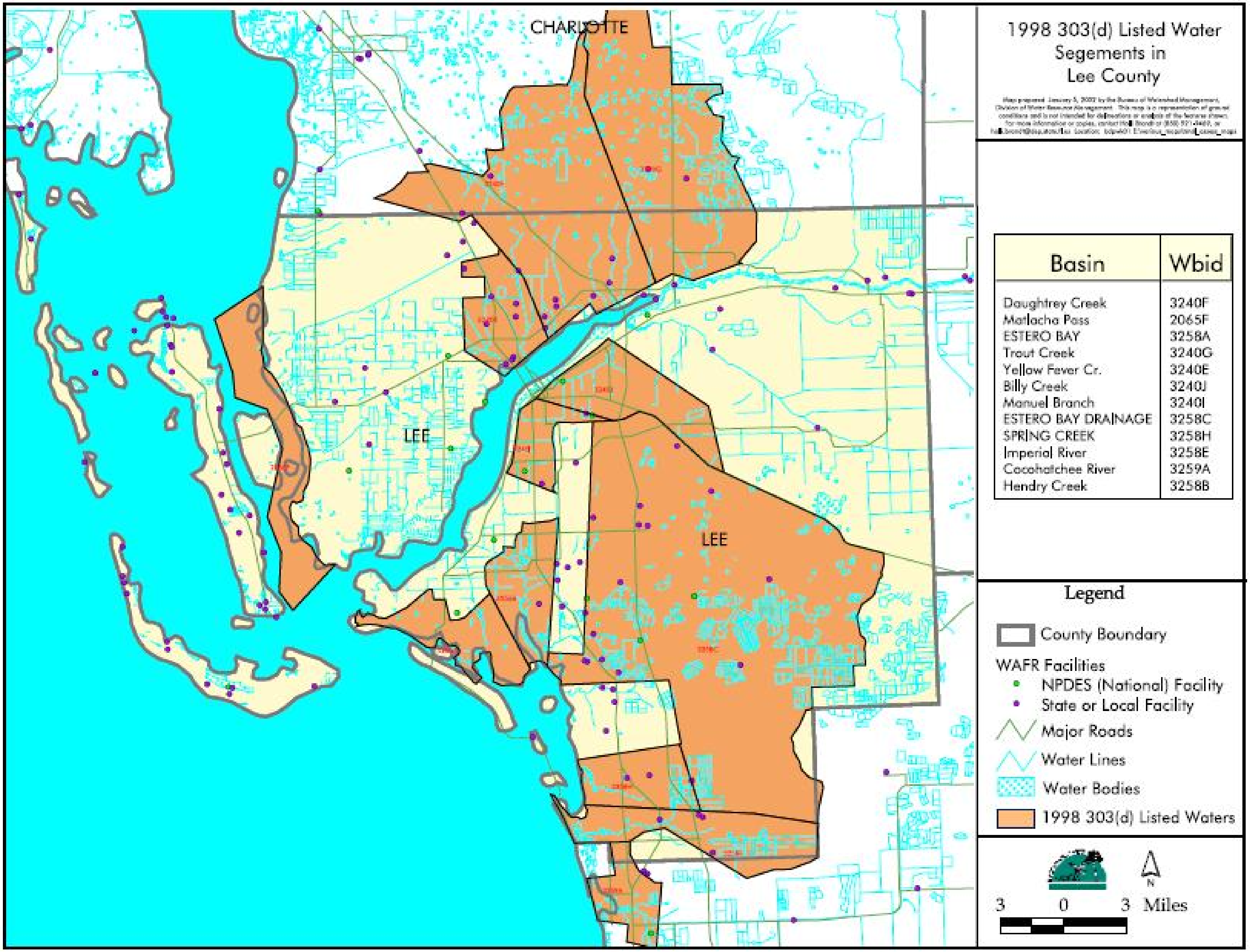

1998 303(d) Listed Water Segements in Charlotte County
SARASOTA
DESOTO
CHARLOTTE
Basin
Wbid
BIG SLOUGH CANAL 1976
LEMON BAY 1983A
GOTTFRIED CREEK 2049
Peace River 2056B
PEACE RIVER 2056A
NO. PRONG ALLIGATOR CR 2071
Daughtrey Creek 3240F
Coral Creek E.Branch 2078B
PRAIRIE CREEK 1962
MYRTLE SLOUGH 2054
Trout Creek 3240G
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
3 0 3 6 Miles
N



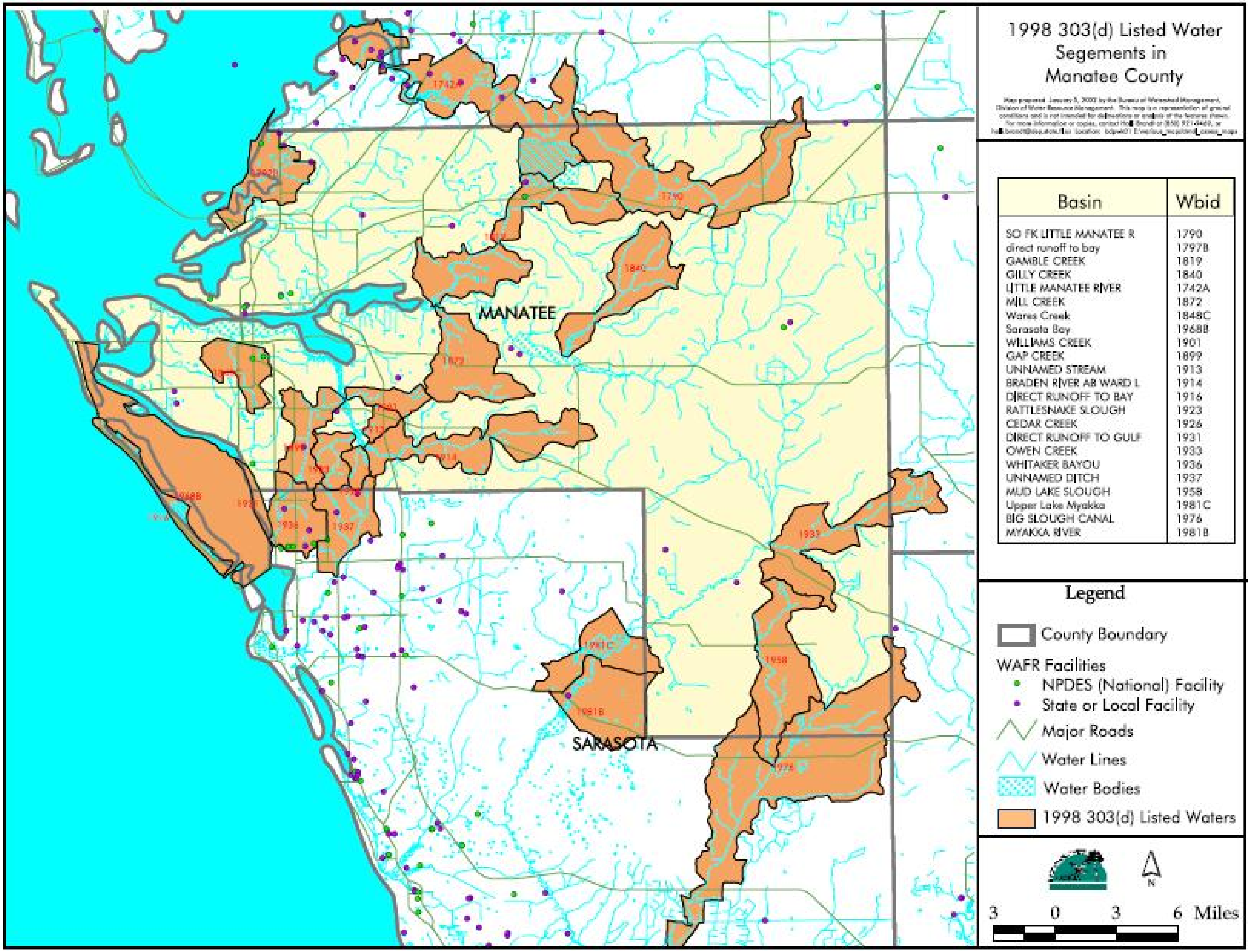
Basin	Wbid
HORSE CREEK	1787A
BRANDY BRANCH	1939
Outfall at Convergence	1939A
BIG SLOUGH CANAL	1976
LIMESTONE CREEK	1921
PEACE RIVER	1623C
BEAR BRANCH	1948
PRAIRIE CREEK	1962
MYRTLE SLOUGH	1995
HAWTHORNE CREEK	1997

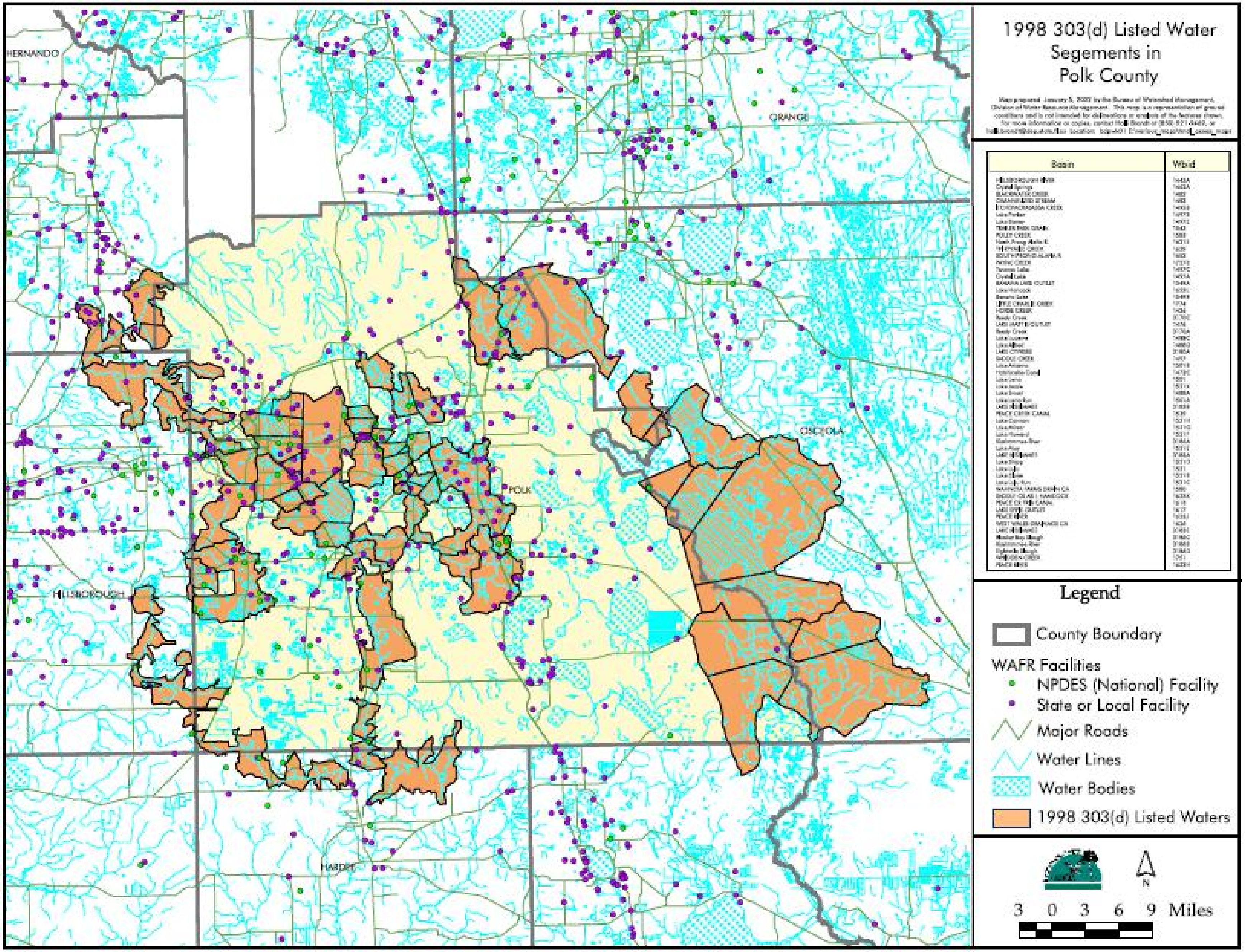

1998 303(d) Listed Water Segements in Hardee County
HARDEE
DESOTO
Basin | Wbid
PAYNE CREEK | 1757B
HORSE CREEK | 1787A
OWEN CREEK | 1933
BRANDY BRANCH | 1939
Outfall at Convergence | 1939A
PEACE RIVER | 1623E
LIMESTONE CREEK | 1921
PEACE RIVER | 1623D
PEACE RIVER | 1623C
BEAR BRANCH | 1948
LITTLE CHARLIE CREEK | 1774
THOMPSON BRANCH | 1844
ALLIGATOR BRANCH | 1871
PEACE RIVER | 1623H
PAYNE CREEK | 1757A
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
3 0 3 Miles

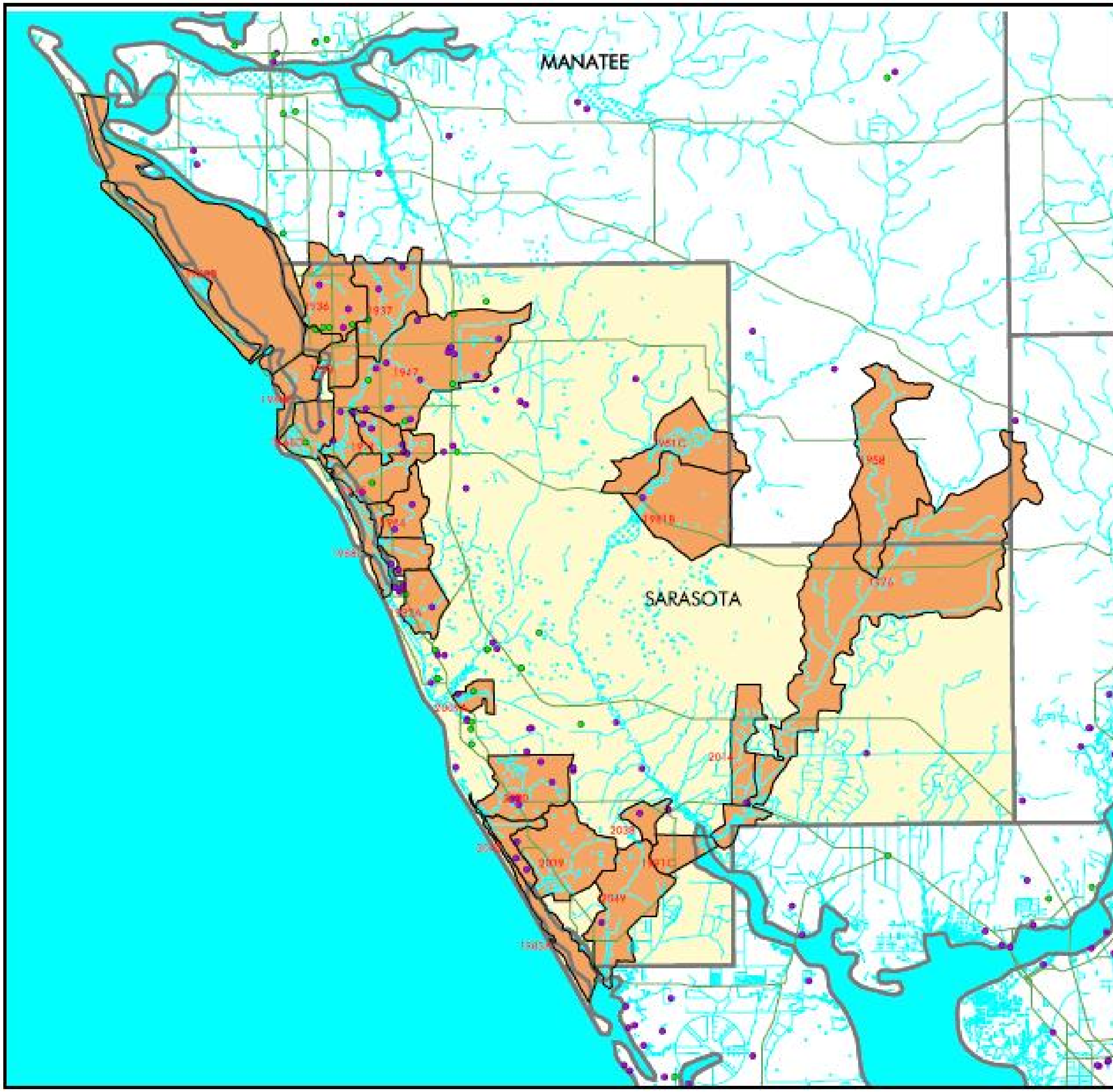

PASCO
HILLSBOROUGH
MANATEE
1998 303(d) Listed Water Segements in Hillsborough County
Basin
Wbid
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
N
3 0 3 6 Miles



Basin	Wbid
Daughtrey Creek	3240F
Matlacha Pass	2065F
ESTERO BAY	3258A
Trout Creek	3240G
Yellow Fever Cr.	3240E
Billy Creek	3240J
Manuel Branch	3240I
ESTERO BAY DRAINAGE	3258C
SPRING CREEK	3258H
Imperial River	3258E
Cocohatchee River	3259A
Hendry Creek	3258B


1998 303(d) Listed Water Segements in Manatee County
Basin | Wbid
SO FK LITTLE MANATEE R | 1790
direct runoff to bay | 1797B
GAMBLE CREEK | 1819
GILLY CREEK | 1840
LITTLE MANATEE RIVER | 1742A
MILL CREEK | 1872
Wares Creek | 1848C
Sarasota Bay | 1968B
WILLIAMS CREEK | 1901
GAP CREEK | 1899
UNNAMED STREAM | 1913
BRADEN RIVER AB WARD L | 1914
DIRECT RUNOFF TO BAY | 1916
RATTLESNAKE SLOUGH | 1923
CEDAR CREEK | 1926
DIRECT RUNOFF TO GULF | 1931
OWEN CREEK | 1933
WHITAKER BAYOU | 1936
UNNAMED DITCH | 1937
MUD LAKE SLOUGH | 1958
Upper Lake Myakka | 1981C
BIG SLOUGH CANAL | 1976
MYAKKA RIVER | 1981B
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
MANATEE
SARASOTA
N
3 0 3 6 Miles


1998 303(d) Listed Water
Segements in
Polk County
Basin
Wbid
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
3 0 3 6 9 Miles
N
HERNANDO
ORANGE
OSCEOLA
POLK
HILLSBOROUGH
HARDEE



1998 303(d) Listed Water Segements in Sarasota County

Basin	Wbid
Sarasota Bay	1968B
DIRECT RUNOFF TO BAY	1916
DIRECT RUNOFF TO GULF	1931
WHITAKER BAYOU	1936
UNNAMED DITCH	1937
PHILIPPE CREEK	1947
DIRECT RUNOFF TO BAY	1951
HUDSON BAYOU	1953
Sarasota Bay	1968C
MUD LAKE SLOUGH	1958
Upper Lake Myakka	1981C
ROBERTS BAY	1968D
UNNAMED DITCH	1971
Elligraw Bayou	1975
BIG SLOUGH CANAL	1976
MYAKKA RIVER	1981B
CATFISH CREEK	1984
Little Sarasota Bay	1968E
Clowers Creek	1975A
North Creek	1984A
SOUTH CREEK	1982A
CURRY CREEK	2009A
UNNAMED DITCH SYSTEM	2014
ALLIGATOR CREEK	2030
LEMON BAY	1983A
UNNAMED CREEK	2038
FORKED CREEK	2039
DIRECT RUNOFF TO BAY	2042
MYAKKA RIVER	1991C
GOTTFRIED CREEK	2049

Legend

County Boundary

WAFR Facilities

- NPDES (National) Facility
- State or Local Facility

Major Roads

Water Lines

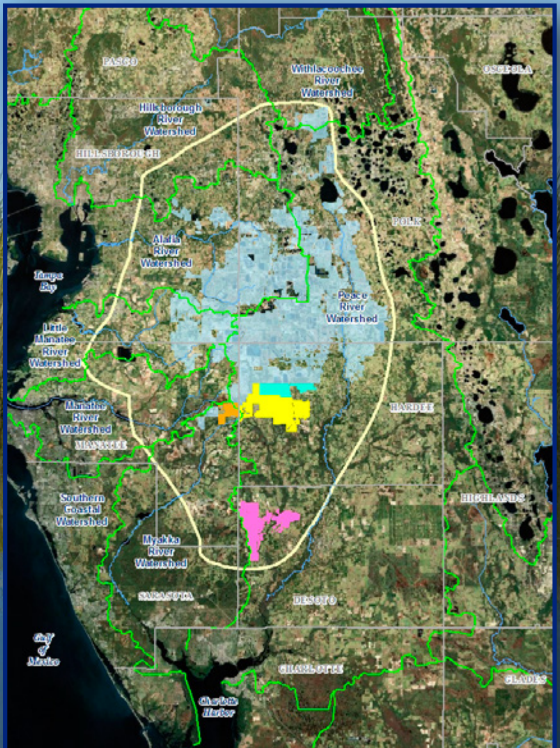
Water Bodies

1998 303(d) Listed Waters

N

3 0 3 6 Miles

Appendix E
Ecological Resource Impact Analysis Methods and Supplemental Data for the Final AEIS on Phosphate Mining in the CFPD



Ecological Resource Impact Analysis Methods and Supplemental Data for the Final AEIS on Phosphate Mining in the CFPD

PREPARED FOR: U.S. Army Corps of Engineers, Jacksonville District

COPY TO: U.S. Environmental Protection Agency
Florida Department of Environmental Protection

PREPARED BY: CH2M HILL

DATE: January 20, 2013

PROJECT NUMBER: 418237.07.01

1.0 Introduction

The U.S. Army Corps of Engineers (USACE) is conducting investigations to support assembly of an Areawide Environmental Impact Statement (AEIS) focused on four phosphate mining projects proposed by Mosaic Fertilizer LLC and CF Industries Inc. (the Applicants) in the Central Florida Phosphate District (CFPD). This technical memorandum summarizes the methods and approaches used to analyze the potential impacts of the Applicants' Preferred Alternatives and offsite alternatives on ecological resources.

2.0 Ecological Resource Impact Analysis Methods

Ecological resources could be impacted by various aspects of phosphate mining operations, such as land clearing in advance of mining, mining activities, and construction of the infrastructure supporting mining such as access roads, pipeline corridors, and clay settling areas. Ecological effects may be direct such as the clearing of wetlands in areas to be mined, or indirect such as the dewatering of wetlands adjacent to mining areas. The analyses of potential impacts of the Applicants' Preferred Alternatives on ecological resources were primarily based on information included in the Applicants' federal Section 404 permit applications for the proposed mines. The information obtained from the Section 404 permit applications for the impact analyses included field data collected by the Applicants on aquatic biological communities, wetlands/waters, wildlife habitats, and listed species, as well as the Applicants' proposed impact avoidance/minimization measures and compensatory mitigation.

Site-specific field data on ecological resources for the offsite alternatives were unavailable at the time of the preparation of this AEIS. In lieu of collecting field data for each offsite alternative, the following geographic information system (GIS)-based data/tools were used to support the analysis of potential impacts of each offsite alternative on ecological resources:

- 2009 Southwest Florida Water Management District (SWFWMD) Florida Land Use, Cover and Forms Classification System (FLUCCS) data (SWFWMD, 2009a)
- U.S. Geological Survey (USGS) National Hydrography Dataset (NHD) data (USGS, 2013b)
- Critical Lands and Waters Identification Project (CLIP) tool (Florida Natural Areas Inventory [FNAI] et al., 2011)

FLUCCS is the primary system used to classify land use and cover in Florida (see Chapter 3 of the AEIS). For this AEIS, FLUCCS data were used to estimate the spatial coverage (in acres) and composition (types) of wetlands, non-stream surface waters, native uplands (rangelands and upland forests), and agricultural land on each offsite alternative. The comprehensive FLUCCS data for the offsite alternatives are provided in Attachment E-1.

The NHD is a USGS digital-vector dataset used for mapping and geospatial analysis of surface waters (USGS, 2013b). For this AEIS, NHD data were used to estimate the total stream length (in linear feet) on each offsite alternative. The linear feet of streams were calculated as the combined length of all NHD flowline features except for the “canal/ditch” feature. The comprehensive NHD data for the offsite alternatives are provided in Attachment E-2.

CLIP is a GIS-based tool that allows rapid assessment of the ecological quality and importance of a given parcel of land in Florida. The CLIP User Tutorial includes guidelines for use of CLIP data, including a disclaimer that CLIP data are not intended to be used for regulatory permitting decisions. For this AEIS, CLIP provides estimates of the quality of wetlands on each offsite alternative without the need to obtain permission to access the sites, do field surveys, etc. Any USACE permitting decisions related to this AEIS will be supported by additional data beyond what are available using CLIP, including site-specific, field-verified information.

The CLIP tool was developed through a collaborative effort between the FNAI, University of Florida, and Florida Fish and Wildlife Conservation Commission (FFWCC). The CLIP tool has been revised and updated with new data since its initial creation in 2006. CLIP 2.0, the 2011 update of the tool used for this AEIS, is organized into a set of core GIS data layers that are combined into five resource models: Biodiversity, Landscapes, Surface Water, Groundwater, and Marine. Depending on the model or data layers used, CLIP can provide a broad assessment of the overall ecological quality of an area, or it can provide a more focused assessment of the quality of a specific resource within an area, such a wetlands. According to the CLIP tool, areas or specific resources that are ranked as CLIP Priority 1 or 2 are considered to have the highest priority for conservation significance (FNAI et al., 2011). Because Wetland Rapid Assessment Procedure (WRAP) or Uniform Mitigation Assessment Method (UMAM) data are not available for the offsite alternatives, the CLIP “Wetlands” GIS data layer (which is a component of the CLIP Surface Water model) was used to assess the quality of wetlands on each offsite alternative. The CLIP Wetlands layer has six priority levels, reported from 1 to 6;-Priority 1 represents the highest conservation priority level and Priority 6 represents the lowest conservation priority level. For this AEIS, wetlands ranked as CLIP Priority 1 and 2 were considered to represent wetlands of high quality, wetlands ranked as CLIP Priority 3 and 4 were considered to represent wetlands of moderate quality, and wetlands ranked as CLIP Priority 5 and 6 were considered to represent wetlands of low quality on each offsite alternative. Accordingly, the percentages of wetlands ranked as CLIP Priority 1 and 2 (high-quality wetlands), wetlands ranked as CLIP Priority 3 and 4 (moderate-quality wetlands), and wetlands ranked as CLIP Priority 5 and 6 (low-quality wetlands) were calculated for each offsite alternative. The comprehensive CLIP Wetland data for the offsite alternatives are provided in Attachment E-3.

3.0 Supplemental Information Appended to this Technical Memorandum

The following attachments include supplemental information that supports the ecological resource impact analyses conducted for the offsite alternatives: Attachment E-1 – FLUCCS Data for Offsite Alternatives; Attachment E-2 – NHD Data for Offsite Alternatives; and Attachment E-3 – CLIP Data for Offsite Alternatives.

Attachment E-1
FLUCCS Data for Offsite Alternatives

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Attachment E-1: Estimated Land Use/Cover on Offsite Alternatives Based on SWFWMD FLUCCS Data

Pine Level/Keys Tract

Land Use	FLUCCS Code	Acreage	Percentage	FLUCCS Description
Urban/Built-Up	110	425.3746983	1.721378682	Residential Low Density < 2 Dwelling Units
Urban/Built-Up	150	39.85822469	0.161295673	Industrial
Urban/Built-Up	180	5.526471321	0.022364165	Recreational
Agriculture	210	6460.431139	26.14365283	Cropland And Pastureland
Agriculture	214	2322.496556	9.39852811	Row Crops
Agriculture	220	995.8440794	4.029917095	Tree Crops
Agriculture	240	9.167720921	0.037099337	Nurseries And Vineyards
Agriculture	250	83.63839189	0.338462408	Specialty Farms
Agriculture	260	1977.622148	8.002912774	Other Open Lands <Rural>
Rangeland	310	19.83377474	0.080262031	Herbaceous
Rangeland	320	3091.108979	12.50889891	Shrub And Brushland
Rangeland	330	288.9690776	1.169381281	Mixed Rangeland
Upland Forest	410	23.73773454	0.096060321	Upland Coniferous Forest
Upland Forest	411	1657.568475	6.707740371	Pine Flatwoods
Upland Forest	420	47.4632514	0.192071201	Upland Hardwood Forests - Part 1
Upland Forest	434	971.7060497	3.932236885	Hardwood Conifer Mixed
Water	530	17.80624114	0.072057139	Reservoirs
Wetland	615	2047.241551	8.284644049	Stream And Lake Swamps (Bottomland)
Wetland	620	19.5638399	0.079169676	Wetland Coniferous Forests
Wetland	621	126.4474664	0.511699388	Cypress
Wetland	630	75.75382012	0.306555636	Wetland Forested Mixed
Wetland	641	2875.499294	11.63638365	Freshwater Marshes
Wetland	643	1120.524246	4.534464688	Wet Prairies
Wetland	644	7.563619472	0.030607964	Emergent Aquatic Vegetation
Wetland	653	0.532715006	0.002155756	Intermittent Ponds
Total		**24711.27956**	**100**	
Total Agriculture		**11849.20**	**47.95**	
Pastureland		**6460.43**	**26.14**	
Total Native Uplands		**6100.39**	**24.69**	
Rangeland		**3399.91**	**13.76**	
Upland Forest		**2700.48**	**10.93**	
Water		**17.81**	**0.07**	
Total Wetlands		**6273.13**	**25.39**	
Forested Wetlands		**2269.01**	**9.18**	
Non-forested Wetlands		**4004.12**	**16.20**	

Pioneer Tract

Land Use	FLUCCS Code	Acreage	Percentage	FLUCCS Description
Urban/Built-up	110	56.85081569	0.225075762	Residential Low Density < 2 Dwelling Units
Urban/Built-up	150	3.090107974	0.012233921	Industrial
Agriculture	210	7022.099571	27.80091001	Cropland And Pastureland
Agriculture	214	59.91144584	0.237192979	Row Crops
Agriculture	220	4586.088597	18.15659762	Tree Crops
Agriculture	240	0.025394016	0.000100536	Nurseries And Vineyards
Agriculture	260	1306.475716	5.172415093	Other Open Lands <Rural>
Rangeland	310	33.02267702	0.130738743	Herbaceous
Rangeland	320	1498.807486	5.933868014	Shrub And Brushland
Rangeland	330	323.1601718	1.279410348	Mixed Rangeland
Upland Forest	411	697.9191137	2.763103296	Pine Flatwoods
Upland Forest	420	70.68855947	0.279860213	Upland Hardwood Forests - Part 1
Upland Forest	434	583.4960037	2.310095396	Hardwood Conifer Mixed
Water	510	0.212409738	0.000840943	Streams And Waterways
Water	520	23.94948552	0.094817438	Lakes
Water	530	11.2818808	0.044665637	Reservoirs
Wetland	615	6084.387619	24.0884526	Stream And Lake Swamps (Bottomland)
Wetland	621	189.6750575	0.750934838	Cypress
Wetland	630	0.071755467	0.000284084	Wetland Forested Mixed
Wetland	641	2121.518867	8.399219422	Freshwater Marshes
Wetland	643	557.8205708	2.208444829	Wet Prairies
Wetland	644	19.50400458	0.077217515	Emergent Aquatic Vegetation
Transportation/Utilities	810	0.264971905	0.00104904	Transportation
Transportation/Utilities	830	8.201875155	0.032471712	Utilities
Total		**25258.52416**	**100**	
Total Agriculture		**12974.60**	**51.37**	
Pastureland		**7022.10**	**27.80**	
Total Native Uplands		**3207.09**	**12.70**	
Rangeland		**1854.99**	**7.34**	
Upland Forest		**1352.10**	**5.35**	
Water		**35.44**	**0.14**	
Total Wetlands		**8972.98**	**35.52**	
Forested Wetlands		**6274.13**	**24.84**	
Non-forested Wetlands		**2698.84**	**10.68**	

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Land Use	FLUCCS Code	Acreage	Percentage	FLUCCS Description
Agriculture	210	4145.876146	50.62922961	Cropland And Pastureland
Agriculture	214	110.8275849	1.353420856	Row Crops
Agriculture	220	967.2960843	11.81257081	Tree Crops
Agriculture	240	20.85646507	0.254698096	Nurseries And Vineyards
Agriculture	260	1217.064215	14.86272658	Other Open Lands <Rural>
Rangeland	320	146.3031581	1.78664676	Shrub And Brushland
Rangeland	330	3.661687654	0.044716344	Mixed Rangeland
Upland Forest	411	152.9057522	1.867277305	Pine Flatwoods
Upland Forest	420	12.81602844	0.156508691	Upland Hardwood Forests - Part 1
Upland Forest	434	37.68740612	0.460236696	Hardwood Conifer Mixed
Water	530	12.19566612	0.148932857	Reservoirs
Wetland	615	438.3076443	5.352590763	Stream And Lake Swamps (Bottomland)
Wetland	621	3.479969687	0.042497214	Cypress
Wetland	630	50.66144012	0.618674942	Wetland Forested Mixed
Wetland	641	643.9360354	7.863714265	Freshwater Marshes
Wetland	643	221.2375857	2.701742196	Wet Prairies
Wetland	644	3.587963152	0.043816024	Emergent Aquatic Vegetation
Total		**8188.700832**	**100**	
Total Agriculture		**6461.92**	**78.91**	
Pastureland		**4145.88**	**50.63**	
Total Native Uplands		**353.37**	**4.32**	
Rangeland		**149.96**	**1.83**	
Upland Forest		**203.41**	**2.48**	
Water		**12.20**	**0.15**	
Total Wetlands		**1361.21**	**16.62**	
Forested Wetlands		**492.45**	**6.01**	
Non-forested Wetlands		**868.76**	**10.61**	

W-2

Land Use	FLUCCS Code	Acreage	Percentage	FLUCCS Description
Agriculture	210	1469.608244	15.12058408	Cropland And Pastureland
Agriculture	214	1884.179029	19.3860422	Row Crops
Agriculture	220	9.665640364	0.099448359	Tree Crops
Agriculture	240	0.39538164	0.004068024	Nurseries And Vineyards
Agriculture	260	1042.019334	10.72118438	Other Open Lands <Rural>
Rangeland	310	8.699946142	0.089512472	Herbaceous
Rangeland	320	1352.996906	13.9207871	Shrub And Brushland
Rangeland	330	93.21213533	0.959046015	Mixed Rangeland
Upland Forest	410	38.36780253	0.394760703	Upland Coniferous Forest
Upland Forest	411	681.8986821	7.015955714	Pine Flatwoods
Upland Forest	420	55.02061323	0.566099035	Upland Hardwood Forests - Part 1
Upland Forest	434	465.8342388	4.792900288	Hardwood Conifer Mixed
Water	520	0.69357877	0.00713613	Lakes
Water	530	34.03324794	0.350163106	Reservoirs
Wetland	610	3.578039461	0.036813924	Wetland Hardwood Forests
Wetland	615	776.45203	7.988801268	Stream And Lake Swamps (Bottomland)
Wetland	621	32.73951352	0.336852062	Cypress
Wetland	630	13.46053111	0.138493434	Wetland Forested Mixed
Wetland	641	1562.503858	16.07637345	Freshwater Marshes
Wetland	643	116.7520033	1.20124427	Wet Prairies
Wetland	644	32.16247796	0.330915027	Emergent Aquatic Vegetation
	740	44.98255892	0.462818963	Disturbed Land
Total		**9719.255792**	**100**	
Total Agriculture		**4405.87**	**45.33**	
Pastureland		**1469.61**	**15.12**	
Total Native Uplands		**2696.03**	**27.74**	
Rangeland		**1454.91**	**14.97**	
Upland Forest		**1241.12**	**12.77**	
Water		**34.73**	**0.36**	
Total Wetlands		**2537.65**	**26.11**	
Forested Wetlands		**826.23**	**8.50**	
Non-forested Wetlands		**1711.42**	**17.61**	

Attachment E-2
NHD Data for Offsite Alternatives

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Attachment E-2: Estimated Total Stream Lengths for Offsite Alternatives Based on USGS NHD Data

(Total Stream Length = Sum Of All Flowline Features Minus "Canal/Ditch" Feature)

Pine Level/Keys Tract

Flowline Feature	Linear Feet
Artificial Path	78,425
Canal / Ditch	378,428
Connector	1,945
Stream/River: Hydrgraphic Category = Intermittent	64,775
Stream/River: Hydrgraphic Category = Perennial	64,804
Total Linear Feet	**588,376**
Total linear Feet Minus Canal/Ditch	**209,949**

Pioneer Tract

Flowline Feature	Linear Feet
Artificial Path	41,367
Canal / Ditch	42,639
Connector	11,16
Stream/River: Hydrgraphic Category = Intermittent	93,394
Stream/River: Hydrgraphic Category = Perennial	194,649
Total Linear Feet	**373,165**
Total linear Feet Minus Canal/Ditch	**330,526**

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Flowline Feature	Linear Feet
Artificial Path	17,765
Canal / Ditch	118,579
Connector	90
Stream/River: Hydrgraphic Category = Intermittent	40,078
Stream/River: Hydrgraphic Category = Perennial	502,92
Total Linear Feet	**226,805**
Total linear Feet Minus Canal/Ditch	**108226**

W-2

Flowline Feature	Linear Feet
Artificial Path	36,539
Canal / Ditch	2,05011
Connector	157
Stream/River: Hydrgraphic Category = Intermittent	19,191
Stream/River: Hydrgraphic Category = Perennial	5,2393
Total Linear Feet	**313,291**
Total linear Feet Minus Canal/Ditch	**108,280**

Grand Total Linear Feet	**1,501,636.618**
Grand Total Linear Feet Minus Canal/Ditch	**756,980.0578**

Flowline Descriptions

Artificial Path: A feature that represents flow through a two-dimensional feature, such as a lake or a double-banked stream.

Canal / Ditch: A canal or ditch (usually with a concrete or earthen surround).

Connector: A known, but nonspecific connection between two nonadjacent network segments

Stream/River: Hydrgraphic Category = Intermittent: Intermittent streams

Stream/River: Hydrgraphic Category = Perennial: Permanent/perennial streams or rivers.

Attachment E-3
CLIP Data for Offsite Alternatives

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Attachment E-3: Estimated Wetland Quality on Offsite Alternatives Based on CLIP Wetland Priority Rankings

Pine Level/Keys Tract

	CLIP Wetland Priority	Acreage
	0	18,584.68434
	1	415.0427162
	2	1,211.824654
	3	2,136.816706
	4	1,741.733847
	5	439.0612632
	6	186.5885272
Total Site Acres		**24,715.75205**
Total Wetland Acres		**6,131.067714**

% of Wetlands Ranked as CLIP Priority 1 and 2 (High Quality) = 26.53

% of Wetlands Ranked as CLIP Priority 3 and 4 (Moderate Quality) = 63.26

% of Wetlands Ranked as CLIP Priority 5 and 6 (Low Quality) = 10.20

Pioneer Tract

	CLIP Wetland Priority	Acreage
	0	16,365.52627
	1	1,220.887208
	2	2,807.278878
	3	3,032.174764
	4	1,086.950449
	5	529.2420114
	6	216.3337185
Total Site Acres		**25,258.3933**
Total Wetland Acres		**8,892.867028**

% of Wetlands Ranked as CLIP Priority 1 and 2 (High Quality) = 45.30

% of Wetlands Ranked as CLIP Priority 3 and 4 (Moderate Quality) = 46.32

% of Wetlands Ranked as CLIP Priority 5 and 6 (Low Quality) = 8.38

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	CLIP Wetland Priority	Acreage
	0	6,841.060411
	2	122.9838564
	3	142.8881153
	4	393.9152906
	5	408.8156855
	6	281.4395485
Total Site Acres		**8,191.102907**
Total Wetland Acres		**1,350.042496**

% of Wetlands Ranked as CLIP Priority 1 and 2 (High Quality) = 9.11

% of Wetlands Ranked as CLIP Priority 3 and 4 (Moderate Quality) = 39.76

% of Wetlands Ranked as CLIP Priority 5 and 6 (Low Quality) = 51.13

W-2

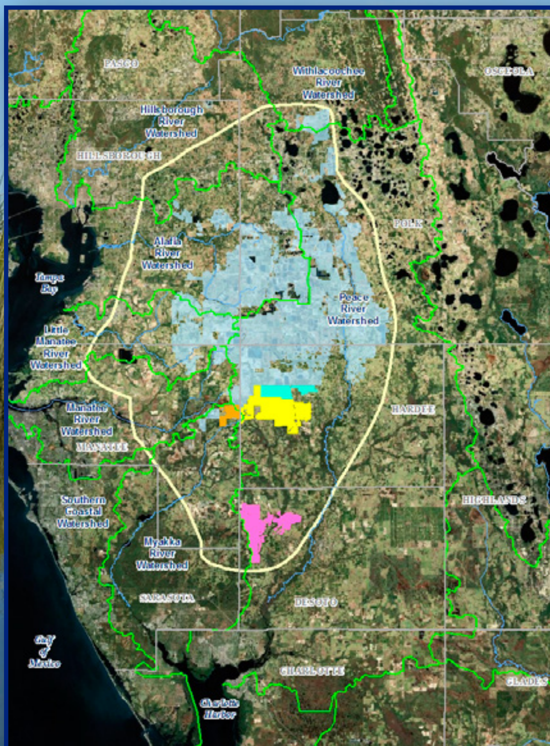
	CLIP Wetland Priority	Acreage
	0	7,215.460632
	1	2.001545584
	2	504.834275
	3	1,532.127546
	4	322.137642
	5	112.0309542
	6	31.30194899
Total Site Acres		**9,719.894544**
Total Wetland Acres		**2,504.433912**

% of Wetlands Ranked as CLIP Priority 1 and 2 (High Quality) = 20.24

% of Wetlands Ranked as CLIP Priority 3 and 4 (Moderate Quality) = 74.04

% of Wetlands Ranked as CLIP Priority 5 and 6 (Low Quality) = 5.72

Appendix F
Groundwater Impact Analysis for the Final AEIS on Phosphate Mining in the CFPD



Groundwater Impact Analysis for the Final AEIS on Phosphate Mining in the CFPD

PREPARED FOR: U.S. Army Corps of Engineers, Jacksonville District

COPY TO: U.S. Environmental Protection Agency
Florida Department of Environmental Protection

PREPARED BY: CH2M HILL

DATE: March 1, 2013

PROJECT NUMBER: 418237.07.01

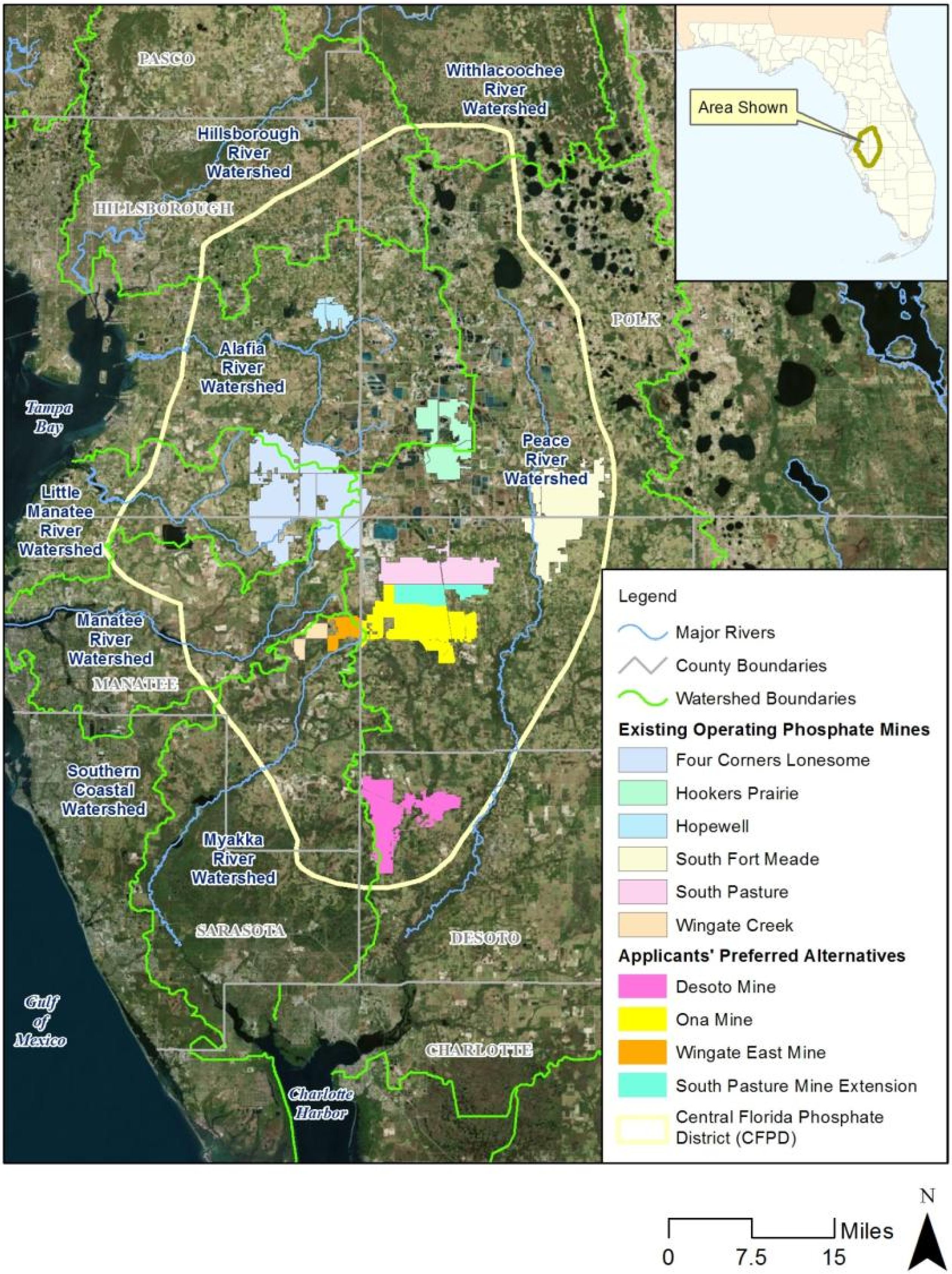
1.0 Introduction

This technical memorandum (TM) documents the development and application of a groundwater flow model to evaluate potential changes in Floridan aquifer water levels associated with anticipated mining water supply withdrawals from the aquifer to support the No Action Alternative, as defined in Chapter 2, and each of the Applicants' Preferred Alternatives, which if all were permitted would add four phosphate mine projects (Desoto [Alternative 2], Ona [Alternative 3], Wingate East [Alternative 4], and South Pasture Mine Extension [Alternative 5]) that would progressively begin operations after the currently operating mines are closed. Figure 1 shows the location of the study area, the six currently operating mines, and the four proposed mine projects that comprise the Applicants' Preferred Alternatives. Two Offsite Alternatives (Pine Level/Keys Tract [Alternative 6] and Pioneer Tract [Alternative 7]) which are considered reasonably foreseeable future mines for cumulative impacts analysis, were not modeled because their water supplies are expected to be from existing wellfields at the Desoto and Ona Mines. Drawdown impacts are expected to remain the same as those of the existing wellfields except the pumping will extent further into the future. The other Offsite Alternatives (A-2 [Alternative 8] and W-2 [Alternative 9]) were not modeled since no water supply plans were available to model. The magnitude of drawdown for each of these would be expected to be similar to the existing mines and gives a general perspective of any new wellfield impacts.

The purpose of the modeling discussed in this TM is to evaluate the *cumulative* Surficial Aquifer System (SAS), Intermediate Aquifer System (IAS) Permeable Zones 1 and 2, and upper Floridan aquifer (UFA) water level changes resulting from the past events as evaluated to include current conditions and the Applicants' Preferred Alternatives. In the process of the modeling analyses, CH2M HILL evaluated a No Action Alternative—equating to none of the proposed mines receiving their requested Clean Water Act (CWA) Section 404 permits from the U.S. Army Corps of Engineers (USACE)—along with the potential effects of the Applicants' Preferred Alternatives.

The groundwater flow model developed to support the USACE Areawide Environmental Impact Statement (AEIS) evaluations was designed to evaluate the impact of the Applicants' Preferred Alternatives on groundwater levels in the Floridan Aquifer System (FAS). The model was based on the Southwest Florida Water Management District (SWFWMD) District-Wide Regulatory Model Version 2 (DWRM2.1), which is a MODFLOW (Harbaugh et al., 2000) model used by SWFWMD to evaluate groundwater use in the District for water resource evaluation and water supply permitting. Additional information on the development and calibration of the DWRM2.1 model can be found in its documentation (Environmental Simulations Inc. [ESI], 2007). The horizontal grid spacing of the DWRM2.1 is 5,000 by 5,000 feet; using the telescopic mesh refinement (TMR) process, the user can build smaller-scale and more refined-mesh models if doing so meets the project requirements. The modeling done for the draft AEIS used a TMR extraction; however, during the review process it was found that the model boundaries were influencing the drawdown contour lines (boundary effects), primarily along the east side of the model. For the final AEIS and this TM, the entire model domain was used; not a TMR extraction.

FIGURE 1
Location of the AEIS Study Area and the Six Existing Mines (No Action Alternative) and the Applicants' Preferred Alternatives 2, 3, 4, and 5)
Central Florida Phosphate District, Florida



Groundwater withdrawals associated with each of these mines have been evaluated by Mosaic Fertilizer LLC and CF Industries, Inc. (collectively, the "Applicants") using DWRM2.1 as part of the SWFWMD consumptive use permitting process. The groundwater modeling discussed herein is different than groundwater modeling previously conducted by the Applicants in that the modeling performed by each Applicant evaluated the impact associated with only that Applicant's proposed allocation relative to its current allocation. For the purposes of the modeling done for this TM, both Applicants' groundwater withdrawals were simulated for existing conditions (2010 explained later in this TM) and modified to reflect future conditions through the life of the existing and Applicants' Preferred Alternative mines. In accordance with how SWFWMD evaluates proposed changes to water use permit (WUP) water allocations, no changes were made to groundwater withdrawals of other water users with the exception of agricultural use. Agricultural uses were left unchanged for the mining only model scenarios so only the mining withdrawals changed over time. Agricultural uses were reduced for the cumulative model scenarios to account for the reductions anticipated by the Southern Water Use Caution Area (SWUCA) Recovery Strategy (SWFWMD, 2006b).

It is acknowledged that the above-mentioned groundwater modeling previously performed by each Applicant was consistent with the SWFWMD WUP process and Florida Statutes. Through that process, SWFWMD determined that the Applicants' future withdrawals will not cause adverse impacts to existing legal users, minimum flows and levels (MFLs), and other water resources. The simulations discussed herein should not be compared directly with those previously performed to support the WUP process, as the model domains, components, and objectives were different. While the simulations discussed herein are not identical to those performed to support the SWFWMD WUP process, the conclusions of the groundwater modeling conducted herein are similar to, and generally consistent with the WUP related findings of the SWFWMD.

2.0 Conceptual Model

2.1 Aquifer Systems

The hydrogeology of the Central Florida Phosphate District (CFPD) and the surrounding area consists of three primary aquifer systems: the SAS, the IAS, and the FAS.

2.1.1 Surficial Aquifer System

The top of the SAS is found at the top of the water table, and has a thickness of 25 to 50 feet over most of the study area (Florida Geological Survey, 2008, Plate 55). The SAS is composed of sand, silt, and carbonate sediments. It is generally unconfined, except for localized areas with lower permeability sediments that may be semi-confined or confined (Florida Geological Survey , 2008). The SAS is recharged through infiltration and percolation of rainfall and water from surface water bodies.

2.1.2 Intermediate Aquifer System

The IAS is composed of lower-permeability sediments between the SAS and the UFA. The sediments are primarily sand, silt, and clay in which laterally continuous higher-permeability intervals serve as local aquifers that are considered the IAS. The IAS is represented by two layers in the model; Layer 2 is Permeable Zone 1, and Layer 3 is Permeable Zone 2.

2.1.3 Floridan Aquifer System

The FAS is a regional carbonate aquifer system that is present throughout peninsular Florida, southern Georgia, and Alabama. The carbonates include interbedded limestone, dolostone, and dolomite with well developed permeability in distinct horizontal beds that are divided into the upper and lower intervals of the FAS. The FAS is recharged through infiltration and percolation of rainfall and water from surface water bodies in north-central Florida, where it is exposed at land surface and unconfined. Further south, the FAS is overlain by the IAS and surficial sediments, and it becomes a confined aquifer. In these areas, recharge and discharge to and from the FAS are at rates lower than in areas where the FAS is unconfined.

2.2 Conceptual Model of Groundwater Flow

The formations comprising the IAS and FAS dip to the south in the study area. A cross section of the geologic formations extending from north to south through the study area is shown in Figure 2 (Florida Geological Survey, 2008). The figure shows the formations associated with the IAS and FAS getting deeper from Polk to Charlotte Counties. The formations correspond to the aquifers so the aquifers are also getting deeper. The deeper IAS and UFA result in increasing differences between water levels in the SAS and UFA from north to south. Figure 3 depicts a hydrogeologic cross section from Bartow to Homeland that shows the formations and water levels of the SAS, IAS, and UFA (Metz and Lewelling, 2009). This figure shows the downward gradient in the aquifers that is present in approximately the northern one-third of the study area. Moving south of this area, the groundwater water levels continue to decline and only in the southern one-third of the study area do the IAS and UFA water levels approach the level of the SAS. Therefore, interaction between the groundwater and surface water systems is primarily from the SAS throughout the study area. The line of the geologic cross section is shown in Figure 3 (Metz and Lewelling, 2009).

The difference in SAS/UFA water levels is shown in hydrographs from monitoring well clusters in the study area. Figure 4 shows the locations of six well clusters that monitor the SAS, IAS, and UFA. Details of the well clusters follow:

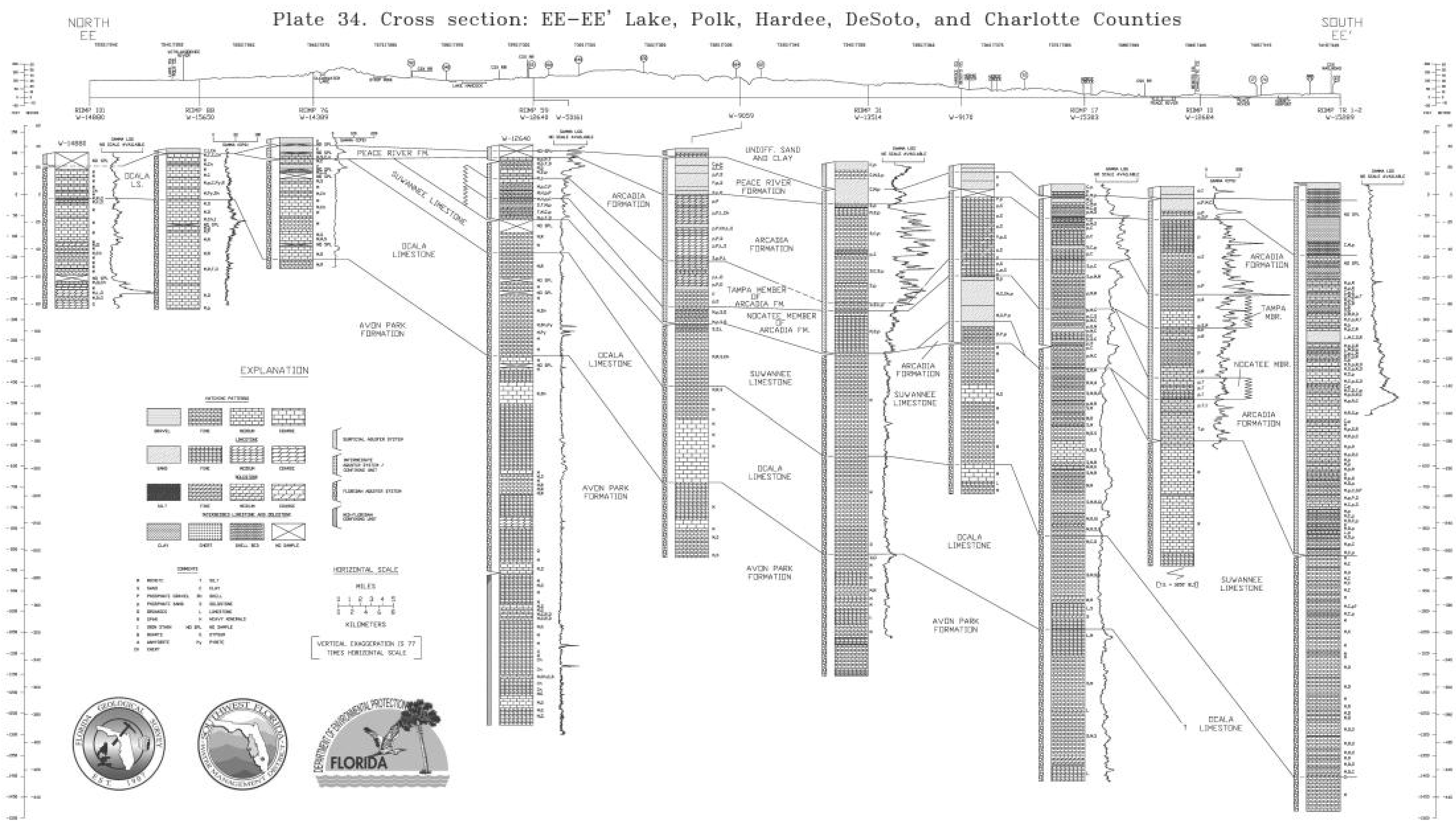
- In Regional Observation Monitoring-Well Program (ROMP) 85, the northernmost well cluster, the SAS and UFA water levels have approximately 15 feet of water level difference. ROMP 70, approximately 25 miles to the southeast of ROMP 85, exhibits approximately 80 feet of water level difference between the SAS and UFA.
- At ROMP 40, approximately 30 miles to the south of ROMP 70, the water levels in the two aquifers are separated by approximately 100 feet. The IAS Zone 1 aquifer level is approximately 10 feet less than the SAS at ROMP 40.
- At ROMP 25, approximately 20 miles to the south of ROMP 40, the water level in the IAS Zone 1 monitor well is about 20 feet less than the SAS and shows increased fluctuations as compared to the SAS. The water level in the UFA is approximately another 40 feet below the IAS Zone 1 and shows additional increased fluctuation.
- ROMP 30 is approximately 15 miles northeast of ROMP 25. The IAS Zone 1, IAS Zone 2, and UFA monitor well water levels are all virtually identical and the fluctuations consistently track one another. These water levels are about 30 feet lower than the SAS and have much greater variation in water level.
- ROMP 13, about 30 miles southeast of ROMP 30, shows a similar pattern. The IAS Zone 1, IAS Zone 2, and UFA monitor wells track one another with water levels about 15 feet below the SAS. All of the wells in the ROMP 13 have similar variation in the water level.

Figures 5 through 10 depict hydrographs from the six well pair clusters. Two additional wells in the IAS Zone 2, ROMP 14 and ROMP TR-9, were included because only two of the six well clusters included data for the IAS Zone 2 aquifer. The ranges in water levels for these monitor wells are presented in Table 1.

FIGURE 2

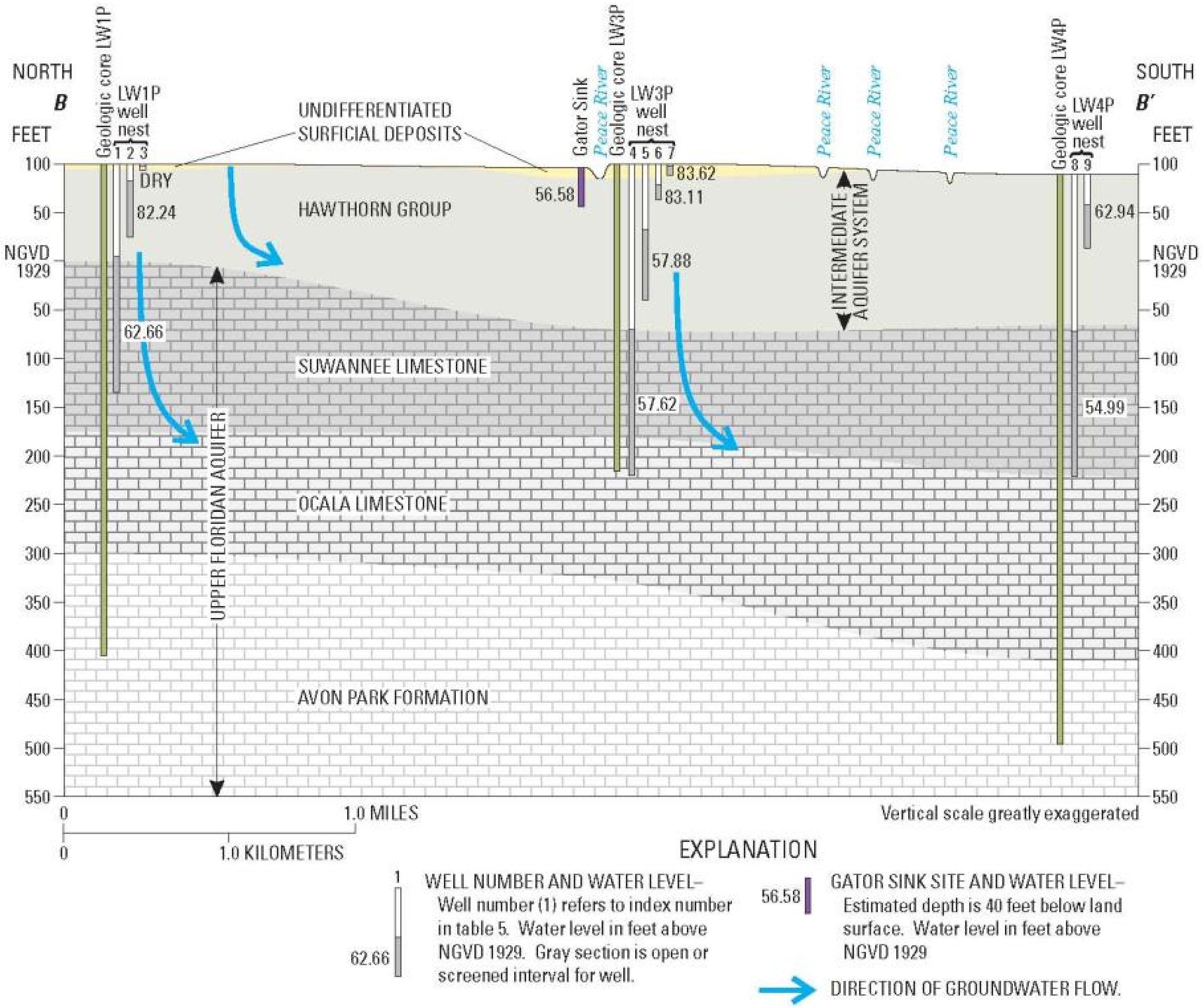
North to South Geologic Cross Section of the Study Area

Central Florida Phosphate District, Florida



Source: Florida Geological Survey, 2008

FIGURE 3
Hydrogeologic Cross Section from Bartow to Homeland
Central Florida Phosphate District, Florida



Source: Metz and Lewelling, 2009

FIGURE 4
Locations of Monitoring Well Clusters
Central Florida Phosphate District, Florida

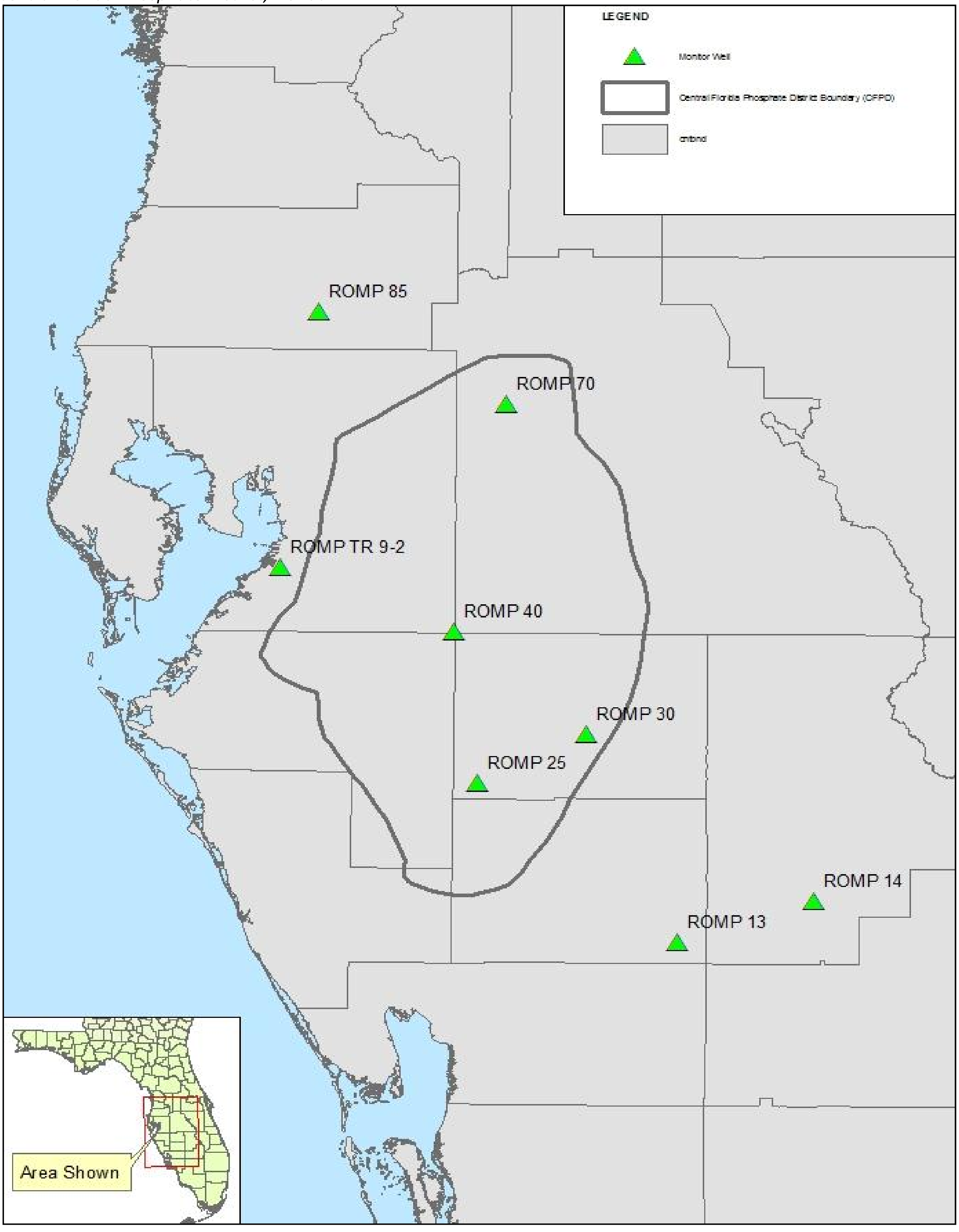


FIGURE 5
UFA, IAS and SAS Monitoring Well Clusters, ROMP 85
Central Florida Phosphate District, Florida

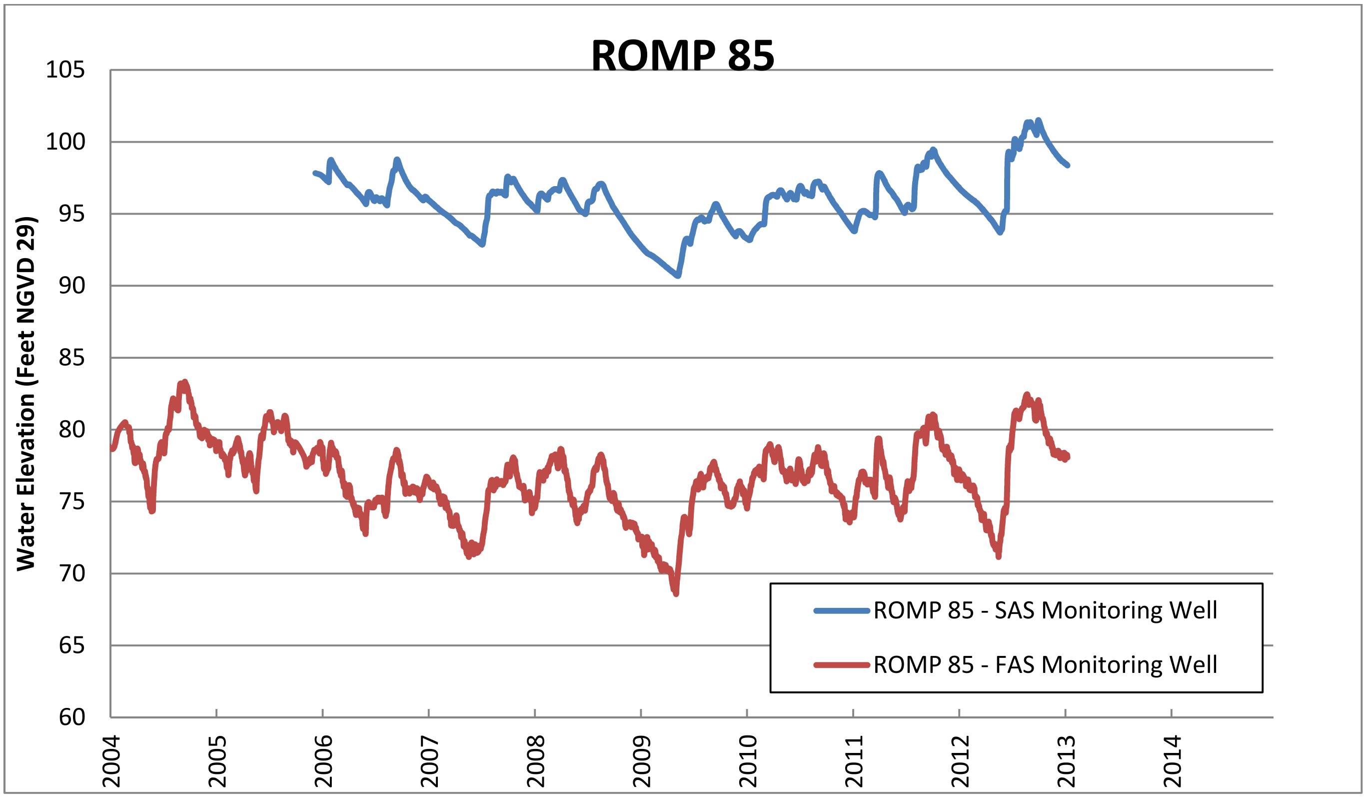


FIGURE 6
UFA, IAS and SAS Monitoring Well Clusters, ROMP 70
Central Florida Phosphate District, Florida

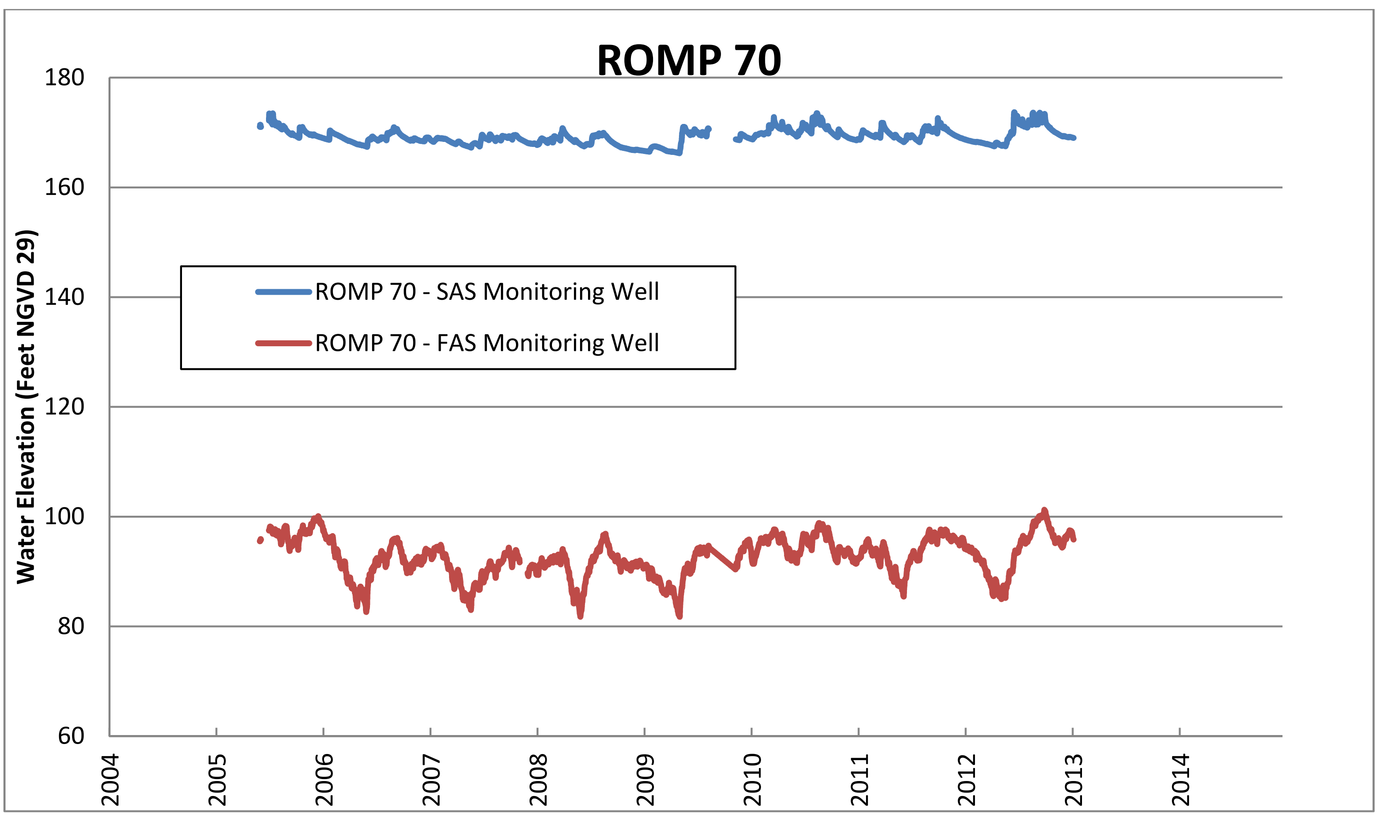


FIGURE 7
UFA, IAS and SAS Monitoring Well Clusters, ROMP 40
Central Florida Phosphate District, Florida

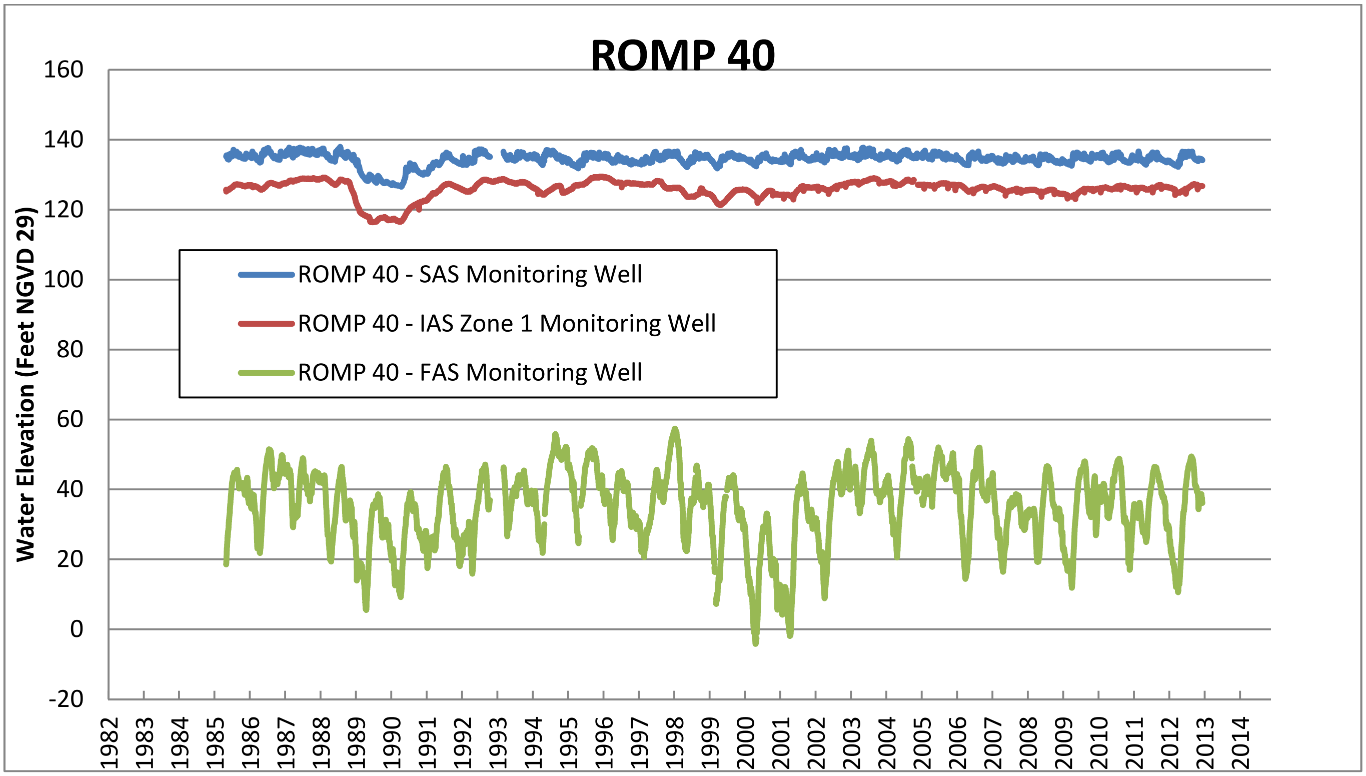


FIGURE 8
UFA, IAS and SAS Monitoring Well Clusters, ROMP 25
Central Florida Phosphate District, Florida

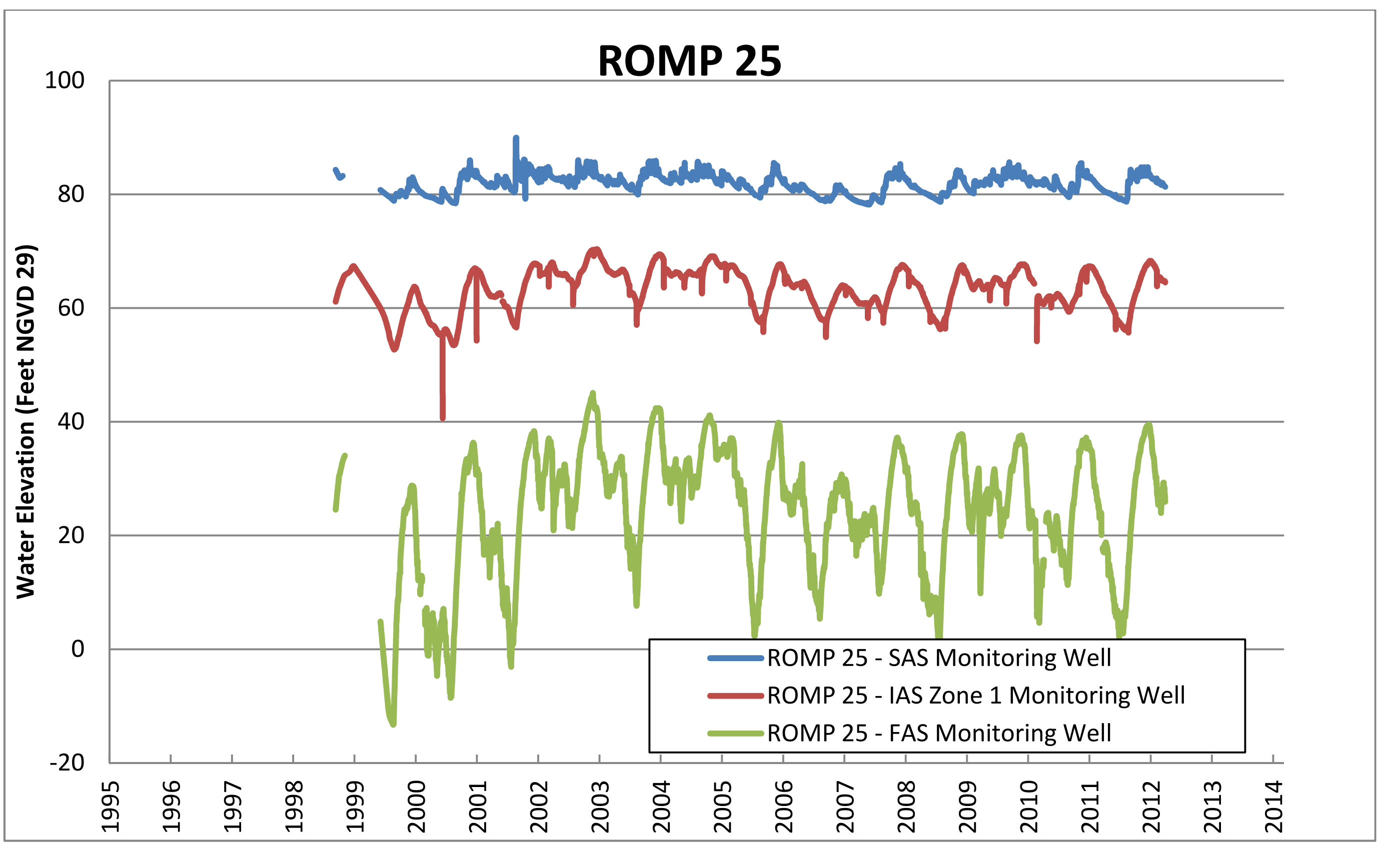


FIGURE 9
UFA, IAS and SAS Monitoring Well Clusters, ROMP 30
Central Florida Phosphate District, Florida

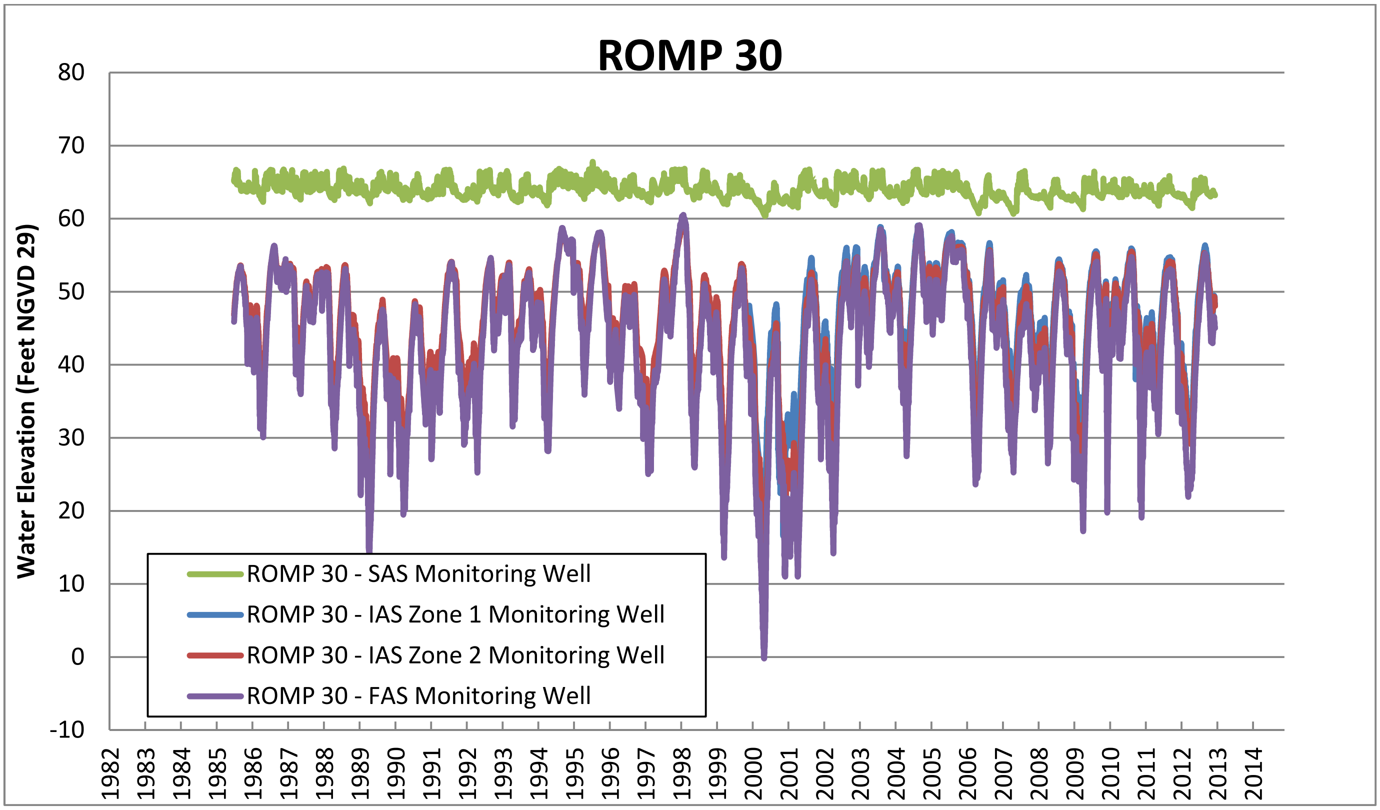


FIGURE 10
UFA, IAS and SAS Monitoring Well Clusters, ROMP 13
Central Florida Phosphate District, Florida

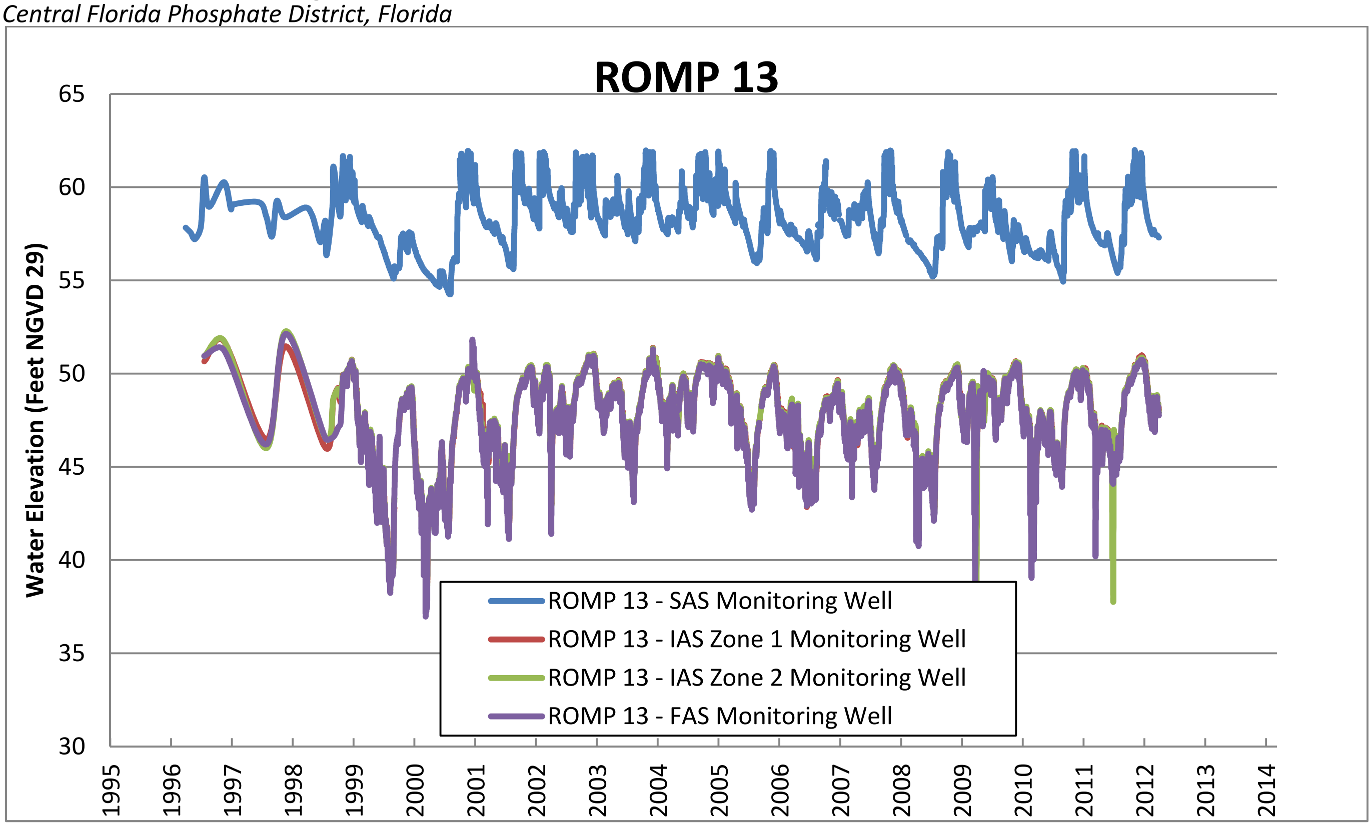


TABLE 1
Historical Groundwater Elevation [1]
Central Florida Phosphate District, Florida

Monitor Well		Maximum Water Elevation (ft)	Minimum Water Elevation (ft)	Change in Water Elevation (ft)	Dates of Monitor Data
ROMP 13 - SAS Monitoring Well		61.99	54.26	7.73	1/23/1997 to 1/18/2013
ROMP 25 - SAS Monitoring Well		89.93	78.22	11.71	7/7/1999 to 1/18/2013
ROMP 30 - SAS Monitoring Well		67.8	60.37	7.43	8/14/1995 to 1/18/2013
ROMP 40 - SAS Monitoring Well		137.93	126.62	11.31	6/18/1995 to 1/18/2013
ROMP 70 - SAS Monitoring Well		173.68	166.24	7.44	6/10/2005 to 1/14/2013
ROMP 85 - SAS Monitoring Well		101.51	90.68	10.83	12/19/2005 to 1/18/2013
ROMP 13 - IAS Zone 1 Monitoring Well		51.73	38.79	12.94	5/15/1997 to 1/18/2013
ROMP 25 - IAS Zone 1 Monitoring Well		70.35	40.6	29.75	7/7/1999 to 1/18/2013
ROMP 30 - IAS Zone 1 Monitoring Well		59.06	16.71	42.35	1/10/2000 to 1/18/2013
ROMP 40 - IAS Zone 1 Monitoring Well		93.89	80.57	13.32	9/19/2006 to 1/17/2013
ROMP 13 - IAS Zone 2 Monitoring Well		52.27	34.99	17.28	5/14/1997 to 1/18/2013
ROMP 14 - IAS Zone 2 Monitoring Well		117.09	104.17	12.92	9/12/1995 to 1/18/2013
ROMP 30 - IAS Zone 2 Monitoring Well		58.98	9.27	49.71	8/14/1985 to 1/18/2013
ROMP TR 9-2 - IAS Zone 2 Monitoring Well		14.79	-5.28	20.07	4/2/1992 to 1/18/2013
ROMP 13 - UFA Monitoring Well		52.13	36.97	15.16	5/14/1997 to 1/18/2013
ROMP 25 - UFA Monitoring Well	UFA	45.06	-13.28	58.34	7/7/1999 to 1/18/2013
ROMP 30 - UFA Monitoring Well	UFA	60.52	-0.2	60.72	8/14/1985 to 1/18/2013
ROMP 40 - UFA Monitoring Well	UFA	57.37	-4.15	61.52	6/18/1995 to 1/18/2013
ROMP 70 - UFA Monitoring Well	UFA	101.24	81.75	19.49	6/10/2005 to 1/14/2013
ROMP 85 - UFA Monitoring Well	UFA	83.78	66.98	16.8	7/1/1985 to 1/18/2013

[1] In feet National Geodetic Vertical Datum of 1929 (ft NGVD 29)

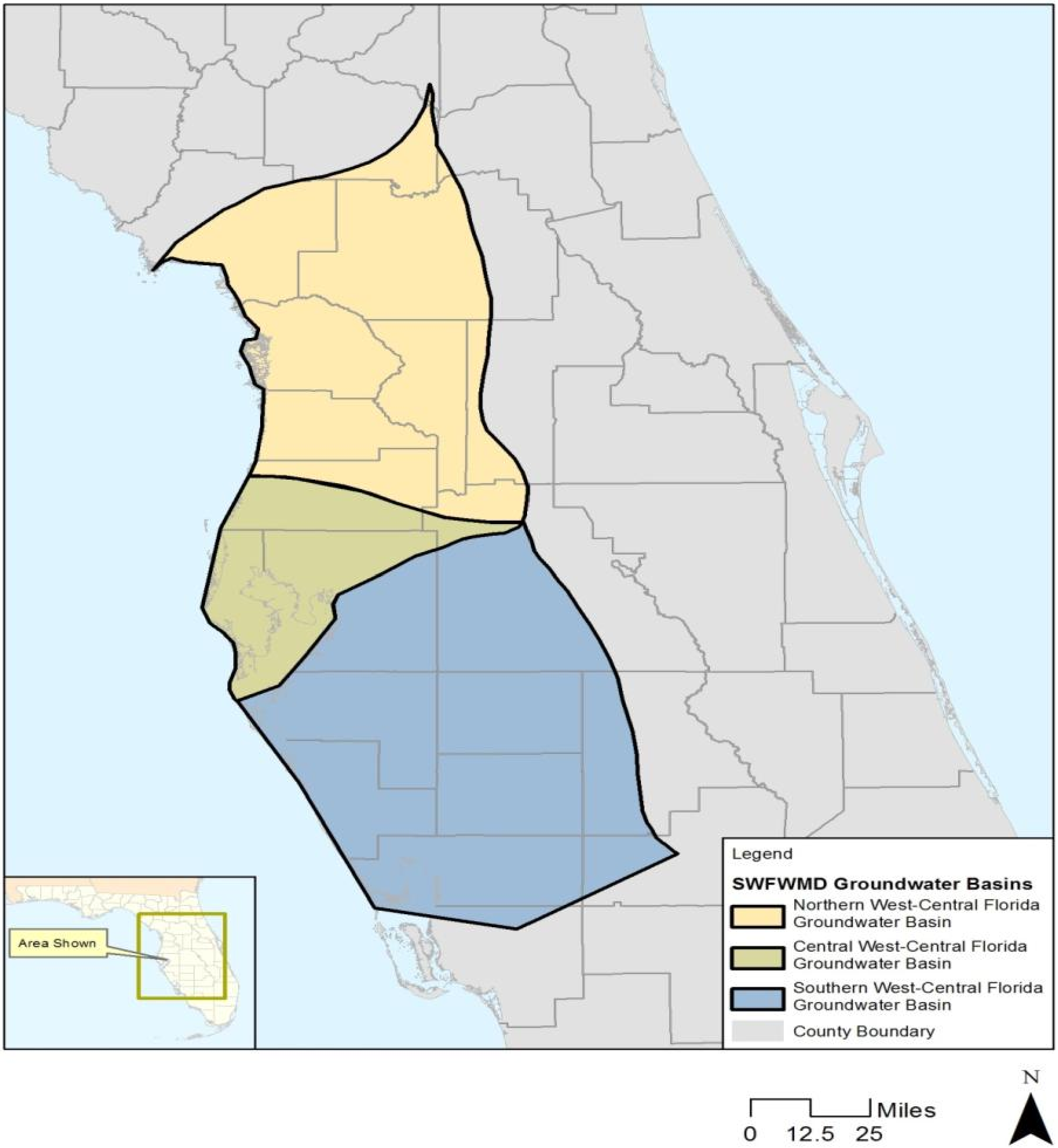
The SAS monitor well water levels range from 7.43 to 11.71 feet. The IAS Zone 1 monitor well water levels range from 12.94 to 42.35 feet. The IAS Zone 2 monitor well water levels range from 12.92 to 49.71 feet. The UFA monitor well water levels range from 15.16 to 61.52 feet. Generally, the deeper the aquifer, the greater the variation is in its water level. The water level variations shown are over a 10- to 25-year duration. Annual seasonal water level variation is expected to be somewhat smaller.

2.3 Hydrologic Boundaries

With the exception of offshore submarine discharge into the Gulf of Mexico and the Atlantic Ocean, the FAS does not contain lateral physical hydrologic boundaries. Groundwater divides that occur in areas where the water table or potentiometric surface is elevated, and are analogous to topographic ridges acting as surface water drainage basin divides, serve as local hydrologic flow boundaries. The area encompassed by one or more groundwater divides is referred to as a groundwater basin. Figure 11 depicts the groundwater basins identified by SWFWMD.

The boundaries of the model cover the counties within the SWFWMD. The model includes the Southern West-Central Florida Groundwater Basin which covers virtually all of the CFPD and the Southern Water Use Caution Area (SWUCA). It also includes the Most Impacted Area (MIA) within the SWUCA where the greatest risk of saltwater intrusion into the UFA exists per SWFWMD analyses. The technical criteria in these regulatory programs were incorporated into the AEIS evaluation, and regulatory program guidance for analyzing groundwater level impacts from mining was used in the modeling to evaluate potential groundwater use by the Applicants.

FIGURE 11
Groundwater Basins
Central Florida Phosphate District, Florida



3.0 Computer Code Selection

The DWRM2.1 (ESI, 2011) model was selected because it uses the industry standard MODFLOW code, which was developed (and is supported) by the U.S. Geological Survey (USGS). The model covers the entire study area and is used by SWFWMD for water use permitting and water supply planning. The model has sufficient layers (including the SAS, Zones 1 and 2 of the IAS, UFA, and lower Floridan aquifer [LFA]) to serve the purposes of the AEIS. The model was calibrated in 2008 in steady-state and transient mode for the years 1998 to 2006. The following models were considered, but none met all of the criteria required for the AEIS evaluation:

- **Northern Tampa Bay** – Hancock and Basso (1993)
- **Charlie Creek Basin and Peace River Watershed** – Lee et al. (2010)
- **Horse Creek Watershed** – SDI Environmental Services, 2003 (Charlotte County and Peace River/Manasota Regional Water Supply Authority)
- **Peace River Basin Integrated Modeling Project, PRIM** – BCI, HydroGeoLogic, Janicki, DHI (SWFWMD, 2010a)
- **Myakka River Watershed Initiative** – Interflow Engineering, LLC in association with Singhofen and Associates, Inc. (Interflow Engineering, LLC, 2008a)
- **Citrus Irrigation Hardee and DeSoto County** – Metz (1995)
- **Lake Wales Ridge and Adjacent Areas** – Yobbi (1996)
- **Eastern Tampa Bay Model** – Barcelo and Basso (1993)
- **SWUCA Model** – HydroGeoLogic (2002)
- **Southern District Model** – Beach and Chan (2003)
- **Peninsular Model** – Sepulveda (2002)

The Peace River and Myakka River integrated models were not readily available to the AEIS team or the public in general. It is understood that an integrated model of the entire Peace River watershed (PRIM) was never finalized. The Myakka River Watershed Initiative only looked at a portion of the watershed (Upper Myakka River), and would require extensive reconfiguration to incorporate more area. Detailed modeling also requires detailed input data for speculative future conditions. These data do not exist and a more complicated model will not provide more reliable results than its inputs. Table 2 includes a summary of the models and the selection criteria.

4.0 Model Construction

The DWRM2.1 model was run using Groundwater Vistas (ESI, 2011). Groundwater Vistas is a commercial groundwater model pre- and post-processor.

The DWRM2.1 model simulates the SAS, IAS, UFA, and the lower Floridan aquifer (LFA). The DWRM2.1 simulates this system with five layers. Table 3 summarizes the model layers and corresponding hydrostratigraphic units of the DWRM2.1 model.

Although the model includes the SAS and the IAS, the regional scale of the model limits the accuracy for evaluating regional water level changes to the SAS for the following reasons:

- The first difficulty in using DWRM2.1 to evaluate SAS water level changes in the CFPD is one of **spatial scale**. Many surface water features of interest to the AEIS (such as wetlands, streams, and small lakes) are essentially surface expressions of the SAS water table. While the size of these features varies, most are significantly smaller than the DWRM2.1 model's grid size. A finite-difference model grid that represented each individual surface water feature would result in a model that would be difficult to manage in terms of file size and run time. Additionally, refining the model grid without changing the underlying model coefficients would only increase the resolution of the model-calculated water levels and would not improve the accuracy of the simulation. The additional effort that would be required to collect detailed model coefficients necessary to provide the additional data is beyond the scope of the AEIS.
- Another issue with using the DWRM2.1 model to evaluate SAS impacts is one of **temporal scale**. The SAS quickly responds to rainfall events, and seasonal variations in precipitation and evapotranspiration can be seen in monitoring well and wetland hydrographs. Adding the temporal level of detail necessary to accurately represent these processes to simulate wetland and surface water levels over the entire CFPD would also result in a difficult to manage model, with no corresponding increase in predictive capability.

TABLE 2
Groundwater Model Selection Criteria
Central Florida Phosphate District, Florida

Description	Grid Spacing	Aquifers	Steady-State Period	Transient Simulation Period	Simulation Code	Adequate Coverage of Region	Relevant Calibration Period?	Adequate Model Layering?	Strength	Weakness	Comments
Northern Tampa Bay	1,320 to 5,280 ft	Surficial and Upper Floridan	May 1989	June 1989 to May 1990	MODFLOW	no	no	no		Model only covers Pasco and Hillsborough County.	
Charlie Creek Basin and Peace River Watershed	300 by 300 ft	Surficial		streamflow data only 2003 to 2005	MIKE-SHE	no	yes	no	Model integrates surface water and surficial aquifer	Only covers peace river basin, Does not simulate upper or lower Floridan aquifer	The exchange of groundwater between the surficial and Upper Floridan aquifers was represented in the model using a linear head-dependent flux boundary with a constant leakance value of 8.64 × 10-6 (ft/d)/ft, representing the vertical hydraulic properties of the Hawthorn Group based on data in Knochenmus (2006). This leakance value results in a net vertical flux of approximately 1 in/yr from the surficial aquifer to the Upper Floridan aquifer.
Peace River Watershed		3 layer groundwater model		streamflow data	MIKE-SHE and MIKE-11	no	yes	no	Model integrates surface water and surficial aquifer	Only covers Peace River basin	
Peace River Basin Integrated Modeling Project, PRIM	2,500 by 2,500 ft	Surficial, Intermediate, and Upper Floridan		1998 to 2002		no	yes	no	Model integrates surface water and surficial aquifer	Model only covers Peace River Basin	

TABLE 2
Groundwater Model Selection Criteria
Central Florida Phosphate District, Florida

Description	Grid Spacing	Aquifers	Steady-State Period	Transient Simulation Period	Simulation Code	Adequate Coverage of Region	Relevant Calibration Period?	Adequate Model Layering?	Strength	Weakness	Comments
Myakka River Watershed Initiative	410.1 by 410.1 ft	Surficial		1994 to 2006	MIKE-SHE and MIKE-11	no	yes	no	Model integrates surface water and surficial aquifer	Model only covers Myakka River Basin, Does not simulate upper or lower Floridan aquifer	The heads in the UFA are specified with an effective leakance between the SAS and UFA which represents multiple aquifers and confining units of the Intermediate aquifer. The UFA is represented by a time-varying series of specified heads developed from the USGS potentiometric surface maps.
Citrus Irrigation Hardee and DeSoto County	5,390 by 6,050 ft	Surficial, Intermediate, and Upper Floridan	September 1988	September 1988 to September 1989	MODFLOW	no	no	no		Model only cover DeSoto County, Calibrated prior to 1990 and does not simulate lower Floridan aquifer	
Lake Wales Ridge and Adjacent Areas	5,280 by 5,280 ft	Surficial, Intermediate, and Upper Floridan	September 1989	October 1989 to October 1990	MODFLOW	no	no	no		Model only covers Polk, Hardee and DeSoto County, Calibrated prior to 1990 and does not simulate lower Floridan aquifer	
Eastern Tampa Bay Model	2 miles	Surficial, Intermediate, and Upper Floridan	1989	October 1988 to September 1989	MODFLOW	yes	no	no		2-mile grid spacing and does not simulate lower Floridan aquifer	Southern District Model is based on this model

TABLE 2
Groundwater Model Selection Criteria
Central Florida Phosphate District, Florida

Description	Grid Spacing	Aquifers	Steady-State Period	Transient Simulation Period	Simulation Code	Adequate Coverage of Region	Relevant Calibration Period?	Adequate Model Layering?	Strength	Weakness	Comments
SWUCA Model	Variable, 2,500 to 5,000 ft	Surficial, Intermediate, and Upper Floridan		1990 to 2000	MODHMS	yes	yes	no		Does not simulate lower Floridan aquifer	Also includes variable-density flow, which may be useful for evaluating impacts associated with saltwater intrusion
DWRM2	5,000 by 5,000 ft	Surficial, Intermediate, Upper and Lower Floridan	Pre-Development and 2006	1995 to 2003	MODFLOW -2000	yes	yes	yes	Most recent model and is used by St. Johns River Water Management District (SJRWMD) to regulate water use and water supply planning		DWRM2 is based on the USGS Peninsular model but with an active water table and recalibrated to additional data.
Southern District Model	5,000 by 5,000 ft	Surficial, Intermediate, and Upper Floridan	1993	1993	MODFLOW	yes	yes	no		Does not simulate lower Floridan aquifer	
Peninsula Model	5,000 by 5,000 ft	Surficial (inactive), Intermediate, Upper and Lower Floridan	Average 1993-1994	N/A	MODFLOW	yes	yes	yes	Considered the benchmark Florida regional model	Does not include an active surficial aquifer	

TABLE 3
DWRM2.1 Model Layers
Central Florida Phosphate District, Florida

Model Layer	Hydrogeologic Unit
1	Surficial aquifer system (SAS)
2	Intermediate Aquifer System (IAS) – Permeable Zone 1
3	IAS – Permeable Zone 2
4	Upper Floridan Aquifer (UFA)
5	Lower Floridan Aquifer (LFA)

For these reasons, using the DWRM2.1 model to support the AEIS evaluations is appropriate for the UFA and the IAS, which both lack the small-scale changes in hydraulic properties and do not exhibit the same degree of temporal variation as the SAS. The SAS simulations do not reflect the rapid response of the SAS to rainfall events, local drainage patterns, and interaction with surface water bodies therefore the model very likely over-predicts the water level changes (up or down) within in the SAS.

4.1 Model Domain

As mentioned previously, the entire DWRM2.1 model was used for these simulations and the model boundaries contain the Southern West-Central Groundwater Basin. Figure 12 depicts the active cells in Layer 4 (UFA) of the model domain. The model consists of 222 rows and 144 columns. Cell dimensions are a uniform 5,000 feet by 5,000 feet.

4.2 Model Parameters

With the exception of the recharge package, no changes were made to any of the DWRM2.1 model properties. The changes made to the simulated pumping rates are described in Section 5. The recharge package of the DWRM2.1 model was revised using water budget information for the Preferred Alternative mines. Table 4 presents the multipliers developed to change the recharge for those alternatives within the mine boundaries, based on changes in evapotranspiration and runoff caused by activities in the specific mining areas, such as tree removal and new ditch and berm construction. The net recharge rate changes as each mine creates a unique change in evapotranspiration and runoff. These changes in net recharge are summarized as a multiplier applied to the base model recharge rate for the model cells comprising the Preferred Alternative mine footprint.

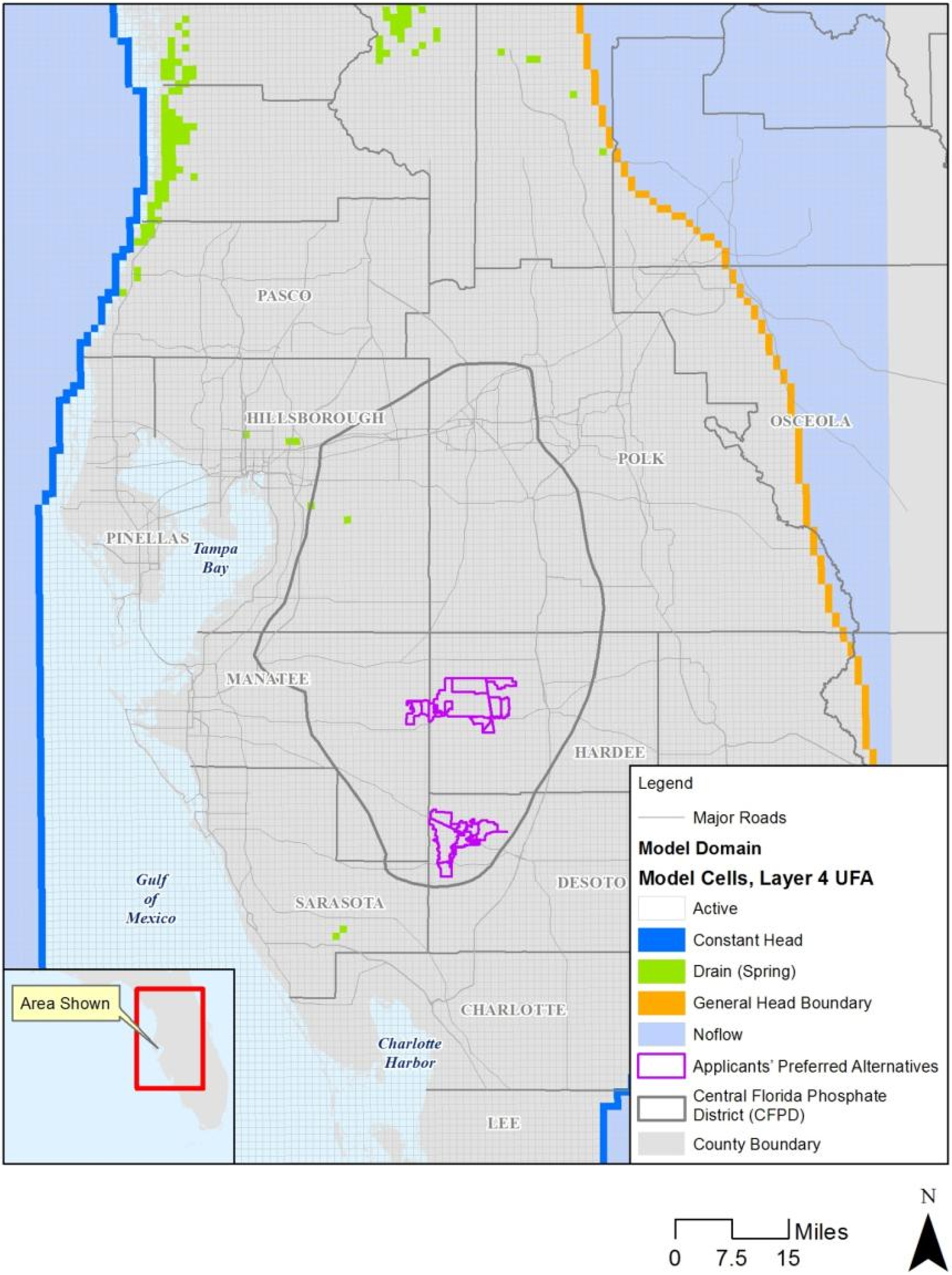
TABLE 4
Recharge Summary (Preferred Alternatives 2, 3, 4, and 5)
Central Florida Phosphate District, Florida

	Multiplier at Mine				Net Recharge at Mine (in/year)			
Year	Ona	Desoto	Wingate East	South Pasture	Ona	Desoto	Wingate East	South Pasture
2010	1.00	1.00	1.00	1.00	6.9	7.0	1.8	7.1
2019	1.00	1.00	0.68	0.92	6.9	7.0	1.2	6.5
2020	1.03	1.00	2.28	1.06	7.1	7.0	4.1	7.5
2025	1.28	1.98	1.64	1.70	8.8	13.9	3.0	12.1
2030	1.31	2.03	4.22	2.60	9.0	14.2	7.6	18.5
2036	1.68	2.60	4.63	0.65	11.6	18.2	8.3	4.6
2047	1.96	1.00	5.54	1.00	13.5	7.0	10.0	7.1
2049	1.82	1.00	3.62	1.00	12.6	7.0	6.5	7.1

4.3 Boundary Conditions

The full DWRM2.1 model was used with no changes to the boundary conditions.

FIGURE 12
DWRM2.1 Upper Floridan Aquifer (Layer 4) Model Cells
Central Florida Phosphate District, Florida



4.4 Model Calibration Targets and Goals

The DWRM2.1 model was revised from version 2.0 and the model remains consistent with the model development documentation. No additional calibration efforts were included as part of the modeling conducted for the AEIS. Table 5 summarizes the DWRM2.0 model steady-state calibration results.

TABLE 5
DWRM2.0 Calibration Statistics
Central Florida Phosphate District, Florida

Statistic	All Model	Layer 1 (SAS)	Layer 2 (IAS)	Layer 3 (IAS)	Layer 4 (UFA)
Number of Targets	10039	315	69	46	609
Range in Observed Values, ft	165.93	160.76	129.91	83.81	133.59
Minimum Residual, ft	-14.12	-14.12	-7.68	-7.65	-10.85
Maximum Residual, ft	19.77	19.77	8.40	11.08	15.12
Residual Mean, ft	0.23	0.62	-0.15	1.80	-0.04
Absolute Residual Mean, ft	3.03	3.33	2.30	3.21	2.95
Standard Deviation, ft	4.05	4.53	3.13	3.86	3.85
Residual Mean over Range, ft	0.1%	0.4%	-0.1%	2.2%	0.0%
Absolute Residual Mean over Range, ft	1.8%	2.1%	1.8%	3.8%	2.2%
Standard Deviation over Range, ft	2.4%	2.8%	2.4%	4.6%	2.9%

Notes:
Data from DWRM2.0 documentation (ESI, 2007), Table 3.5
No calibration statistics available for Layer 5 (LFA)
Source: ESI, 2007

Although there is no definitive standard for model calibration, ESI (2007) used the following criteria when calibrating the DWRM2.0 model and remain consistent for version 2.1:

- The residual standard deviation divided by the range in head targets should be less than 10 percent.
- The absolute residual mean divided by the range in head targets should be less than 10 percent.
- The residual mean divided by the range in head targets should be less than 5 percent.

All three criteria are met; the model is considered well-calibrated for all layers in the model except the LFA Layer 5. While the SAS has good steady state calibration statistics, the spatial and temporal factors described previously make any transient simulation of the SAS suspect. While the model achieves reasonable calibration to target water levels under steady state model conditions, the rapid response of the SAS to rainfall events, local drainage patterns, and interaction with surface water bodies are not reflected in the steady state calibration statistics. The IAS and UFA more reliably simulate actual conditions since changes that occur to those aquifers typically require months or years to develop, a timeframe more in line with steady-state conditions.

It should also be noted that the objectives of this groundwater modeling effort do not include accurately predicting the water level of the Floridan aquifer at some point in the future. Rather, the groundwater model described herein was used to evaluate the relative differences among potential alternative mining scenarios and to evaluate the water level change from those alternative mines in conjunction with other Floridan aquifer water use changes in the area.

In developing the DWRM2.1 model, ESI also performed a 7-year calibration to determine storage properties of the aquifers. The model used 125 calibration targets in the IAS and UFA. Transient calibration of the SAS was not attempted. Also, the River and Drain Cell elevations were not modified from steady state. As a result, the DWRM2.1 cannot simulate the SAS under transient conditions.

Any model is a simplification of real-world conditions. Simplification is necessary to develop an efficient predictive tool that can be applied to evaluate potential future conditions such as those considered here. The DWRM2.1 documentation discusses the simplifications, assumptions, and uncertainty associated with the model. Overall the DWRM2.1 model is considered well-calibrated, and its continued use for regulatory purposes by SWFWMD demonstrates that it is an acceptable tool for predicting and evaluating water level changes associated with groundwater withdrawals from the Floridan aquifer.

The following additional assumptions were made in developing the model scenarios discussed in this report:

- Future groundwater withdrawals in the model area will be consistent with the SWUCA recovery strategy. Should the SWUCA recovery strategy be revised at some point in the future, FAS allocations may be different than those simulated in this evaluation.
- It is assumed that the 50-million-gallon-per-day (mgd) reduction in UFA withdrawals from the SWUCA will come from agriculture, and that the reductions will be proportionally applied to all existing agricultural wells. It is acknowledged that it is more likely that agricultural allocations will be reduced as individual permits come up for renewal and/or agricultural land converts to other uses as land-use patterns change. For the AEIS simulations, a uniform approach was applied because there was no feasible way to identify which specific agricultural withdrawals would be involved in future reductions in allocations.
- The Applicants' withdrawal rates, presented in Table 6, are very conservative in that:
  - The mines would probably not be pumping at the maximum permitted drought rate for an entire year. This would be most likely for only a few months or during the dry season.
  - All of the mines would not be pumping at the maximum drought rate at the same time, given the rainfall variation in the area encompassed by the Applicants' Preferred Alternative mines.
  - The requirement for groundwater augmentation of the mine recirculation system depends on many factors, such as:
    a. Production rate of the beneficiation plant
    b. Available storage in the mine, which depends on the time within the life of the mine because:
       (1) Mine startup will require more pumping to fill (charge) the initial clay settling area.
       (2) The mine available storage depends on the clay settling areas (CSAs) available, open mine pits, and reclamation storage in wetlands and open water bodies.
    c. Rainfall within the mine capture area
    d. Number of draglines in operation and number of dredge ponds

TABLE 6
Mine Withdrawal Rate Comparison (mgd) No Action and Preferred Alternatives
Central Florida Phosphate District, Florida

Withdrawal Type	Four Corners	Hookers Prairie	Hopewell	Ona	Desoto	South Fort Meade	Wingate/ Wingate East	South Pasture	TOTAL
Average Conditions	11.2	3.2	0.5	7.9	7.1	8.7	5.8	3.52	47.92
Wet Conditions	6.5	1.8	0.5	4.3	4.2	5.9	5.8	0.70	29.70
Dry Conditions (used in "A" model scenarios)	15.6	4.2	0.5	11.9	10.7	11.3	5.8	6.39	66.39
Peak Month	19.5	5.3	0.6	14.9	13.4	14.1	7.3	7.5	
Flexible (used in "B" and "C" model scenarios)	20	5.8	N/A	15	N/A	15.4	N/A	N/A	N/A
2008 Actual	6.16	4.75	0.89	N/A	N/A	5.57	4.84	4.67	26.88
2009 Actual	6.28	3.71	1.01	N/A	N/A	3.37	5.16	2.14	21.67
2010 Actual	6.96	4.49	0.54	N/A	N/A	0.29	3.89	0.21	16.38
2011 Actual	5.54	3.65	0.06	N/A	N/A	0.21	3.79	0.41	13.66

Each mine has three withdrawal scenarios in its WUP, representing an average, wet, and dry condition. These are estimated from water budgets using average, above average, and below average precipitation. In addition, four of the mines have a flexible withdrawal rate that is meant only for short time periods. The actual withdrawal rates from 2008 to 2011 are presented in Table 6 to show that the actual withdrawal is usually less than the permitted average conditions withdrawal rate. The permitted two-in-ten drought year withdrawal rate is shown as the dry conditions withdrawal type in the table. This rate is used in all modeling scenarios (including the “A” scenarios), which is highly conservative. The model scenarios labeled “B” and “C” use the flexible pumping rates and are intended to evaluate the extreme worst-case scenarios for those particular mines. All model scenarios were run under steady state conditions.

4.5 Numerical Parameters

DWRM2.1 was run using the Pre-Conditioned Conjugate Gradient (PCG) solver, with head and residual closure tolerances of 0.001 foot and 1 foot, respectively.

5.0 Simulation Approach

5.1 Simulated Water Level Change in the SAS, IAS, and UFA

DWRM2.1 was used to evaluate drawdown in the SAS, IAS, and UFA relative to current conditions for the following alternatives:

- No Action Alternative
  - This alternative assumes that currently operating phosphate mines will continue to operate and that no new mines involving USACE issuance of CWA Section 404 permits will be constructed.
- Applicants’ Preferred Alternatives 2, 3, 4, and 5
  - Applicants’ Preferred Alternatives 2, 3, 4, and 5 assume that the Ona, Wingate East, and Desoto Mines and the South Pasture Mine Extension will operate for the time periods defined in their §404 applications, as modified by information provided in the respective WUPs issued by SWFWMD.

For the predictive simulations, groundwater pumpage for the Applicants was based on information provided by the Applicants or allocated quantities in the Applicants’ SWFWMD WUPs, and are described in greater detail in the discussions below for each alternative. The SWFWMD 2010 Regional Water Supply Plan (RWSP) (SWFWMD, 2010a) indicates that additional groundwater demands in the region for 2010 and the future will be met by sources other than fresh groundwater. Therefore, simulated groundwater withdrawals for other users in the model domain, with the exception of agriculture, were maintained at the 2006 withdrawal rates included in the DWRM2.1 model. It was assumed that withdrawal rates in the base year conditions of 2010 were the same as those in 2006, as there was very little growth in demand between 2006 and 2010. The total withdrawals by water use category for each aquifer and model layer in the SWUCA are shown in Table 7.

TABLE 7
Total Withdrawals by Use Category from DWRM2.1 Model Files (2006 actual and 2010 assumed) in the SWUCA, mgd
Central Florida Phosphate District, Florida

Water Use Category	SAS (Layer 1)	IAS Zone 1 (Layer 2)	IAS Zone 2 (Layer 3)	UFA (Layer 4)	LFA (Layer 5)	Total
Agriculture	10.74	6.46	14.29	351.16	1.64	384.30
Industrial/Commercial	0.04	0.23	0.10	31.94	1.16	33.46
Mining/Dewatering	0.00	0.04	0.29	27.69	0.01	28.03
Power	0.02	1.25	15.95	134.27	0.27	151.75
Recreation	0.32	1.60	2.87	23.57	0.26	28.62
Total	**11.12**	**9.57**	**33.50**	**568.63**	**3.34**	**626.16**

The SWUCA recovery strategy (SWFWMD, 2006b) assumes that groundwater use by agriculture will decrease by 50 mgd between 2005 and 2025. This reduction will meet the goal of limiting all FAS withdrawal allocations in the SWUCA to a total of an annual average rate of 600 mgd. For this analysis, a linear rate of decrease (-2.5 mgd/year) in agricultural withdrawal allocations was assumed to occur between 2005 and 2025.

This reduction was simulated as follows:

- 2010 12.5-mgd reduction
- 2020 37.5-mgd reduction
- 2030–2060 50-mgd reduction

These reductions were applied proportionally to each agricultural well in the SWUCA, based on the well's simulated withdrawals. While it is recognized that agricultural use reductions will not be uniform throughout the region, there is no reasonable methodology available to predict the future pattern of change; therefore, the uniform assumption is the best available method for incorporating the changes in agricultural use in the model.

Demands are presented in terms of conservative permitted drought year annual averages of water used for mineral extraction and transport to the beneficiation plants. The quantities include minor withdrawals of make-up water by pump sealing wells. The actual pumping rates vary depending on precipitation. Over the past decade, phosphate mines have used substantially less than their annual average water supply allocations because of modified water management practices, including a greater reliance on surface waters contained within their recirculation systems. For the AEIS evaluation, however, the conservative approach was taken toward analysis of potential effects of these proposed mine projects on the UFA. Model simulations were conducted using the permitted drought year annual average allocation rates rather than any projected actual UFA pumpages. The drought year pumping rate is determined using the 2 in 10-year drought event, as defined by SWFWMD. This is a drought level that statistically occurs on the average of twice in a given 10-year period. It also should be noted that the actual mining schedule may vary from that analyzed through these DWRM2.1 simulations because of market drivers or regulatory factors. Because such conservative input assumptions have been applied, the simulation results present a very conservative estimate of water level changes and are therefore worst-case scenarios.

Each model run consisted of a steady-state simulation for which drawdown was calculated and compared relative to 2010 conditions. While water demand projections were developed for every mine for the years 2010 through 2050, model runs were only conducted for years in which there were significant changes in withdrawals relative to adjacent years (for example, a new mine might begin operating, or a mine might have shut down). Many years have the same pumpage as the preceding and following years. In these situations no additional information would be gained by running annual simulations, as the results would be identical.

5.2 Simulated Water Level Changes on the SWFWMD's Saltwater Intrusion Metric

SWFWMD has established a Saltwater Intrusion Minimum Aquifer Level (SWIMAL) for the SWUCA (SWFWMD, 2002b). This level is the "*minimum aquifer level necessary to prevent significant harm caused by saltwater intrusion in the UFA in the SWUCA*." Progress meeting the SWIMAL water level targets is calculated each year based on the 10-year average water level in 10 specific SWFWMD monitoring wells in the SWUCA. Each well is assigned a weight based on a geographic information system (GIS) analysis performed by SWFWMD. The individual well averages and weights are used to develop a single SWIMAL value for the aquifer to assess progress toward attaining the target water level.

As this study evaluated simulated drawdown rather than aquifer levels, the simulated water level change at each observation well was multiplied by the adjusted SWIMAL weight to obtain a weighted water level change for the well. Individual weighted water level changes were summed to quantify the simulated change in the SWIMAL for each model run.

5.3 Simulated Water Level Changes on Regional ROMP Monitoring Wells

The simulated water level change is presented in ROMP 85 monitor wells that are within the model domain: 16 wells in Layer 1, 17 wells in Layer 2, 18 wells in Layer 3, and 34 wells in Layer 4. The locations of all of these SWFWMD reference wells are depicted in Figures 13 through 16. Unlike the SWIMAL, the water level change at each of these wells is assessed separately. The monitor wells were selected from a database of 1,304 wells in the SWFWMD. The 85 wells were selected because they comprised the network of wells within the SWUCA, were not located close to one another, represented a good distribution across the study area, and were completed in each of the aquifer zones of interest (SAS, IAS, and UFA).

FIGURE 13
Locations of SAS ROMP Wells – Layer 1
Central Florida Phosphate District, Florida

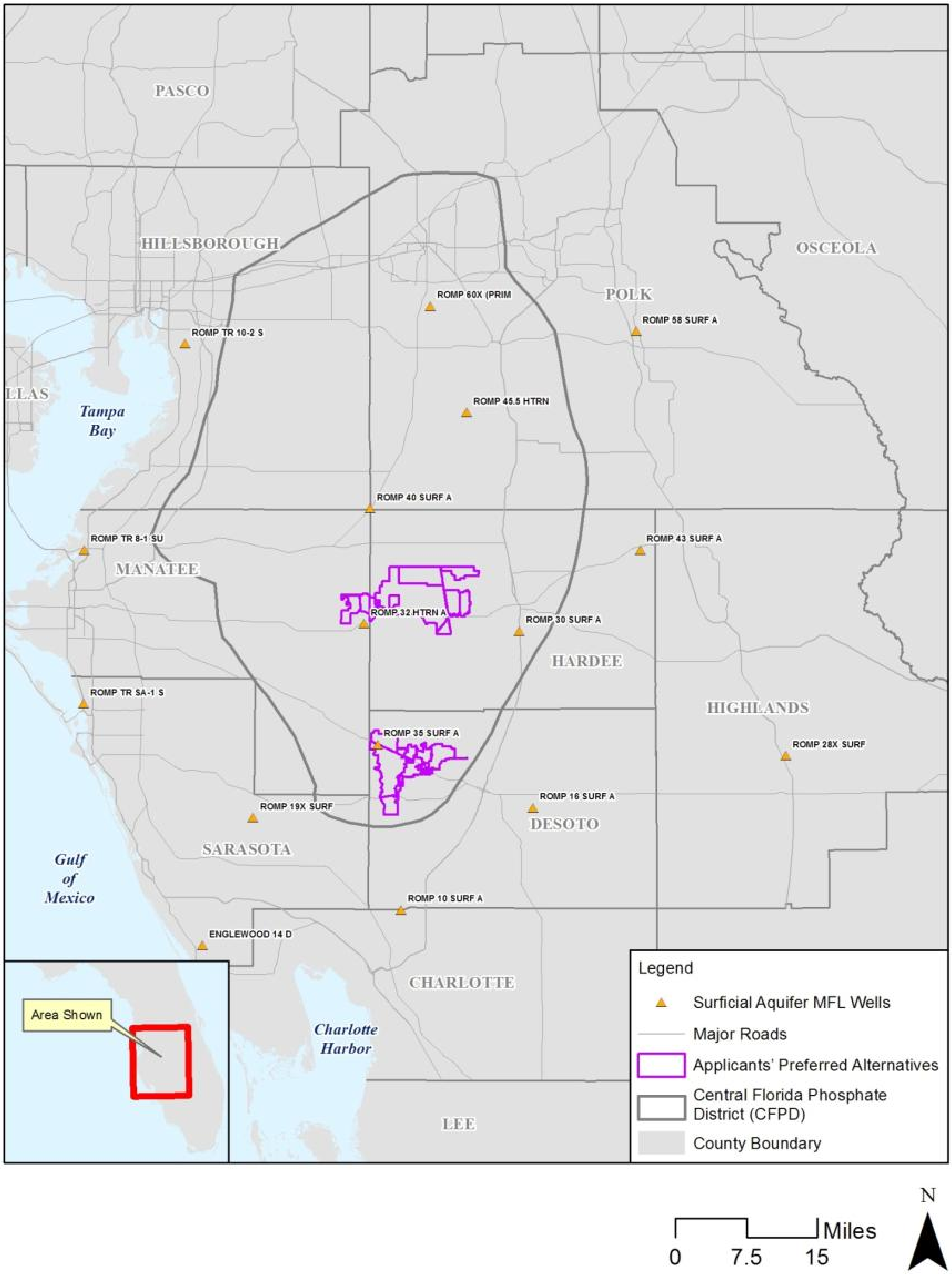


FIGURE 14
Locations of IAS Zone 1 ROMP Wells – Layer 2
Central Florida Phosphate District, Florida

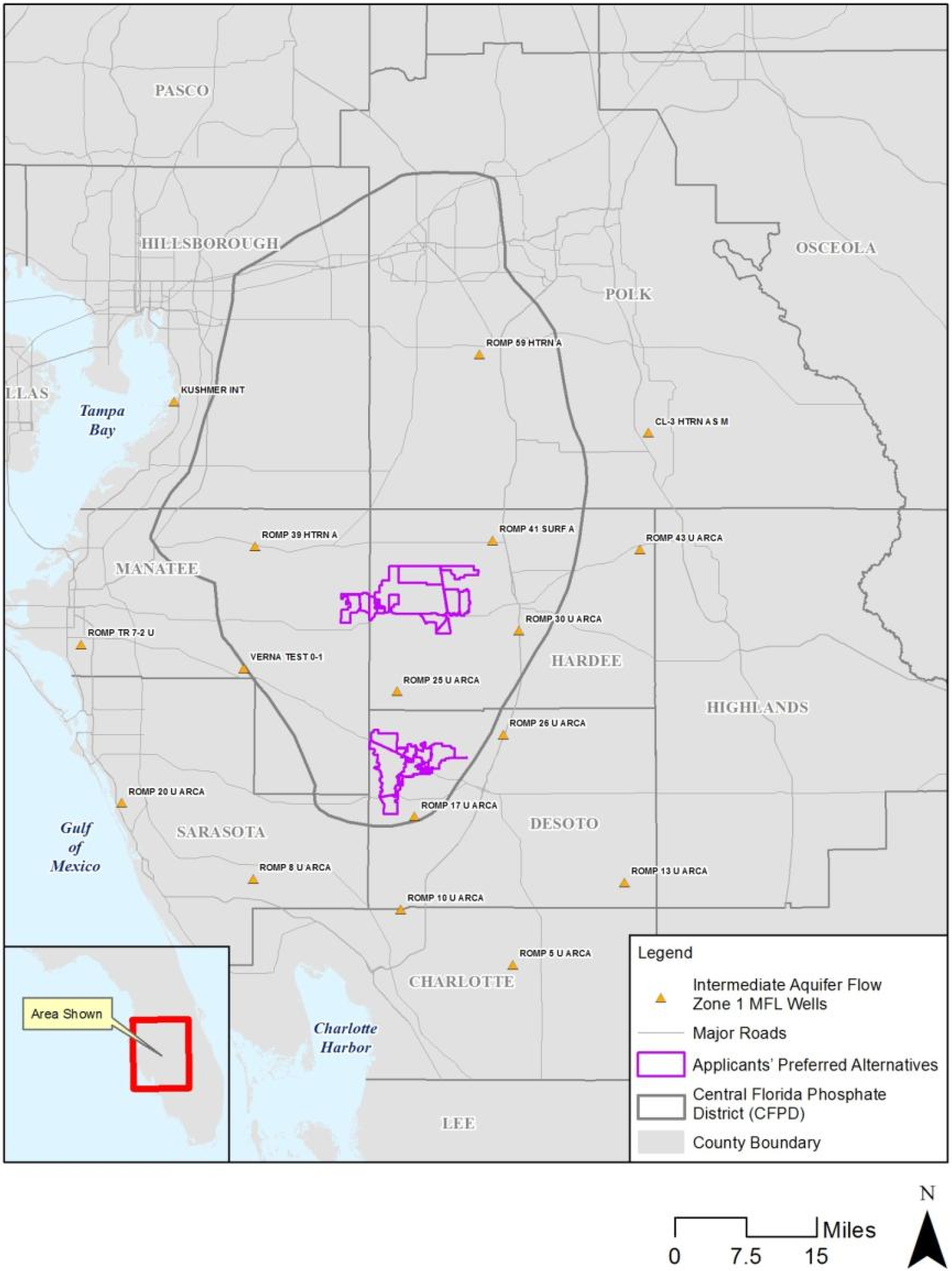


FIGURE 15
Locations of IAS Zone 2 ROMP Wells – Layer 3
Central Florida Phosphate District, Florida

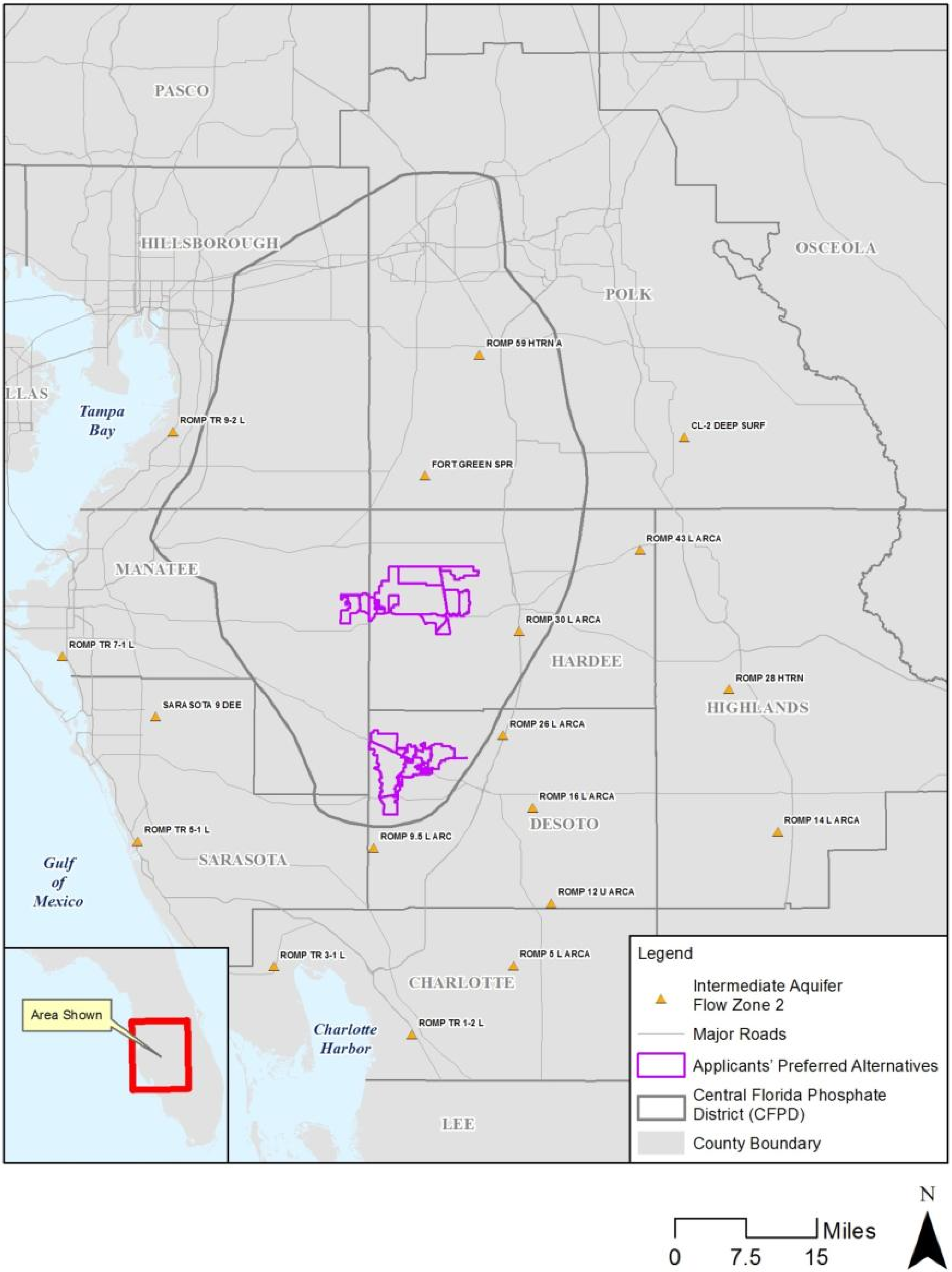
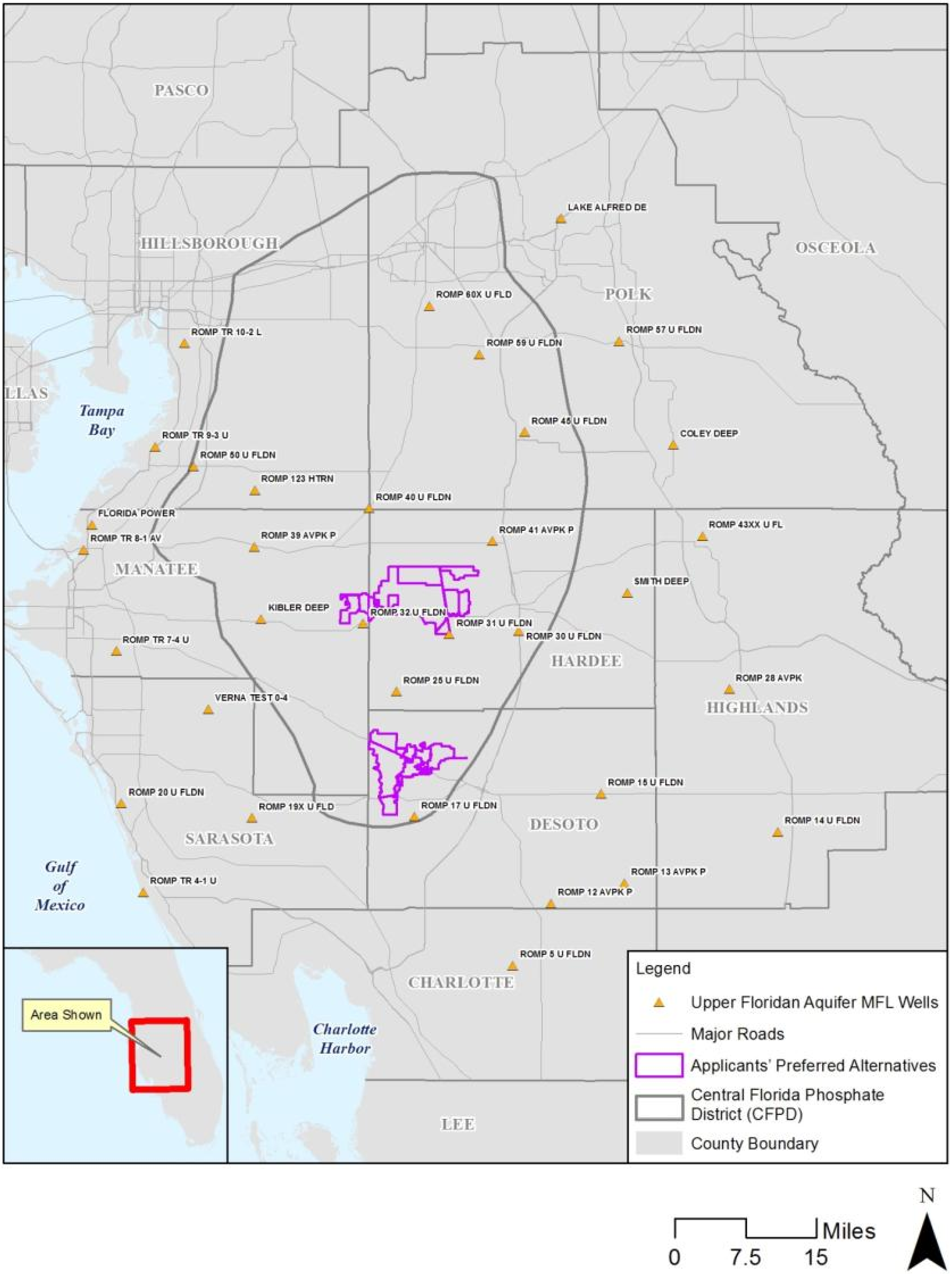


FIGURE 16
Locations of UFA ROMP Wells – Layer 4
Central Florida Phosphate District, Florida



6.0 Results

6.1 Alternative 1 – No Action

The No Action Alternative assumes that the Applicants' Preferred Alternative mines are not permitted by the USACE with regard to the CWA Section 404 applications currently under agency review. Existing permitted mines would continue operations through their currently permitted acreages; no additional infill projects are included in this analysis. The projected operational periods summarized in this TM are based on the best available information derived from the existing Mosaic and CF Industries WUPs, with operational projections beyond the current WUP periods based on information provided by the Applicants to support the AEIS.

Under the No Action Alternative scenario, there are no additional Floridan aquifer withdrawals for phosphate mining for any new mines. Table 8 summarizes the projected permitted drought year withdrawal rates for the currently operating mines that will operate through 2025. Highlighted rows indicate years for which steady-state model simulations were conducted and output was generated. In the No Action Alternative modeling results (Figures 17 through 20), the areas within which changes in drawdown or rebound of each aquifer layer of 0.5 foot or greater are shaded to reflect the areas within the study area influenced by the indicated simulation conditions. The magnitude of these zones of drawdown or rebound should be reviewed in relation to the water level variations historically experienced within the study area, as reflected in the ROMP well water level records summarized in Figures 5 through 10 and Table 1. For these wells, the records reflect seasonal variations of 20 to 40 feet, suggesting that the simulation results indicate only localized and relatively minor influence of phosphate mining withdrawals on the overall water levels within the AEIS study area.

TABLE 8
Projected Floridan Aquifer Groundwater Withdrawal Rates (mgd) - Alternative 1
Central Florida Phosphate District, Florida

Year	Four Corners	Hookers Prairie	Hopewell	Ona	Desoto	South Fort Meade	Wingate	South Pasture	Total
2010	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2011	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2012	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2013	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2014	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2015	15.6	0	0.5	0	0	11.3	5.8	6.39	39.59
2016	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2017	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2018	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2019	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2020	0	0	0	0	0	11.3		6.39	17.69
2021	0	0	0	0	0	0	0	6.39	6.39
2022	0	0	0	0	0	0	0	6.39	6.39
2023	0	0	0	0	0	0	0	6.39	6.39
2024	0	0	0	0	0	0	0	6.39	6.39
2025	0	0	0	0	0	0	0	6.39	6.39
2026	0	0	0	0	0	0	0	0.00	0.00
2027	0	0	0	0	0	0	0	0.00	0.00
2028	0	0	0	0	0	0	0	0.00	0.00
2029	0	0	0	0	0	0	0	0.00	0.00
2030	0	0	0	0	0	0	0	0.00	0.00

FIGURE 17
Simulated Water Change in SAS (Model Layer 1) Water Level (ft) 2010 to 2025
Alternative 1 (Existing Mining Only with no Agicultural Reduction)
Central Florida Phosphate District, Florida

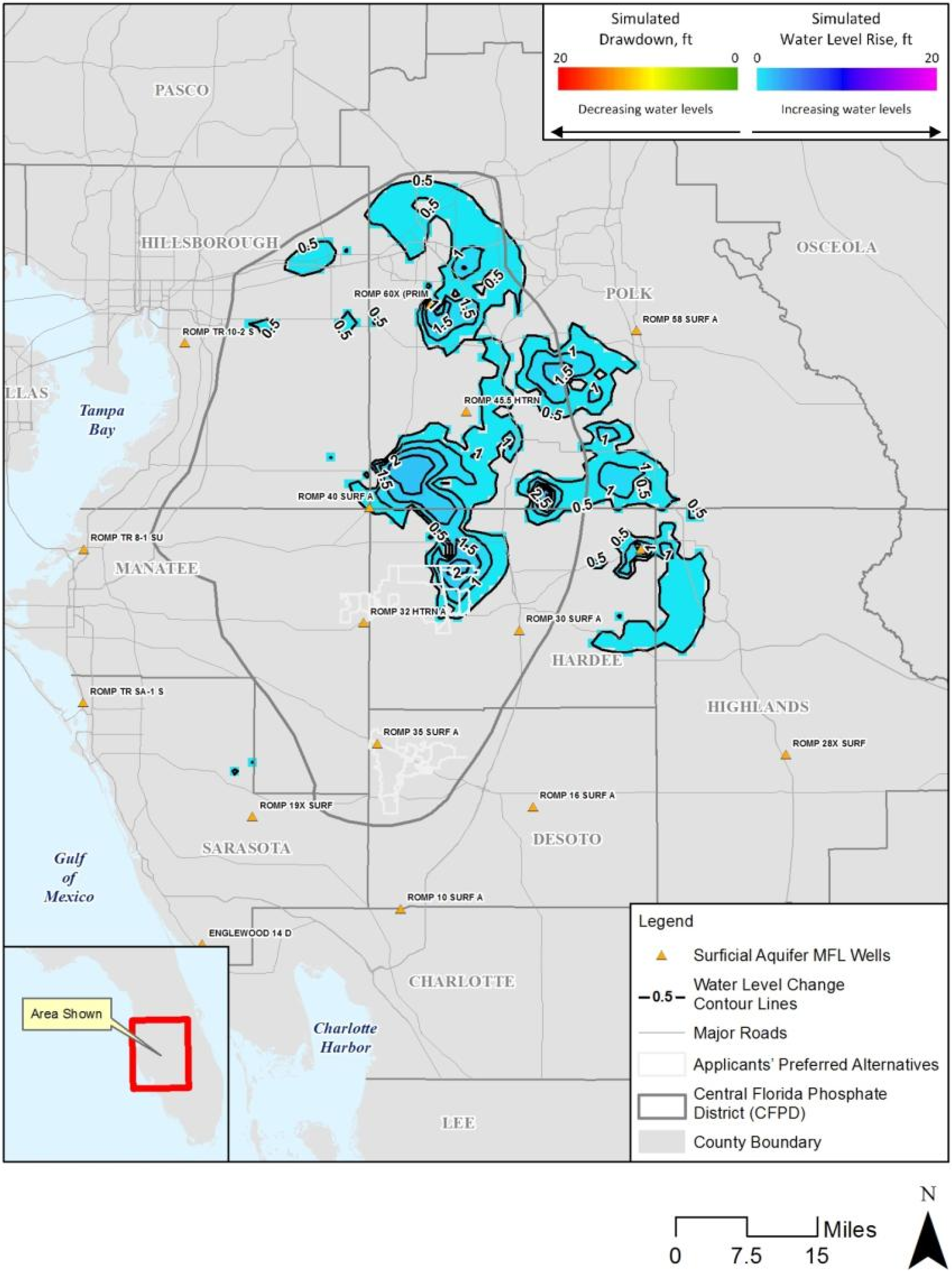


FIGURE 18
Simulated Water Change in IAS Zone 1 (Model Layer 2) Water Level (ft) 2010 to 2025
Alternative 1 (Existing Mining Only with no Agicultural Reduction)
Central Florida Phosphate District, Florida

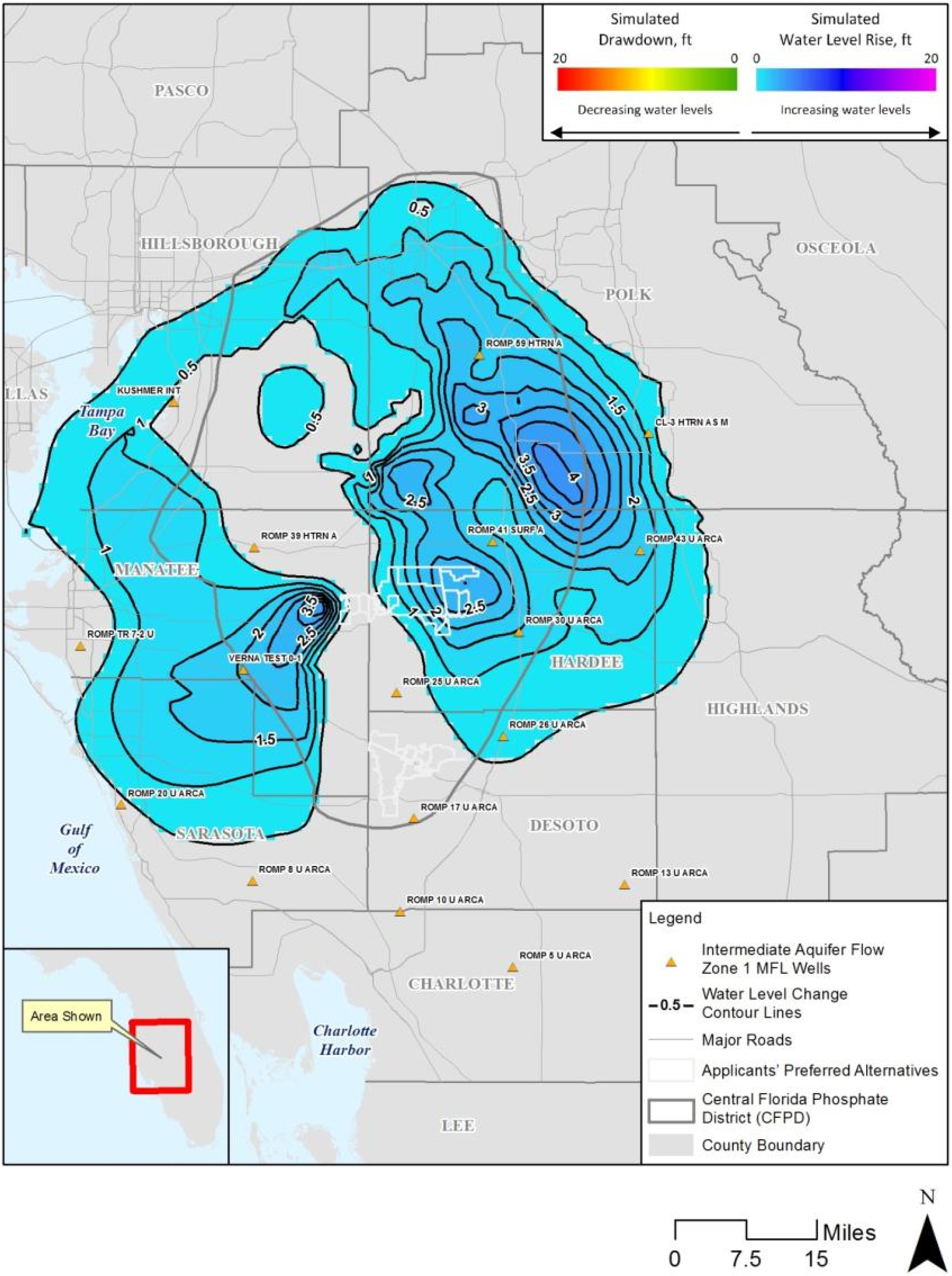


FIGURE 19
Simulated Water Change in IAS Zone2 (Model Layer 3) Water Level (ft) 2010 to 2025
Alternative 1 (Existing Mining Only with no Agicultural Reduction)
Central Florida Phosphate District, Florida

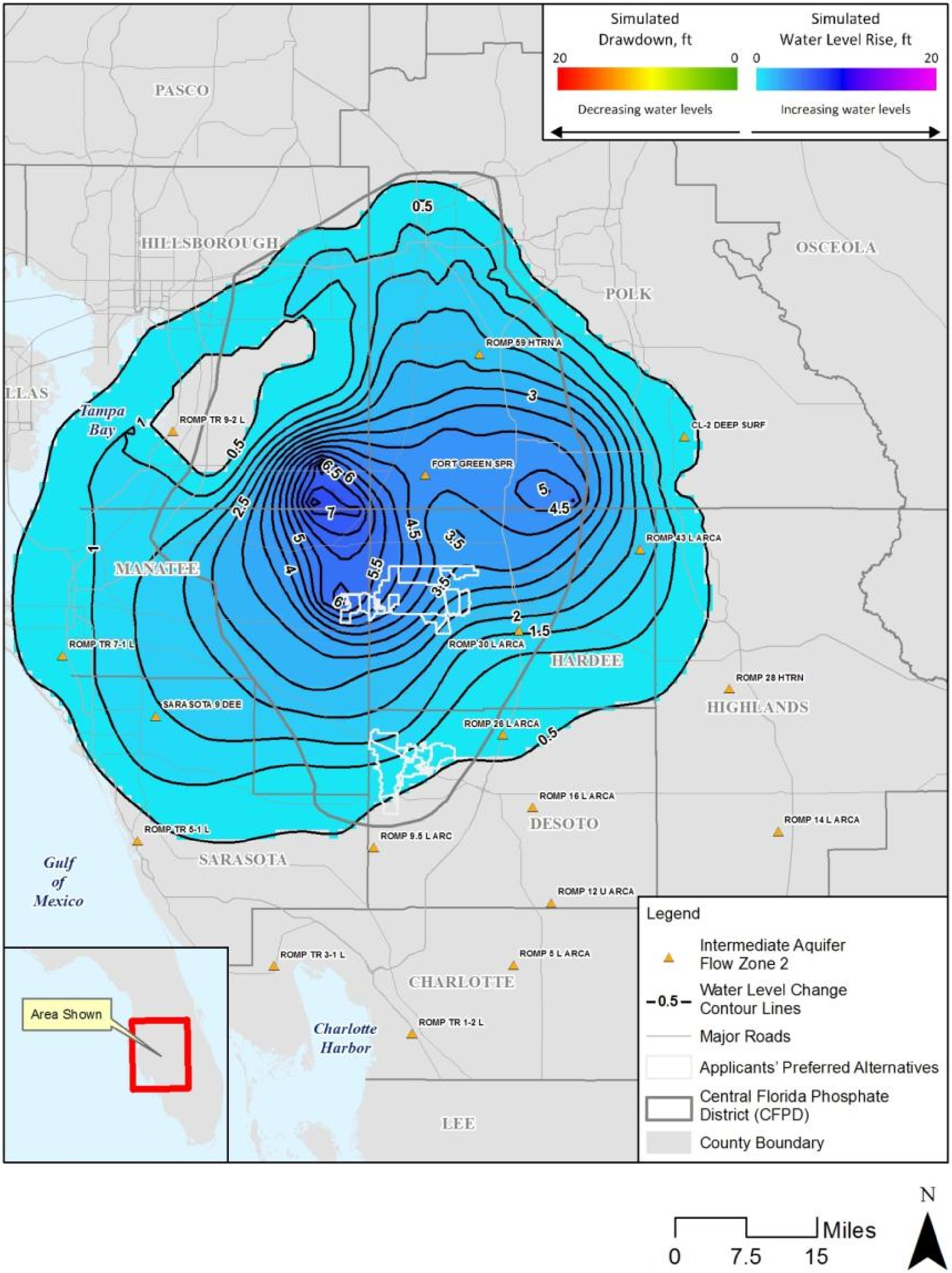
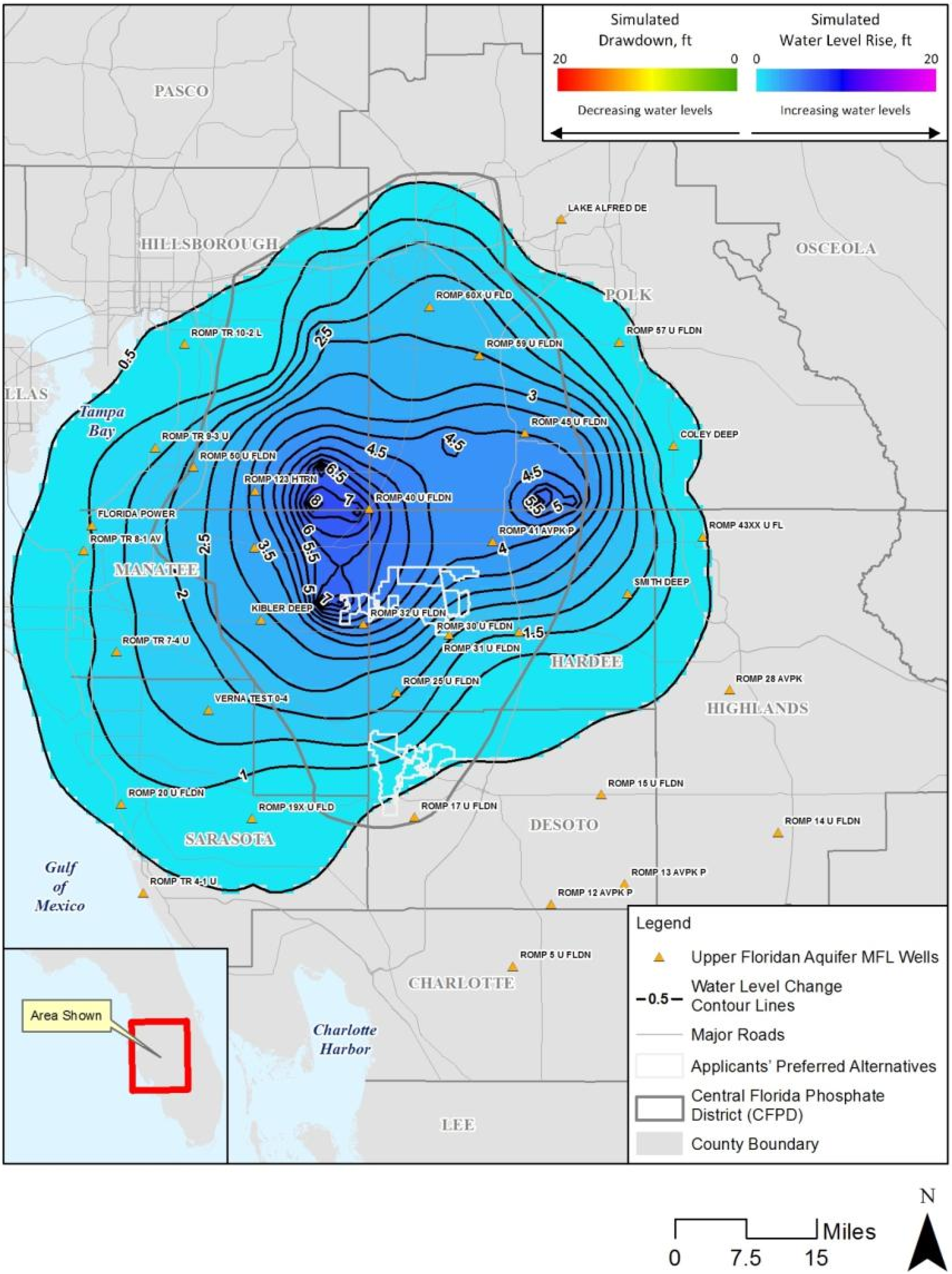


FIGURE 20
Simulated Water Change in Upper Floridan Aquifer (Model Layer 4) Water Level (ft) 2010 to 2025
Alternative 1 (Existing Mining Only with no Agicultural Reduction)
Central Florida Phosphate District, Florida



6.1.1 Simulated Aquifer Water Level Changes

Too many figures would be required to graphically represent every scenario for four aquifer layers (166 figures); therefore, only representative figures are presented for the year 2025. Tables 9 through 12 provide representative monitor well coverage of the CFPD for all four aquifer layers and show the changes in water level.

6.1.1.1 2010 to 2015

Tables 9 through 12 depict the simulated change in aquifer water levels from existing mining in 2015 relative to 2010 (other users at 2010 rates, no agricultural withdrawal reduction), assuming that the Applicants' Preferred Alternative mines are not permitted by the USACE with regard to the CWA Section 404 applications currently under agency review. By 2015, it is assumed that Four Corners will be withdrawing 15.6 mgd (unchanged from 2010) and Hookers Prairie will have ceased operating. Hopewell, South Fort Meade, Wingate, and South Pasture are assumed to continue operating at their 2010 withdrawal rates of 0.5 mgd, 11.3 mgd, 5.8 mgd, and 6.39 mgd, respectively. The simulated water level increases (indicated by positive values) in all monitor wells in every layer, with the greatest increases of 0.71 foot in Layer 3 at Fort Green Springs (Table 11) and 0.69 foot in Layer 4 at ROMP 45 (Table 12). The SWIMAL value increases by 0.09 foot relative to 2010 as shown on Table 12.

TABLE 9
Simulated SAS ROMP Monitor Well Water Level Change Relative to 2010, Alternative 1 (Existing Mining Only with no Agricultural Reduction) Layer 1
Central Florida Phosphate District, Florida

		Existing Mining Only Simulated Water Level Change Relative to 2010 (ft)			
Well	**SWIMAL Weight***	**2015**	**2020**	**2025**	**2030**
ENGLEWOOD 14 DEEP	NA	0.00	0.00	0.00	0.00
ROMP 10 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00
ROMP 16 SURF AQ MONITOR	NA	0.00	0.01	0.01	0.01
ROMP 19X SURF AQ MONITOR	NA	0.00	0.03	0.04	0.04
ROMP 28X SURF AQ MONITOR	NA	0.00	0.01	0.01	0.02
ROMP 30 SURF AQ MONITOR	NA	0.01	0.04	0.07	0.08
ROMP 32 HTRN AS MONITOR	NA	0.00	0.05	0.06	0.08
ROMP 35 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00
ROMP 40 SURF AQ MONITOR	NA	0.05	0.52	0.61	0.72
ROMP 43 SURF AQ MONITOR REPL	NA	0.17	0.58	1.45	1.69
ROMP 45.5 HTRN CU MONITOR	NA	0.06	0.18	0.29	0.35
ROMP 58 SURF AQ MONITOR	NA	0.05	0.17	0.30	0.36
ROMP 60X (PRIM SC06) SURF AQ MONITOR	NA	0.25	0.96	1.34	1.54
ROMP TR 10-2 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00
ROMP TR 8-1 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00
ROMP TR SA-1 SURF	NA	0.00	0.01	0.01	0.01

Note:
* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 10
Simulated IAS Zone 1 ROMP Monitor Well Water Level Change Relative to 2010, Alternative 1 (Existing Mining Only with no Agricultural Reduction) Layer 2
Central Florida Phosphate District, Florida

Well	SWIMAL Weight*	Existing Mining Only Simulated Water Level Change Relative to 2010 (ft)			
		2015	2020	2025	2030
CL-3 HTRN AS MONITOR	NA	0.10	0.34	0.80	0.93
KUSHMER INT	NA	0.02	0.23	0.26	0.29
ROMP 10 U ARCA AQ MONITOR 2	NA	0.01	0.09	0.12	0.14
ROMP 13 U ARCA AQ MONITOR	NA	0.02	0.19	0.26	0.32
ROMP 17 U ARCA AQ MONITOR	NA	0.03	0.25	0.34	0.40
ROMP 20 U ARCA AQ MONITOR	NA	0.02	0.37	0.42	0.48
ROMP 25 U ARCA AQ MONITOR	NA	0.02	0.15	0.20	0.25
ROMP 26 U ARCA AQ MONITOR	NA	0.05	0.38	0.54	0.66
ROMP 30 U ARCA AQ MONITOR	NA	0.16	0.84	1.45	1.82
ROMP 39 HTRN AS MONITOR	NA	0.01	0.19	0.21	0.24
ROMP 41 SURF AQ MONITOR	NA	0.23	0.91	1.62	2.11
ROMP 43 U ARCA AQ MONITOR	NA	0.21	0.72	1.83	2.13
ROMP 5 U ARCA AQ MONITOR	NA	0.03	0.23	0.31	0.38
ROMP 59 HTRN AS MONITOR 1	NA	0.37	1.32	1.98	2.32
ROMP 8 U ARCA AQ MONITOR	NA	0.02	0.23	0.28	0.33
ROMP TR 7-2 U ARCA AQ MONITOR	NA	0.00	0.04	0.04	0.05
VERNA TEST 0-1	NA	0.10	1.85	2.08	2.34

Note:
* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 11
Simulated IAS Zone 2 ROMP Monitor Well Water Level Change Relative to 2010, Alternative 1 (Existing Mining Only with no Agricultural Reduction) Layer 3
Central Florida Phosphate District, Florida

		Existing Mining Only Simulated Water Level Change Relative to 2010 (ft)			
Well	**SWIMAL Weight***	**2015**	**2020**	**2025**	**2030**
CL-2 DEEP SURF AQ MONITOR	NA	0.08	0.25	0.59	0.68
FORT GREEN SPRINGS INT	NA	0.71	2.86	4.19	5.12
ROMP 12 U ARCA AQ MONITOR	NA	0.03	0.26	0.36	0.44
ROMP 14 L ARCA AQ MONITOR	NA	0.01	0.05	0.07	0.08
ROMP 16 L ARCA AQ MONITOR	NA	0.03	0.30	0.42	0.50
ROMP 26 L ARCA AQ MONITOR	NA	0.05	0.38	0.54	0.66
ROMP 28 HTRN	NA	0.01	0.08	0.14	0.16
ROMP 30 L ARCA AQ MONITOR	NA	0.18	0.91	1.59	1.98
ROMP 43 L ARCA AQ MONITOR	NA	0.21	0.73	1.85	2.16
ROMP 5 L ARCA AQ MONITOR	NA	0.03	0.23	0.32	0.38
ROMP 59 HTRN AS MONITOR 2	NA	0.41	1.49	2.24	2.63
ROMP 9.5 L ARCA AQ MONITOR (MW-2)	NA	0.03	0.34	0.44	0.53
ROMP TR 1-2 L ARCA AQ MONITOR	NA	0.01	0.06	0.09	0.10
ROMP TR 3-1 L ARCA AQ MONITOR 2	NA	0.02	0.27	0.34	0.41
ROMP TR 5-1 L ARCA AQ MONITOR	NA	0.02	0.32	0.37	0.42
ROMP TR 7-1 L ARCA AQ INTERFACE MONITOR	8.84%	0.04	0.68	0.76	0.86
ROMP TR 9-2 L ARCA AQ MONITOR	NA	0.02	0.27	0.31	0.34
SARASOTA 9 DEEP	8.66%	0.07	1.28	1.44	1.63

Note:
* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 12
Simulated ROMP UFA Monitor Well Water Level Change Relative to 2010, Alternative 1 (Existing Mining Only with no Agricultural Reduction) Layer 4
Central Florida Phosphate District, Florida

		Existing Mining Only Simulated Water Level Change Relative to 2010 (ft)			
Well	**SWIMAL Weight***	**2015**	**2020**	**2025**	**2030**
COLEY DEEP	NA	0.09	0.30	0.71	0.83
FLORIDA POWER FLDN AT PINEY POINT	NA	0.05	0.91	1.03	1.15
KIBLER DEEP	14.01%	0.14	2.61	2.92	3.28
LAKE ALFRED DEEP AT LAKE ALFRED	NA	0.03	0.12	0.18	0.21
ROMP 12 AVPK PZ MONITOR	NA	0.03	0.26	0.36	0.44
ROMP 123 HTRN AS/U FLDN AQ MONITOR	9.55%	0.19	3.34	3.72	4.11
ROMP 13 AVPK PZ MONITOR	NA	0.02	0.19	0.27	0.33
ROMP 14 U FLDN AQ MONITOR (AVPK)	NA	0.01	0.05	0.07	0.08
ROMP 15 U FLDN AQ MONITOR MOD	NA	0.03	0.28	0.39	0.48
ROMP 17 U FLDN AQ MONITOR (AVPK)	NA	0.04	0.34	0.45	0.54
ROMP 19X U FLDN AQ MONITOR (SWNN)	NA	0.04	0.51	0.62	0.72
ROMP 20 U FLDN AQ MONITOR (OCAL)	NA	0.03	0.55	0.62	0.71
ROMP 25 U FLDN AQ MONITOR	NA	0.12	1.73	2.04	2.41
ROMP 28 AVPK	NA	0.02	0.08	0.14	0.17
ROMP 30 U FLDN AQ MONITOR	NA	0.18	0.91	1.59	1.98
ROMP 31 U FLDN AQ MONITOR	NA	0.19	1.56	2.11	2.73
ROMP 32 U FLDN AQ MONITOR (AVPK)	NA	0.24	4.00	4.56	5.38
ROMP 39 AVPK PZ MONITOR	NA	0.16	3.03	3.37	3.75
ROMP 40 U FLDN AQ MONITOR	NA	0.44	5.66	6.55	7.53
ROMP 41 AVPK PZ MONITOR	NA	0.62	2.26	4.16	5.29
ROMP 43XX U FLDN AQ MONITOR	NA	0.06	0.23	0.54	0.63
ROMP 45 U FLDN AQ MONITOR (AVPK)	NA	0.69	2.08	3.98	4.75
ROMP 5 U FLDN AQ MONITOR (SWNN)	NA	0.03	0.23	0.32	0.38
ROMP 50 U FLDN AQ MONITOR (SWNN)	13.25%	0.12	1.94	2.17	2.41
ROMP 57 U FLDN AQ MONITOR	NA	0.12	0.38	0.70	0.83
ROMP 59 U FLDN AQ INTERFACE MONITOR	NA	0.47	1.68	2.52	2.95
ROMP 60X U FLDN AQ MONITOR	NA	0.41	1.61	2.32	2.70
ROMP TR 10-2 L ARCA AQ MONITOR	5.41%	0.05	0.55	0.64	0.71
ROMP TR 4-1 U FLDN AQ INTERFACE MONITOR	NA	0.02	0.36	0.42	0.48
ROMP TR 7-4 U FLDN AQ MONITOR (SWNN)	13.54%	0.06	1.14	1.28	1.44
ROMP TR 8-1 AVPK PZ MONITOR	14.08%	0.05	0.81	0.91	1.02
ROMP TR 9-3 U FLDN AQ MONITOR (SWNN)	7.17%	0.08	1.22	1.37	1.53
SMITH DEEP	NA	0.18	0.66	1.59	1.88
VERNA TEST 0-4	5.50%	0.08	1.55	1.74	1.97
Simulated Change in SWIMAL, ft		0.09	1.58	1.77	1.98

Note:
* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

Tables 13 through 16 depict the No Action Alternative Existing Mining and All Users and are similar to the previous tables; however, they include the impacts from the reduction in agricultural pumpage. The simulated reduction in agricultural use of 50 mgd results in a simulated water level rise in all monitor wells in every layer, with the greatest increases of 1.14 at Fort Green Springs (Table 15) and 1.13 at ROMP 45 (Table 16). The SWIMAL value increases by 0.58 foot, as shown in Table 16.

TABLE 13
Simulated SAS ROMP Monitor Well Water Level Change Relative to 2010, Alternative 1 (Existing Mining and All Users with Agricultural Reduction) Layer 1
Central Florida Phosphate District, Florida

		Existing Mining and All Users Simulated Water Level Change Relative to 2010 (ft)			
Well	**SWIMAL Weight***	**2015**	**2020**	**2025**	**2030**
ENGLEWOOD 14 DEEP	NA	0.00	0.00	0.00	0.00
ROMP 10 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00
ROMP 16 SURF AQ MONITOR	NA	0.01	0.02	0.03	0.03
ROMP 19X SURF AQ MONITOR	NA	0.02	0.06	0.08	0.09
ROMP 28X SURF AQ MONITOR	NA	0.03	0.06	0.09	0.09
ROMP 30 SURF AQ MONITOR	NA	0.03	0.08	0.13	0.15
ROMP 32 HTRN AS MONITOR	NA	0.01	0.71	0.73	0.74
ROMP 35 SURF AQ MONITOR	NA	0.00	0.00	0.01	0.01
ROMP 40 SURF AQ MONITOR	NA	0.11	0.63	0.79	0.89
ROMP 43 SURF AQ MONITOR REPL	NA	0.49	1.24	2.43	2.67
ROMP 45.5 HTRN CU MONITOR	NA	0.09	0.25	0.39	0.45
ROMP 58 SURF AQ MONITOR	NA	0.23	0.52	0.83	0.88
ROMP 60X (PRIM SC06) SURF AQ MONITOR	NA	0.43	1.27	1.77	1.95
ROMP TR 10-2 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00
ROMP TR 8-1 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00
ROMP TR SA-1 SURF	NA	0.00	0.01	0.02	0.02

Note:
* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 14
Simulated IAS Zone 1 ROMP Monitor Well Water Level Change Relative to 2010, Alternative 1 (Existing Mining and All Users with Agricultural Reduction) Layer 2
Central Florida Phosphate District, Florida

		Existing Mining and All Users Simulated Water Level Change Relative to 2010 (ft)			
Well	**SWIMAL Weight***	**2015**	**2020**	**2025**	**2030**
CL-3 HTRN AS MONITOR	NA	0.36	0.85	1.56	1.69
KUSHMER INT	NA	0.09	0.37	0.47	0.50
ROMP 10 U ARCA AQ MONITOR 2	NA	0.09	0.24	0.35	0.37
ROMP 13 U ARCA AQ MONITOR	NA	0.23	0.60	0.88	0.94
ROMP 17 U ARCA AQ MONITOR	NA	0.25	0.71	1.02	1.08
ROMP 20 U ARCA AQ MONITOR	NA	0.18	0.69	0.90	0.96
ROMP 25 U ARCA AQ MONITOR	NA	0.10	0.35	0.48	0.53
ROMP 26 U ARCA AQ MONITOR	NA	0.40	1.10	1.61	1.73
ROMP 30 U ARCA AQ MONITOR	NA	0.60	1.77	2.81	3.18
ROMP 39 HTRN AS MONITOR	NA	0.07	0.32	0.40	0.43
ROMP 41 SURF AQ MONITOR	NA	0.44	1.42	2.33	2.81
ROMP 43 U ARCA AQ MONITOR	NA	0.62	1.56	3.06	3.36
ROMP 5 U ARCA AQ MONITOR	NA	0.25	0.69	1.00	1.06
ROMP 59 HTRN AS MONITOR 1	NA	0.61	1.82	2.71	3.05
ROMP 8 U ARCA AQ MONITOR	NA	0.16	0.52	0.70	0.75
ROMP TR 7-2 U ARCA AQ MONITOR	NA	0.02	0.06	0.08	0.09
VERNA TEST 0-1	NA	0.73	3.13	3.98	4.25

Note:
* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 15

Simulated IAS Zone 2 ROMP Monitor Well Water Level Change Relative to 2010, Alternative 1 (Existing Mining and All Users with Agricultural Reduction) Layer 3

Central Florida Phosphate District, Florida

		Existing Mining and All Users Simulated Water Level Change Relative to 2010 (ft)			
Well	**SWIMAL Weight***	**2015**	**2020**	**2025**	**2030**
CL-2 DEEP SURF AQ MONITOR	NA	0.38	0.86	1.49	1.58
FORT GREEN SPRINGS INT	NA	1.14	3.76	5.49	6.42
ROMP 12 U ARCA AQ MONITOR	NA	0.30	0.81	1.18	1.25
ROMP 14 L ARCA AQ MONITOR	NA	0.07	0.19	0.27	0.29
ROMP 16 L ARCA AQ MONITOR	NA	0.33	0.91	1.33	1.41
ROMP 26 L ARCA AQ MONITOR	NA	0.40	1.10	1.60	1.72
ROMP 28 HTRN	NA	0.13	0.30	0.47	0.50
ROMP 30 L ARCA AQ MONITOR	NA	0.65	1.92	3.06	3.45
ROMP 43 L ARCA AQ MONITOR	NA	0.62	1.58	3.09	3.40
ROMP 5 L ARCA AQ MONITOR	NA	0.25	0.70	1.01	1.07
ROMP 59 HTRN AS MONITOR 2	NA	0.69	2.06	3.07	3.46
ROMP 9.5 L ARCA AQ MONITOR (MW-2)	NA	0.32	0.93	1.33	1.41
ROMP TR 1-2 L ARCA AQ MONITOR	NA	0.06	0.18	0.26	0.28
ROMP TR 3-1 L ARCA AQ MONITOR 2	NA	0.23	0.69	0.97	1.03
ROMP TR 5-1 L ARCA AQ MONITOR	NA	0.17	0.62	0.81	0.86
ROMP TR 7-1 L ARCA AQ INTERFACE MONITOR	8.84%	0.29	1.20	1.53	1.63
ROMP TR 9-2 L ARCA AQ MONITOR	NA	0.11	0.46	0.59	0.63
SARASOTA 9 DEEP	8.66%	0.55	2.26	2.89	3.08

Note:

* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 16
Simulated UFA ROMP Monitor Well Water Level Change Relative to 2010, Alternative 1 (Existing Mining and All Users with Agricultural Reduction) Layer 4
Central Florida Phosphate District, Florida

Well	SWIMAL Weight*	Existing Mining and All Users Simulated Water Level Change Relative to 2010 (ft)			
		2015	**2020**	**2025**	**2030**
COLEY DEEP	NA	0.41	0.94	1.66	1.78
FLORIDA POWER FLDN AT PINEY POINT	NA	0.40	1.62	2.08	2.20
KIBLER DEEP	14.01%	0.92	4.21	5.29	5.66
LAKE ALFRED DEEP AT LAKE ALFRED	NA	0.12	0.30	0.45	0.48
ROMP 12 AVPK PZ MONITOR	NA	0.30	0.81	1.18	1.25
ROMP 123 HTRN AS/U FLDN AQ MONITOR	9.55%	0.90	4.78	5.87	6.26
ROMP 13 AVPK PZ MONITOR	NA	0.23	0.62	0.91	0.97
ROMP 14 U FLDN AQ MONITOR (AVPK)	NA	0.07	0.19	0.27	0.29
ROMP 15 U FLDN AQ MONITOR MOD	NA	0.34	0.89	1.31	1.40
ROMP 17 U FLDN AQ MONITOR (AVPK)	NA	0.34	0.96	1.38	1.47
ROMP 19X U FLDN AQ MONITOR (SWNN)	NA	0.35	1.15	1.58	1.68
ROMP 20 U FLDN AQ MONITOR (OCAL)	NA	0.27	1.02	1.33	1.42
ROMP 25 U FLDN AQ MONITOR	NA	0.84	3.21	4.23	4.61
ROMP 28 AVPK	NA	0.13	0.31	0.49	0.52
ROMP 30 U FLDN AQ MONITOR	NA	0.65	1.92	3.06	3.46
ROMP 31 U FLDN AQ MONITOR	NA	0.73	2.79	3.88	4.50
ROMP 32 U FLDN AQ MONITOR (AVPK)	NA	1.01	5.60	6.93	7.74
ROMP 39 AVPK PZ MONITOR	NA	0.95	4.62	5.74	6.12
ROMP 40 U FLDN AQ MONITOR	NA	1.01	6.86	8.31	9.30
ROMP 41 AVPK PZ MONITOR	NA	1.11	3.30	5.69	6.81
ROMP 43XX U FLDN AQ MONITOR	NA	0.43	0.96	1.64	1.73
ROMP 45 U FLDN AQ MONITOR (AVPK)	NA	1.13	3.00	5.33	6.10
ROMP 5 U FLDN AQ MONITOR (SWNN)	NA	0.25	0.70	1.01	1.07
ROMP 50 U FLDN AQ MONITOR (SWNN)	13.25%	0.70	3.11	3.92	4.16
ROMP 57 U FLDN AQ MONITOR	NA	0.40	0.95	1.54	1.67
ROMP 59 U FLDN AQ INTERFACE MONITOR	NA	0.77	2.31	3.45	3.88
ROMP 60X U FLDN AQ MONITOR	NA	0.70	2.19	3.18	3.56
ROMP TR 10-2 L ARCA AQ MONITOR	5.41%	0.18	0.82	1.04	1.11
ROMP TR 4-1 U FLDN AQ INTERFACE MONITOR	NA	0.20	0.71	0.94	1.00
ROMP TR 7-4 U FLDN AQ MONITOR (SWNN)	13.54%	0.48	1.99	2.55	2.71
ROMP TR 8-1 AVPK PZ MONITOR	14.08%	0.35	1.43	1.84	1.95
ROMP TR 9-3 U FLDN AQ MONITOR (SWNN)	7.17%	0.50	2.07	2.64	2.79
SMITH DEEP	NA	0.58	1.49	2.80	3.08
VERNA TEST 0-4	5.50%	0.65	2.71	3.47	3.70
Simulated Change in SWIMAL, ft		0.58	2.57	3.25	3.46

Note:
* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

6.1.1.2 2010 to 2020

Tables 9 through 12 depict the simulated change in aquifer water levels from 2010 to 2020 from mining only, assuming that no new mines are permitted. By 2020, the Four Corners Mine is no longer operating and the South Fort Meade and South Pasture Mines are projected to pump 11.3 mgd and 6.39 mgd, respectively (unchanged from 2010). The simulated water level increases in all monitor wells in every layer, with the greatest increases of 2.86 feet in Layer 3 at Fort Green Springs (Table 11) and 5.66 feet in Layer 4 at ROMP 40 (Table 12). The SWIMAL value increases by 1.58 feet relative to 2010, as shown on Table 12.

Tables 12 through 16 include the effect of the reduction in agricultural withdrawals between 2010 and 2020. The simulated reduction in agricultural use (37.5 mgd reduction for year 2020 of the baseline 2010 agricultural use) results in a simulated water level rise in all monitor wells in every layer, with the greatest increases of 3.76 at Fort Green Springs (Table 15) and 6.86 at ROMP 40 (Table 16). The SWIMAL value increases by 2.57 feet, as shown in Table 16.

6.1.1.3 2010 to 2025

Tables 9 through 12 depict the simulated change in aquifer water levels from 2010 to 2025 from mining only. By 2025, all mines except South Pasture are projected to have ceased operations. South Pasture's 2025 pumping rate is unchanged from its 2010 pumping rate. The simulated water level increases in all monitor wells in every layer, with the greatest increases of 4.19 feet in Layer 3 at Fort Green Springs (Table 11) and 6.55 feet in Layer 4 at ROMP 40 (Table 12). The SWIMAL value increases by 1.77 feet relative to 2010, as shown on Table 12. The 2025 Mining Only scenarios are also presented graphically in Figures 17 through 20.

Tables 13 through 16 include the effect of the agricultural withdrawal reduction between 2010 and 2025. By 2025, the SWUCA recovery strategy assumes that agricultural withdrawals have been reduced by 50 mgd. The implementation of these additional reductions in agricultural withdrawals results in a simulated water level rise in all monitor wells in every layer, with the greatest increases of 5.49 at Fort Green Springs (Table 15) and 8.31 at ROMP 40 (Table 16). The SWIMAL value increases by 3.25 feet, as shown in Table 16. The 2025 All Users scenarios are also presented graphically in Figures 21 through 24.

6.1.1.4 2010 to 2030

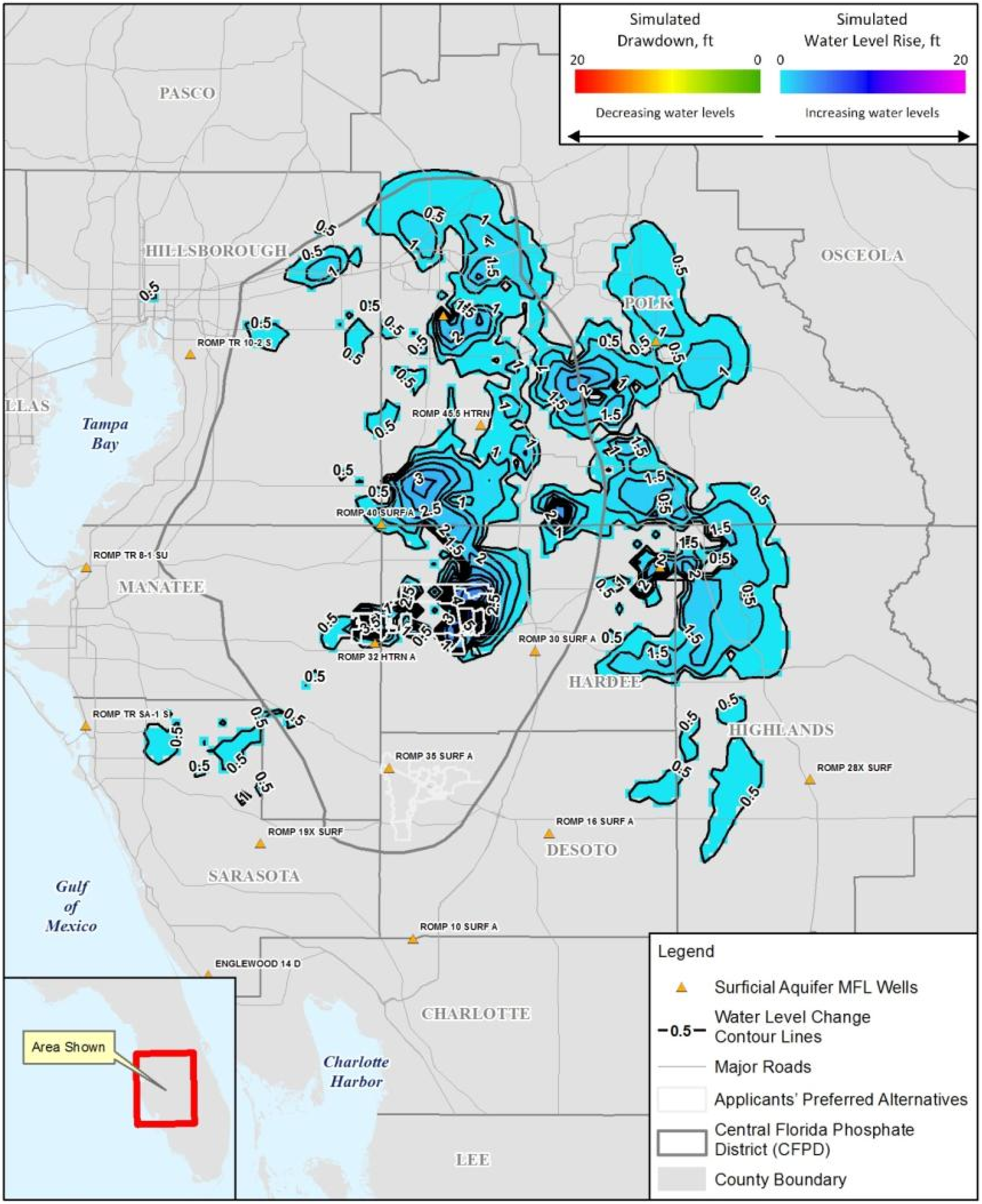
Tables 9 through 12 depict the simulated change in aquifer water levels between 2010 and 2030. In this scenario, it is projected that all of the mines operating in 2010 will have ceased pumping. No agriculture demand reduction is included. The simulated water level increases in all monitor wells in every layer, with the greatest increases of 5.12 feet in Layer 3 at Fort Green Springs (Table 11) and 7.53 feet in Layer 4 at ROMP 40 (Table 12). The SWIMAL value increases by 1.98 feet relative to 2010, as shown on Table 12.

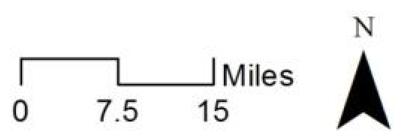
Tables 13 through 16 include the effect of the agricultural withdrawal reduction between 2010 and 2030. Agriculture demands are maintained at their 2025 levels, per the SWUCA recovery strategy. The implementation of these additional reductions in agricultural withdrawals results in a simulated water level rise in all monitor wells in every layer, with the greatest increases of 6.42 at Fort Green Springs (Table 15) and 9.30 at ROMP 40 (Table 16). The SWIMAL value increases by 3.46 feet, as shown in Table 16.

6.1.2 Summary

The model results for No Action Alternative Existing Mining indicate that the simulated water level in all aquifer layers will increase throughout the model domain as existing mines cease operations and overall water use in the SWUCA decreases. If only water level changes from phosphate mining are considered, the 2030 simulated water level rise at ROMP targets of interest is up to 1.69 feet in the SAS, 2.34 feet in the IAS (Zone 1), 5.12 feet in the IAS (Zone 2), and 7.53 feet in the UFA. Factoring in the effects of all other users, the simulated water level increase by 2030 is up to 2.67 feet in the SAS, 3.36 feet in the IAS (Zone 1), 6.42 feet in the IAS (Zone 2), and 9.30 feet in the UFA. The difference in water level due to the Agriculture withdrawal by itself is 0.98 foot in the SAS, 1.02 feet in the IAS (Zone 1), 1.30 feet in the IAS (Zone 2), and 1.77 feet in the UFA.

FIGURE 21
Simulated Water Change in SAS (Model Layer 1) Water Level (ft) 2010 to 2025
Alternative 1 (Existing Mining with Agicultural Reduction)
Central Florida Phosphate District, Florida





f

FIGURE 22
Simulated Water Change in IAS Zone 1 (Model Layer 2) Water Level (ft) 2010 to 2025
Alternative 1 (Existing Mining with Agricultural Reduction)
Central Florida Phosphate District, Florida

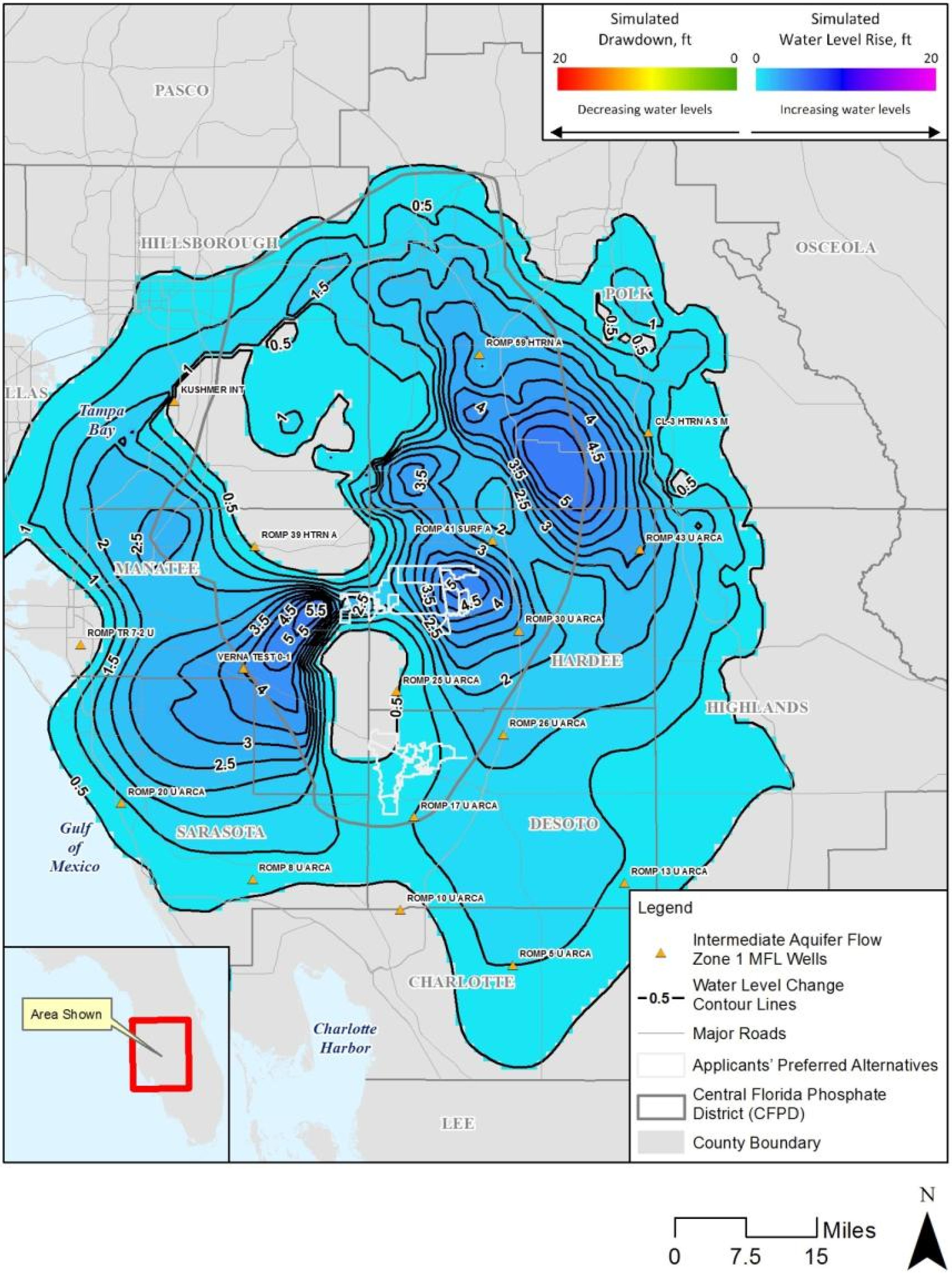


FIGURE 23
Simulated Water Change in IAS Zone 2 (Model Layer 3) Water Level (ft) 2010 to 2025
Alternative 1 (Existing Mining with Agicultural Reduction)
Central Florida Phosphate District, Florida

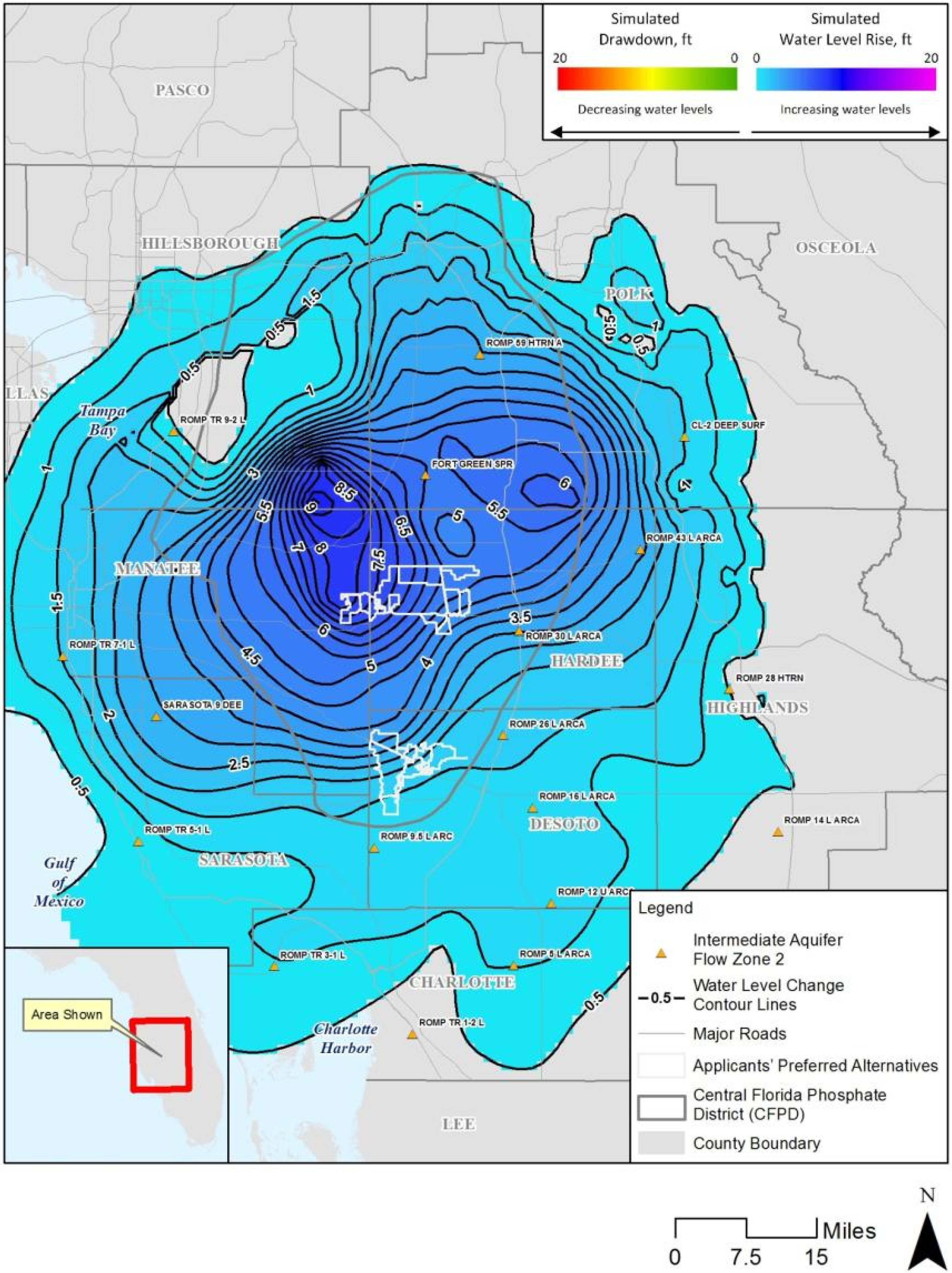
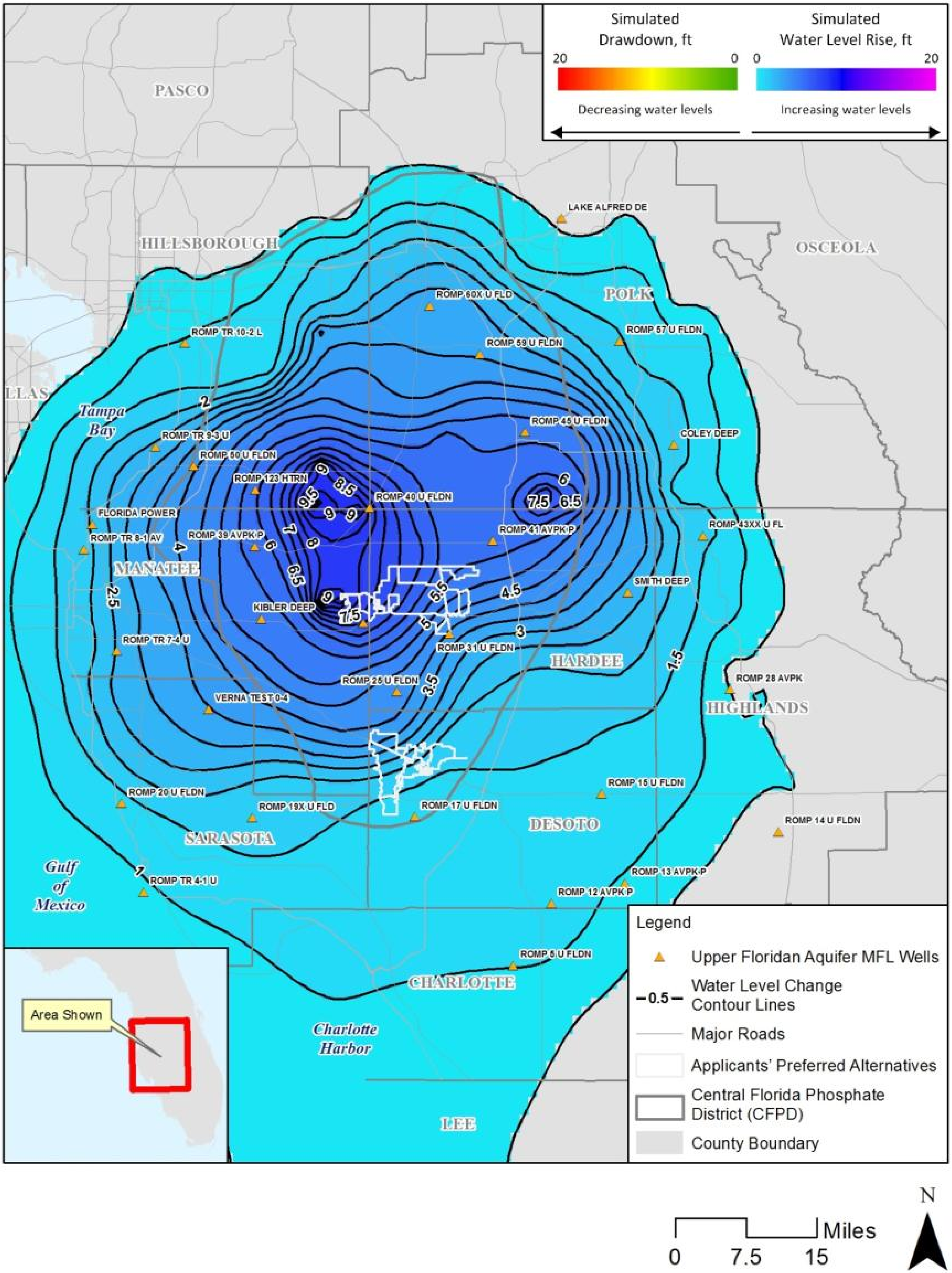


FIGURE 24
Simulated Water Change in Upper Floridan Aquifer (Model Layer 4) Water Level (ft) 2010 to 2025
Alternative 1 (Existing Mining with Agicultural Reduction)
Central Florida Phosphate District, Florida



6.2 Alternatives 2 through 5 – The Applicants' Preferred Alternatives

Projected Floridan drought year aquifer demands were provided annually by the Applicants for the Preferred Alternative mines as shown in Table 6. It is highly conservative to use the drought year withdrawal rates for steady-state modeling; therefore, these model scenarios represent worst-case conditions and are highly unlikely to actually occur. It is more likely that these rates would only be used for a few months during the dry season, with withdrawals returning to a more average annual rate thereafter. Four of the mines (Four Corners, Hookers Prairie, Ona, and South Fort Meade) also have permitted flexible quantities that exceed the drought year aquifer demand, but are intended to be pumped for short time periods, most likely for periods of only days or weeks. A mine may pump the flexible permit quantities, but the other mines included in the WUP (Mosaic) have to reduce their pumping so that the total pumping of all mines does not exceed the sum of their drought year annual average. Because of this complexity, alternative scenarios were developed for many of the scenario years to represent these specialized cases. The Floridan aquifer water allocations associated with each currently operating mine and the Applicants' Preferred Alternatives are summarized as follows:

- Four Corners Mine – Floridan aquifer water use at the existing Four Corners Mine is projected to be up to a drought year annual average of 15.6 mgd through the end of active mining in 2019. Four Corners Mine also has a flexible permit withdrawal limit of 20 mgd. The 2015B and 2019B scenarios show the impacts of Four Corners Mine using its flexible permit withdrawal, and the other operating mines adjusting their pumpage so that the total withdrawal does not exceed the sum of the drought year withdrawal for all operating mines.
- Hookers Prairie Mine – The Hookers Prairie Mine is an existing mine that is projected to withdraw a drought year annual average of 4.2 mgd through the end of mining in 2014.
- Hopewell Mine – The existing Hopewell Mine is projected to use a drought year annual average of up to 0.5 mgd through 2015.
- Ona Mine – The proposed Ona Mine is expected to withdraw up to a drought year annual average of 11.9 mgd beginning in 2020 from a new wellfield. It is assumed that active mining and reclamation will continue through approximately 2048. Only the Ona Mine includes new UFA withdrawal locations and allocations beyond the current levels of water supply allocation for phosphate mining within the CFPD. The Ona Mine has a flexible permit withdrawal limit of 15 mgd. The 2020B, 2025B, 2036B, and 2047B scenarios show the impacts of Ona Mine using its flexible permit withdrawal limit, and the other operating Mosaic mines adjusting their pumpage so that the total withdrawal does not exceed the sum of the drought year withdrawal for all operating mines.
- Desoto Mine – The proposed Desoto Mine is expected to operate for 15 years (including reclamation) beginning in 2021, and withdraw groundwater from the Floridan aquifer at a drought year annual average rate of up to 10.7 mgd. It was assumed for this analysis that water demands during reclamation would be equivalent to that during active mining. Floridan groundwater for the Desoto Mine will be provided by pumpage of existing wells at the Fort Green facility and conveyance via pipeline to the Desoto Mine location. No new supply wells will be constructed to support this new mine.
- South Fort Meade Mine – The existing South Fort Meade Mine is projected to withdraw groundwater from the existing Floridan aquifer wells located at the South Fort Meade Mine at a drought year annual average rate of 11.3 mgd through 2020. The South Fort Meade Mine also has a flexible permit withdrawal limit of 15.4 mgd. The 2015C, 2019C, and 2020B scenarios show the impacts of South Fort Meade Mine using its flexible permit withdrawal, and the other Mosaic mines adjusting their pumpage so that the total withdrawal does not exceed the sum of the drought year withdrawal for all operating mines.
- Wingate Creek/Wingate East Mine – The existing Wingate Creek Mine and the proposed Wingate East Mine would withdraw from existing Floridan aquifer wells at the existing mine at a rate of up to a drought year annual average of 5.8 mgd for 36 years, through 2046.

- South Pasture Mine/South Pasture Mine Extension – The South Pasture Mine/South Pasture Mine Extension combined would withdraw from existing Floridan aquifer wells up to its SWFWMD-permitted drought year annual average rate of 6.39 mgd through 2037.

Table 17 summarizes the simulated withdrawal rates for the currently operating and Applicants' Preferred Alternative mines that will operate through 2050. Highlighted rows indicate years for which model simulations were run and output was generated. The monthly peaking factors used in transient modeling (described later in this TM) are provided at the bottom of Table 17. On the basis of these annual average allocations and the projected operational periods of all of the existing and projected phosphate mines, the maximal usage of the Floridan aquifer by mining would occur in the period ranging from approximately 2010 to 2019. Thus, from a worst-case (most conservative) perspective, the simulations for the 2015 and 2019 periods represent the maximal cumulative effects analyses. By 2025, only Alternatives 2, 3, 4 and 5 mine projects would be operating. By 2036, only three of these mine projects would remain in operation. By 2047, only one of the four mines would remain in operation. These simulations provide perspectives on the relative influence of each of these proposed mine projects on SAS, IAS, and UFA drawdowns.

TABLE 17

Projected Floridan Aquifer Groundwater Withdrawal Rates, mgd – Applicants' Preferred Alternatives 2, 3, 4, and 5 using Drought Year and Flexible Withdrawals

Central Florida Phosphate District, Florida

Year	Four Corners	Hookers Prairie	Hopewell	Ona	Desoto	South Fort Meade	Wingate/Wingate East	South Pasture	Total
2010*	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2011	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2012	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2013	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2014	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2015A	15.6	0	0.5	0	0	11.3	5.8	6.39	39.59
2015B	20	0	0.5	0	0	11.2	5.7	6.39	43.79
2015C	15.7	0	0.5	0	0	15.4	5.8	6.39	43.79
2016	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2017	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2018	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2019A	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2019B	20	0	0	0	0	11.6	5.8	6.39	43.79
2019C	16.2	0	0	0	0	15.4	5.8	6.39	43.79
2020A	0	0	0	11.9	0	11.3	5.8	6.39	35.39
2020B	0	0	0	15.0	0	15.4	5.8	6.39	42.59
2021	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2022	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2023	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2024	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2025A	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2025B*	0	0	0	15	10.7	0	5.8	6.39	37.89
2026	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2027	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2028	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2029	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2030	0	0	0	11.9	10.7	0	5.8	6.39	34.79

TABLE 17

Projected Floridan Aquifer Groundwater Withdrawal Rates, mgd – Applicants' Preferred Alternatives 2, 3, 4, and 5 using Drought Year and Flexible Withdrawals

Central Florida Phosphate District, Florida

Year	Four Corners	Hookers Prairie	Hopewell	Ona	Desoto	South Fort Meade	Wingate/Wingate East	South Pasture	Total
2031	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2032	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2033	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2034	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2035	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2036A	0	0	0	11.9	0	0	5.8	6.39	24.09
2036B	0	0	0	15	0	0	5.8	6.39	27.19
2037	0	0	0	11.9		0	5.8	6.39	24.09
2038	0	0	0	11.9		0	5.8		17.70
2039	0	0	0	11.9		0	5.8		17.70
2040	0	0	0	11.9		0	5.8		17.70
2041	0	0	0	11.9		0	5.8		17.70
2042	0	0	0	11.9		0	5.8		17.70
2043	0	0	0	11.9		0	5.8		17.70
2044	0	0	0	11.9		0	5.8		17.70
2045	0	0	0	11.9		0	5.8		17.70
2046	0	0	0	11.9		0	5.8		17.70
2047A	0	0	0	11.9		0	0		11.90
2047B	0	0	0	15		0	0		15.00
2048	0	0	0	11.9		0	0		11.90
2049	0	0	0	0		0	0		0.00
2050	0	0	0	0		0	0		0.00
Transient Model Peaking Factor	1.74	1.64	1.25	1.88	1.88	1.62	1.25	2.12	

Note:
*Transient Models also developed for these scenarios.
Minor Quantities May be used for reclamation activities as facilities close down, South Pasture withdrawal in years 2036 and 2037 are for reclamation and infill parcels.
Yellow-shaded rows indicate years for which steady-state model simulations were conducted and output was generated.

6.2.1 Simulated SAS, IAS and UFA Water Table Changes

As noted previously, too many figures would be required to graphically represent every scenario for four aquifer layers; therefore, only representative figures are presented for the year 2025 (Alternative B). Tables 18 through 21 provide representative monitor well coverage of the CFPD for all four aquifer layers and show the changes in water level. In the Alternative 2, 3, 4, and 5 modeling results, the areas within which changes in drawdown or rebound of each aquifer layer of 0.5 foot or greater are shaded to reflect the areas within the study area influenced by the indicated simulation conditions. As noted under the Alternative 1 set of simulation results, the magnitude of these zones of drawdown or rebound should be reviewed in relation to the water level variations historically experienced within the study area, as reflected in the example ROMP well water level records summarized in Figures 5 through 10 and Table 1. Specifically for these ROMP wells, the records reflect seasonal variations of 7 to 10 feet in the SAS, 13 to 42 feet in the IAS Zone 1, 13 to 49 feet in IAS Zone 2, and 16 to 61 feet in the Floridan aquifer, suggesting that the simulation results indicate only localized and relatively minor influence of phosphate mining withdrawals on the overall aquifer water levels within the AEIS study area.

6.2.1.1 2010 to 2015

In scenario 2015A under the Applicants' Preferred Alternatives 2, 3, 4 and 5, it is projected that: the Four Corners Mine will continue to operate at its 2010 rate of 15.6 mgd; the Hookers Prairie Mine will cease operating; and that the Hopewell, South Fort Meade, Wingate, and South Pasture Mines will continue pumping at their 2010 rates of 0.5, 11.3, 5.8, and 6.39 mgd, respectively. In scenario 2015B, the Four Corners Mine will withdraw its flexible permit limit of 20 mgd, and South Fort Meade and Wingate Mines will withdraw slightly less, so that the sum of the Mosaic mine withdrawals does not exceed the total drought year annual permit capacity of 37.4 mgd. In scenario 2015C, the South Fort Meade Mine will withdraw its flexible permit limit of 15.4 mgd and the Four Corners Mine will withdraw slightly more (15.7 mgd), so that the sum of the Mosaic mines does not exceed the total drought year annual permit capacity of 37.4 mgd. In the 2015 scenarios, agricultural withdrawals were reduced to 93 percent of their 2010 rates, in line with the SWUCA recovery strategy.

Tables 18 through 21 depict the simulated change in Floridan aquifer water levels from 2010 to 2015 from Mining Only with other users at 2010 rates and no agricultural reduction for scenarios 2015A, 2015B, and 2015C. In scenario 2015A Mining Only with no agricultural reduction, the monitor well water level changes range from 0 to 0.25 foot in Layer 1, 0 to 0.37 foot in Layer 2, 0.01 to 0.71 foot in Layer 3, and 0.01 to 0.69 foot in Layer 4. The 2015A Mining Only SWIMAL value increases by 0.09 foot, as shown in Table 21. In scenario 2015B Mining Only with no agricultural reduction, the monitor well water level changes range from -0.05 to 0.09 foot in Layer 1, -0.18 to 0.16 foot in Layer 2, -0.13 to 0.26 foot in Layer 3, and -0.74 to 0.41 foot in Layer 4. The 2015B Mining Only with no agricultural reduction SWIMAL value decreases by 0.19 foot, as shown in Table 21. In scenario 2015C Mining Only with no agricultural reduction, the monitor well water level changes range from -0.19 to 0.09 foot in Layer 1, -0.19 to 0.17 foot in Layer 2, -0.13 to 0.23 foot in Layer 3, and -0.76 to 0.36 foot in Layer 4. The 2015C Mining Only with no agricultural reduction SWIMAL value decreases by 0.19 foot, as shown in Table 21.

Tables 22 through 25 depict the simulated change in Floridan aquifer water levels from 2010 to 2015 considering withdrawal by All Users with agricultural reduction for scenarios 2015A, 2015B, and 2015C. In scenario 2015A, the monitor well water levels range from 0 to 0.49 foot in Layer 1, 0.02 to 0.62 foot in Layer 2, 0.06 to 1.14 foot in Layer 3, and 0.07 to 1.13 foot in Layer 4. The 2015A All Users with agricultural reduction SWIMAL value increases by 0.58 foot, as shown in Table 25. In scenario 2015B All Users with agricultural reduction, the monitor well water levels range from 0 to 0.42 foot in Layer 1, 0.01 to 0.52 foot in Layer 2, 0.05 to 0.68 foot in Layer 3, and -0.17 to 0.86 foot in Layer 4. The 2015B All Users with agricultural reduction SWIMAL value increases by 0.30 foot, as shown in Table 25. In scenario 2015C All Users with agricultural reduction, the monitor well water levels range from 0 to 0.26 foot in Layer 1, 0.01 to 0.64 foot in Layer 2, 0.06 to 0.64 foot in Layer 3, and 0.07 to 0.81 foot in Layer 4. The 2015C All Users SWIMAL value increases by 0.50 foot, as shown in Table 25.

6.2.1.2 2010 to 2019

In 2019A under Alternative 2, 3, 4, and 5 it is projected that: the Four Corners Mine will continue to operate at its 2010 rate of 15.6 mgd; Hookers Prairie and Hopewell Mines will cease operating; and that the South Fort Meade, Wingate, and South Pasture Mines will continue pumping at their 2010 rates of 11.3, 5.8, and 6.39 mgd, respectively. In 2019B, it is assumed that Four Corners Mine is withdrawing its flexible permit limit of 20 mgd and the South Fort Meade Mine will withdraw slightly more, so that the sum of the Mosaic mine withdrawals does not exceed the total drought year annual permit capacity of 37.4 mgd. In scenario 2019C, the South Fort Meade Mine is withdrawing its flexible permit limit of 15.4 mgd and the Four Corners Mine is withdrawing some of its flexible permit capacity, so that the sum of the Mosaic mine withdrawals does not exceed the total drought year annual permit capacity of 37.4 mgd. In the 2019 All Users scenarios, agricultural withdrawals were reduced to 90 percent of their 2010 rates, in line with the SWUCA recovery strategy.

TABLE 18

Simulated ROMP SAS Monitor Well Water Level Change Relative to 2010, Alternatives 2, 3, 4, and 5 (Mining Only without Agricultural Reduction) Layer 1

Central Florida Phosphate District, FL

		Mining Only Simulated Water Level Change Relative to 2010 (ft)														
Well	**SWIMAL Weight***	**2015A**	**2015B**	**2015C**	**2019A**	**2019B**	**2019C**	**2020A**	**2020B**	**2025A**	**2025B**	**2036A**	**2036B**	**2047A**	**2047B**	**2049**
ENGLEWOOD 14 DEEP	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROMP 10 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROMP 16 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
ROMP 19X SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.02	0.04
ROMP 28X SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02
ROMP 30 SURF AQ MONITOR	NA	0.01	0.00	0.00	0.01	0.00	0.00	-0.02	-0.04	0.00	-0.02	0.01	0.00	0.04	0.03	0.09
ROMP 32 HTRN AS MONITOR	NA	0.00	0.00	-0.19	-0.18	-0.19	-0.19	0.53	0.52	0.35	0.34	1.43	1.42	1.76	1.75	1.25
ROMP 35 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.19	0.31	0.31	0.00	0.00	0.00
ROMP 40 SURF AQ MONITOR	NA	0.05	-0.05	-0.06	0.05	-0.06	0.00	0.27	0.19	0.03	-0.01	0.37	0.33	0.57	0.53	0.73
ROMP 43 SURF AQ MONITOR REPL	NA	0.17	0.09	0.06	0.17	0.06	-0.17	0.14	-0.28	0.74	0.65	1.03	0.94	1.39	1.30	1.72
ROMP 45.5 HTRN CU MONITOR	NA	0.06	0.04	0.04	0.06	0.03	0.02	0.09	0.03	0.12	0.10	0.21	0.19	0.29	0.27	0.35
ROMP 58 SURF AQ MONITOR	NA	0.05	0.03	0.02	0.05	0.02	0.00	0.08	0.01	0.14	0.12	0.22	0.20	0.30	0.28	0.36
ROMP 60X (PRIM SC06) SURF AQ MONITOR	NA	0.25	0.08	0.09	0.27	0.09	0.08	0.56	0.32	0.53	0.46	0.98	0.91	1.31	1.25	1.55
ROMP TR 10-2 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROMP TR 8-1 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROMP TR SA-1 SURF	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01

Note:

* if well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 19

Simulated ROMP IAS Zone 1 Monitor Well Water Level Change Relative to 2010, Alternatives 2, 3, 4, and 5 (Mining Only without Agricultural Reduction) Layer 2

Central Florida Phosphate District, FL

		Mining Only Simulated Water Level Change Relative to 2010 (ft)														
Well	**SWIMAL Weight***	**2015A**	**2015B**	**2015C**	**2019A**	**2019B**	**2019C**	**2020A**	**2020B**	**2025A**	**2025B**	**2036A**	**2036B**	**2047A**	**2047B**	**2049**
CL-3 HTRN AS MONITOR	NA	0.10	0.06	0.05	0.11	0.04	-0.07	0.13	-0.08	0.42	0.38	0.60	0.55	0.79	0.75	0.95
KUSHMER INT	NA	0.02	-0.03	-0.03	0.02	-0.03	0.00	0.12	0.10	0.09	0.08	0.16	0.14	0.24	0.22	0.29
ROMP 10 U ARCA AQ MONITOR 2	NA	0.01	0.00	0.00	0.01	-0.01	0.00	-0.01	-0.04	-0.01	-0.03	0.02	0.00	0.07	0.06	0.14
ROMP 13 U ARCA AQ MONITOR	NA	0.02	0.00	-0.01	0.02	-0.01	-0.01	-0.05	-0.12	-0.03	-0.08	0.04	-0.01	0.16	0.11	0.33
ROMP 17 U ARCA AQ MONITOR	NA	0.03	-0.01	-0.01	0.03	-0.01	-0.01	-0.05	-0.14	0.06	0.00	0.17	0.12	0.21	0.16	0.42
ROMP 20 U ARCA AQ MONITOR	NA	0.02	-0.03	-0.04	0.02	-0.04	0.00	0.09	0.03	0.05	0.01	0.15	0.11	0.35	0.31	0.49
ROMP 25 U ARCA AQ MONITOR	NA	0.02	-0.01	-0.01	0.02	-0.01	-0.01	-0.10	-0.17	-0.01	-0.07	0.08	0.03	0.10	0.05	0.29
ROMP 26 U ARCA AQ MONITOR	NA	0.05	-0.01	-0.01	0.05	-0.01	-0.02	-0.14	-0.30	-0.09	-0.19	0.05	-0.05	0.31	0.21	0.70
ROMP 30 U ARCA AQ MONITOR	NA	0.16	0.04	0.02	0.16	0.02	-0.08	-0.36	-0.84	-0.07	-0.32	0.31	0.06	0.94	0.69	1.91
ROMP 39 HTRN AS MONITOR	NA	0.01	-0.02	-0.02	0.01	-0.02	0.00	0.06	0.04	0.04	0.02	0.09	0.07	0.18	0.17	0.24
ROMP 41 SURF AQ MONITOR	NA	0.23	0.10	0.08	0.21	0.05	-0.07	0.04	-0.42	0.48	0.30	0.72	0.53	1.53	1.35	2.21
ROMP 43 U ARCA AQ MONITOR	NA	0.21	0.11	0.08	0.21	0.07	-0.21	0.17	-0.35	0.92	0.81	1.29	1.18	1.75	1.64	2.16
ROMP 5 U ARCA AQ MONITOR	NA	0.03	-0.01	-0.01	0.03	-0.01	-0.01	-0.05	-0.14	-0.04	-0.09	0.05	-0.01	0.20	0.14	0.39
ROMP 59 HTRN AS MONITOR 1	NA	0.37	0.16	0.17	0.39	0.16	0.12	0.73	0.38	0.76	0.66	1.41	1.30	1.94	1.83	2.34
ROMP 8 U ARCA AQ MONITOR	NA	0.02	-0.02	-0.02	0.02	-0.02	0.00	0.01	-0.04	0.00	-0.03	0.07	0.04	0.21	0.17	0.33
ROMP TR 7-2 U ARCA AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.02	0.01	0.03	0.03	0.05
VERNA TEST 0-1	NA	0.10	-0.18	-0.19	0.10	-0.19	-0.02	0.47	0.21	0.24	0.07	0.71	0.54	1.73	1.56	2.38

Note:

* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 20

Simulated ROMP IAS Zone 2 Target Water Level Change Relative to 2010, Alternatives 2, 3, 4, and 5 (Mining Only without Agricultural Reduction) Layer 3

Central Florida Phosphate District, FL

		Mining Only Simulated Water Level Relative to 2010 (ft)														
Well	**SWIMAL Weight***	**2015 A**	**2015B**	**2015C**	**2019A**	**2019B**	**2019C**	**2020A**	**2020B**	**2025A**	**2025B**	**2036A**	**2036B**	**2047A**	**2047B**	**2049**
CL-2 DEEP SURF AQ MONITOR	NA	0.08	0.04	0.03	0.08	0.03	-0.05	0.09	-0.06	0.30	0.27	0.43	0.40	0.57	0.54	0.69
FORT GREEN SPRINGS INT	NA	0.71	0.26	0.23	0.73	0.22	0.18	1.33	0.55	0.59	0.31	2.69	2.40	4.11	3.83	5.19
ROMP 12 U ARCA AQ MONITOR	NA	0.03	-0.01	-0.01	0.03	-0.01	-0.01	-0.07	-0.17	-0.04	-0.11	0.05	-0.01	0.22	0.16	0.46
ROMP 14 L ARCA AQ MONITOR	NA	0.01	0.00	0.00	0.01	0.00	0.00	-0.01	-0.03	-0.01	-0.02	0.01	0.00	0.04	0.03	0.09
ROMP 16 L ARCA AQ MONITOR	NA	0.03	-0.01	-0.01	0.04	-0.01	-0.01	-0.09	-0.20	-0.05	-0.13	0.05	-0.02	0.25	0.18	0.53
ROMP 26 L ARCA AQ MONITOR	NA	0.05	-0.01	-0.01	0.05	-0.01	-0.02	-0.14	-0.30	-0.09	-0.19	0.05	-0.05	0.31	0.21	0.69
ROMP 28 HTRN	NA	0.01	0.00	0.00	0.01	0.00	-0.01	0.00	-0.04	0.03	0.02	0.06	0.05	0.11	0.10	0.17
ROMP 30 L ARCA AQ MONITOR	NA	0.18	0.05	0.03	0.18	0.02	-0.09	-0.37	-0.89	-0.04	-0.31	0.38	0.10	1.05	0.78	2.08
ROMP 43 L ARCA AQ MONITOR	NA	0.21	0.11	0.08	0.21	0.07	-0.21	0.17	-0.35	0.93	0.82	1.31	1.20	1.77	1.66	2.19
ROMP 5 L ARCA AQ MONITOR	NA	0.03	-0.01	-0.01	0.03	-0.01	-0.01	-0.05	-0.14	-0.04	-0.09	0.05	-0.01	0.20	0.14	0.40
ROMP 59 HTRN AS MONITOR 2	NA	0.41	0.19	0.19	0.44	0.18	0.14	0.83	0.43	0.87	0.74	1.59	1.47	2.19	2.07	2.65
ROMP 9.5 L ARCA AQ MONITOR (MW-2)	NA	0.03	-0.01	-0.02	0.03	-0.02	-0.01	-0.05	-0.16	-0.04	-0.11	0.07	0.00	0.29	0.22	0.55
ROMP TR 1-2 L ARCA AQ MONITOR	NA	0.01	0.00	0.00	0.01	0.00	0.00	-0.01	-0.03	-0.01	-0.02	0.01	0.00	0.05	0.04	0.11
ROMP TR 3-1 L ARCA AQ MONITOR 2	NA	0.02	-0.01	-0.02	0.02	-0.02	-0.01	-0.02	-0.10	-0.02	-0.07	0.07	0.02	0.23	0.18	0.42
ROMP TR 5-1 L ARCA AQ MONITOR	NA	0.02	-0.03	-0.03	0.02	-0.03	0.00	0.07	0.01	0.04	0.00	0.12	0.09	0.30	0.26	0.43
ROMP TR 7-1 L ARCA AQ INTERFACE MONITOR	8.84%	0.04	-0.07	-0.08	0.04	-0.08	-0.01	0.23	0.15	0.15	0.09	0.32	0.27	0.65	0.60	0.87
ROMP TR 9-2 L ARCA AQ MONITOR	NA	0.02	-0.03	-0.03	0.02	-0.03	0.00	0.14	0.11	0.10	0.08	0.17	0.16	0.28	0.26	0.35
SARASOTA 9 DEEP	8.66%	0.07	-0.13	-0.13	0.07	-0.13	-0.01	0.35	0.17	0.19	0.08	0.53	0.41	1.20	1.09	1.65

Note:
* if well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 21

Simulated ROMP UFA Target Water Level Change Relative to 2010, Alternatives 2, 3, 4, and 5 (Mining Only without Agricultural Reduction) Layer 4

Central Florida Phosphate District, FL

		Mining Only Simulated Water Level Change Relative to 2010 (ft)														
Well	**SWIMAL Weight***	**2015A**	**2015B**	**2015C**	**2019A**	**2019B**	**2019C**	**2020A**	**2020B**	**2025A**	**2025B**	**2036A**	**2036B**	**2047A**	**2047B**	**2049**
COLEY DEEP	NA	0.09	0.05	0.04	0.09	0.04	-0.06	0.11	-0.08	0.37	0.33	0.52	0.49	0.70	0.66	0.84
FLORIDA POWER FLDN AT PINEY POINT	NA	0.05	-0.11	-0.11	0.06	-0.11	-0.01	0.39	0.28	0.26	0.19	0.50	0.44	0.90	0.83	1.16
KIBLER DEEP	14.01%	0.14	-0.25	-0.27	0.14	-0.27	-0.02	0.71	0.37	0.38	0.15	1.04	0.81	2.46	2.23	3.33
LAKE ALFRED DEEP AT LAKE ALFRED	NA	0.03	0.01	0.01	0.03	0.01	0.01	0.06	0.03	0.07	0.06	0.13	0.12	0.17	0.16	0.21
ROMP 12 AVPK PZ MONITOR	NA	0.03	-0.01	-0.01	0.03	-0.01	-0.01	-0.07	-0.17	-0.04	-0.11	0.05	-0.01	0.22	0.16	0.46
ROMP 123 HTRN AS/U FLDN AQ MONITOR	9.55%	0.19	-0.49	-0.49	0.21	-0.50	-0.02	1.96	1.63	1.46	1.27	2.36	2.17	3.42	3.23	4.15
ROMP 13 AVPK PZ MONITOR	NA	0.02	0.00	-0.01	0.02	-0.01	-0.01	-0.05	-0.13	-0.03	-0.08	0.04	-0.01	0.16	0.12	0.34
ROMP 14 U FLDN AQ MONITOR (AVPK)	NA	0.01	0.00	0.00	0.01	0.00	0.00	-0.01	-0.03	-0.01	-0.02	0.01	0.00	0.04	0.03	0.09
ROMP 15 U FLDN AQ MONITOR MOD	NA	0.03	-0.01	-0.01	0.03	-0.01	-0.01	-0.08	-0.19	-0.05	-0.12	0.05	-0.02	0.24	0.17	0.50
ROMP 17 U FLDN AQ MONITOR (AVPK)	NA	0.04	-0.01	-0.02	0.04	-0.02	-0.01	-0.07	-0.19	-0.05	-0.12	0.06	-0.01	0.28	0.21	0.56
ROMP 19X U FLDN AQ MONITOR (SWNN)	NA	0.04	-0.04	-0.04	0.04	-0.04	-0.01	0.02	-0.10	0.00	-0.08	0.15	0.07	0.45	0.37	0.74
ROMP 20 U FLDN AQ MONITOR (OCAL)	NA	0.03	-0.05	-0.05	0.03	-0.06	-0.01	0.13	0.05	0.07	0.02	0.22	0.16	0.51	0.46	0.72
ROMP 25 U FLDN AQ MONITOR	NA	0.12	-0.11	-0.13	0.12	-0.13	-0.03	-0.28	-0.74	-0.43	-0.76	0.08	-0.26	1.21	0.88	2.49
ROMP 28 AVPK	NA	0.02	0.00	0.00	0.02	0.00	-0.01	0.00	-0.04	0.03	0.02	0.07	0.05	0.12	0.10	0.17
ROMP 30 U FLDN AQ MONITOR	NA	0.18	0.05	0.03	0.18	0.02	-0.09	-0.37	-0.89	-0.04	-0.31	0.38	0.10	1.05	0.78	2.08
ROMP 31 U FLDN AQ MONITOR	NA	0.19	-0.04	-0.05	0.19	-0.07	-0.05	-1.90	-2.88	-1.82	-2.59	-1.18	-1.94	0.06	-0.70	2.97
ROMP 32 U FLDN AQ MONITOR (AVPK)	NA	0.24	-0.27	-0.30	0.25	-0.31	-0.04	-0.23	-1.06	-0.73	-1.35	0.41	-0.22	3.12	2.50	5.49
ROMP 39 AVPK PZ MONITOR	NA	0.16	-0.38	-0.39	0.17	-0.40	-0.03	1.34	1.00	0.91	0.69	1.71	1.49	2.98	2.76	3.80
ROMP 40 U FLDN AQ MONITOR	NA	0.44	-0.74	-0.76	0.46	-0.77	-0.04	3.11	2.36	1.09	0.67	4.04	3.62	6.03	5.61	7.61
ROMP 41 AVPK PZ MONITOR	NA	0.62	0.31	0.25	0.63	0.24	-0.11	0.54	-0.50	1.26	0.91	2.49	2.14	4.08	3.74	5.38
ROMP 43XX U FLDN AQ MONITOR	NA	0.06	0.03	0.02	0.06	0.02	-0.06	0.06	-0.10	0.26	0.23	0.38	0.34	0.52	0.48	0.64
ROMP 45 U FLDN AQ MONITOR (AVPK)	NA	0.69	0.41	0.36	0.71	0.36	-0.03	0.90	-0.03	1.77	1.54	2.84	2.61	3.95	3.72	4.81
ROMP 5 U FLDN AQ MONITOR (SWNN)	NA	0.03	-0.01	-0.01	0.03	-0.01	-0.01	-0.05	-0.14	-0.04	-0.09	0.05	-0.01	0.20	0.14	0.40
ROMP 50 U FLDN AQ MONITOR (SWNN)	13.25%	0.12	-0.26	-0.25	0.13	-0.26	-0.01	1.03	0.81	0.74	0.62	1.28	1.15	1.97	1.85	2.43

TABLE 21

Simulated ROMP UFA Target Water Level Change Relative to 2010, Alternatives 2, 3, 4, and 5 (Mining Only without Agricultural Reduction) Layer 4

Central Florida Phosphate District, FL

		Mining Only Simulated Water Level Change Relative to 2010 (ft)														
Well	**SWIMAL Weight***	**2015A**	**2015B**	**2015C**	**2019A**	**2019B**	**2019C**	**2020A**	**2020B**	**2025A**	**2025B**	**2036A**	**2036B**	**2047A**	**2047B**	**2049**
ROMP 57 U FLDN AQ MONITOR	NA	0.12	0.06	0.05	0.12	0.05	0.00	0.18	0.03	0.31	0.28	0.51	0.47	0.69	0.65	0.84
ROMP 59 U FLDN AQ INTERFACE MONITOR	NA	0.47	0.21	0.21	0.50	0.21	0.15	0.93	0.48	0.97	0.83	1.79	1.65	2.46	2.33	2.98
ROMP 60X U FLDN AQ MONITOR	NA	0.41	0.15	0.17	0.45	0.16	0.15	0.92	0.53	0.87	0.74	1.65	1.52	2.26	2.14	2.73
ROMP TR 10-2 L ARCA AQ MONITOR	5.41%	0.05	-0.06	-0.05	0.06	-0.05	0.02	0.34	0.28	0.26	0.23	0.43	0.40	0.60	0.57	0.72
ROMP TR 4-1 U FLDN AQ INTERFACE MONITOR	NA	0.02	-0.03	-0.03	0.02	-0.03	0.00	0.07	0.01	0.04	0.00	0.14	0.09	0.33	0.29	0.49
ROMP TR 7-4 U FLDN AQ MONITOR (SWNN)	13.54%	0.06	-0.12	-0.12	0.07	-0.13	-0.01	0.37	0.22	0.22	0.12	0.52	0.42	1.09	0.99	1.46
ROMP TR 8-1 AVPK PZ MONITOR	14.08%	0.05	-0.09	-0.10	0.05	-0.10	-0.01	0.32	0.22	0.21	0.15	0.43	0.37	0.79	0.73	1.03
ROMP TR 9-3 U FLDN AQ MONITOR (SWNN)	7.17%	0.08	-0.15	-0.15	0.09	-0.15	0.00	0.62	0.49	0.45	0.37	0.79	0.71	1.24	1.16	1.54
SMITH DEEP	NA	0.18	0.09	0.06	0.18	0.06	-0.17	0.12	-0.34	0.73	0.62	1.06	0.95	1.49	1.38	1.91
VERNA TEST 0-4	5.50%	0.08	-0.15	-0.16	0.09	-0.16	-0.01	0.40	0.19	0.21	0.07	0.61	0.47	1.45	1.31	2.00
Simulated Change in SWIMAL, ft		0.09	-0.19	-0.19	0.10	-0.19	-0.01	0.65	0.46	0.44	0.32	0.86	0.74	1.55	1.44	2.01

Note:

*if well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 22

Simulated ROMP SAS Monitor Well Water Level Change Relative to 2010, Alternatives 2, 3, 4, and 5 (All Users with Agricultural Reduction) Layer 1

Central Florida Phosphate District, FL

		All Users Simulated Water Level Change Relative to 2010 (ft)														
Well	**SWIMAL Weight***	**2015A**	**2015B**	**2015C**	**2019A**	**2019B**	**2019C**	**2020A**	**2020B**	**2025A**	**2025B**	**2036A**	**2036B**	**2047A**	**2047B**	**2049**
ENGLEWOOD 14 DEEP	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROMP 10 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROMP 16 SURF AQ MONITOR	NA	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03
ROMP 19X SURF AQ MONITOR	NA	0.02	0.01	0.02	0.03	0.02	0.03	0.03	0.03	0.05	0.04	0.06	0.05	0.07	0.07	0.09
ROMP 28X SURF AQ MONITOR	NA	0.03	0.02	0.02	0.05	0.04	0.04	0.05	0.04	0.07	0.07	0.08	0.08	0.08	0.08	0.09
ROMP 30 SURF AQ MONITOR	NA	0.03	0.02	0.02	0.05	0.04	0.04	0.03	0.00	0.06	0.05	0.08	0.07	0.11	0.10	0.15
ROMP 32 HTRN AS MONITOR	NA	0.01	0.01	0.01	-0.16	-0.17	-0.16	0.55	0.53	0.37	0.36	1.45	1.44	1.78	1.77	1.27
ROMP 35 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.31	0.31	0.00	0.00	0.01
ROMP 40 SURF AQ MONITOR	NA	0.11	0.00	0.07	0.15	0.05	0.10	0.38	0.30	0.20	0.16	0.54	0.50	0.74	0.70	0.89
ROMP 43 SURF AQ MONITOR REPL	NA	0.49	0.42	0.17	0.75	0.65	0.42	0.79	0.38	1.70	1.62	1.99	1.91	2.35	2.27	2.68
ROMP 45.5 HTRN CU MONITOR	NA	0.09	0.07	0.05	0.12	0.09	0.08	0.16	0.10	0.21	0.20	0.30	0.29	0.38	0.37	0.45
ROMP 58 SURF AQ MONITOR	NA	0.23	0.21	0.18	0.38	0.35	0.33	0.44	0.37	0.66	0.65	0.74	0.73	0.82	0.80	0.88
ROMP 60X (PRIM SC06) SURF AQ MONITOR	NA	0.43	0.27	0.26	0.59	0.41	0.41	0.89	0.67	1.02	0.95	1.43	1.36	1.73	1.67	1.96
ROMP TR 10-2 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROMP TR 8-1 SURF AQ MONITOR	NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROMP TR SA-1 SURF	NA	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02

Note:

* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 23

Simulated ROMP IAS Zone 1 Target Water Level Change Relative to 2010, Alternatives 2, 3, 4, and 5 (All Users with Agricultural Reduction) Layer 2

Central Florida Phosphate District, FL

Well	SWIMAL Weight*	All Users Simulated Water Level Change Relative to 2010 (ft)														
		2015A	2015B	2015C	2019A	2019B	2019C	2020A	2020B	2025A	2025B	2036A	2036B	2047A	2047B	2049
CL-3 HTRN AS MONITOR	NA	0.36	0.31	0.19	0.56	0.50	0.39	0.63	0.42	1.18	1.14	1.35	1.31	1.54	1.50	1.70
KUSHMER INT	NA	0.09	0.04	0.07	0.15	0.10	0.13	0.26	0.24	0.30	0.29	0.37	0.35	0.44	0.43	0.50
ROMP 10 U ARCA AQ MONITOR 2	NA	0.09	0.07	0.07	0.15	0.13	0.14	0.14	0.11	0.22	0.20	0.25	0.24	0.30	0.29	0.37
ROMP 13 U ARCA AQ MONITOR	NA	0.23	0.20	0.20	0.39	0.36	0.36	0.36	0.29	0.58	0.54	0.65	0.60	0.77	0.73	0.94
ROMP 17 U ARCA AQ MONITOR	NA	0.25	0.21	0.22	0.43	0.39	0.39	0.40	0.31	0.73	0.67	0.84	0.79	0.88	0.83	1.09
ROMP 20 U ARCA AQ MONITOR	NA	0.18	0.12	0.16	0.31	0.25	0.28	0.41	0.35	0.52	0.49	0.62	0.58	0.82	0.78	0.96
ROMP 25 U ARCA AQ MONITOR	NA	0.10	0.08	0.08	0.17	0.14	0.15	0.07	0.00	0.24	0.19	0.34	0.29	0.35	0.30	0.54
ROMP 26 U ARCA AQ MONITOR	NA	0.40	0.34	0.33	0.67	0.61	0.61	0.56	0.40	0.95	0.85	1.10	0.99	1.35	1.25	1.74
ROMP 30 U ARCA AQ MONITOR	NA	0.60	0.48	0.37	0.95	0.80	0.71	0.51	0.03	1.24	0.98	1.62	1.36	2.24	1.99	3.20
ROMP 39 HTRN AS MONITOR	NA	0.07	0.04	0.06	0.12	0.09	0.11	0.19	0.17	0.23	0.21	0.28	0.26	0.37	0.35	0.43
ROMP 41 SURF AQ MONITOR	NA	0.44	0.31	0.17	0.58	0.42	0.30	0.46	0.00	1.09	0.91	1.34	1.15	2.14	1.96	2.81
ROMP 43 U ARCA AQ MONITOR	NA	0.62	0.52	0.21	0.95	0.81	0.53	0.99	0.48	2.14	2.03	2.51	2.40	2.96	2.85	3.37
ROMP 5 U ARCA AQ MONITOR	NA	0.25	0.22	0.22	0.43	0.39	0.40	0.40	0.31	0.64	0.59	0.72	0.67	0.87	0.82	1.07
ROMP 59 HTRN AS MONITOR 1	NA	0.61	0.41	0.36	0.83	0.60	0.56	1.21	0.86	1.49	1.38	2.13	2.02	2.65	2.55	3.06
ROMP 8 U ARCA AQ MONITOR	NA	0.16	0.12	0.14	0.27	0.23	0.25	0.29	0.24	0.42	0.39	0.49	0.46	0.62	0.59	0.75
ROMP TR 7-2 U ARCA AQ MONITOR	NA	0.02	0.01	0.01	0.03	0.02	0.02	0.04	0.03	0.05	0.04	0.06	0.05	0.07	0.07	0.09
VERNA TEST 0-1	NA	0.73	0.45	0.64	1.24	0.95	1.12	1.72	1.47	2.12	1.95	2.60	2.42	3.61	3.44	4.26

Note:

* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 24

Simulated ROMP IAS Zone 2 Target Water Level Change Relative to 2010, Alternatives 2, 3, 4, and 5 (All Users with Agricultural Reduction) Layer 3

Central Florida Phosphate District, FL

Well	SWIMAL Weight*	All Users Simulated Water Level Change Relative to 2010 (ft)														
		2015A	2015B	2015C	2019A	2019B	2019C	2020A	2020B	2025A	2025B	2036A	2036B	2047A	2047B	2049
CL-2 DEEP SURF AQ MONITOR	NA	0.38	0.34	0.25	0.62	0.57	0.49	0.69	0.54	1.20	1.17	1.33	1.30	1.47	1.44	1.58
FORT GREEN SPRINGS INT	NA	1.14	0.68	0.64	1.50	0.99	0.95	2.17	1.40	1.86	1.58	3.95	3.67	5.37	5.09	6.44
ROMP 12 U ARCA AQ MONITOR	NA	0.30	0.26	0.26	0.51	0.47	0.47	0.47	0.37	0.76	0.70	0.85	0.79	1.02	0.96	1.26
ROMP 14 L ARCA AQ MONITOR	NA	0.07	0.07	0.07	0.13	0.12	0.12	0.12	0.10	0.20	0.19	0.21	0.20	0.25	0.24	0.29
ROMP 16 L ARCA AQ MONITOR	NA	0.33	0.29	0.29	0.57	0.53	0.52	0.51	0.40	0.84	0.77	0.95	0.88	1.14	1.07	1.42
ROMP 26 L ARCA AQ MONITOR	NA	0.40	0.34	0.33	0.67	0.61	0.61	0.56	0.40	0.95	0.85	1.10	0.99	1.35	1.25	1.73
ROMP 28 HTRN	NA	0.13	0.12	0.10	0.22	0.20	0.19	0.22	0.18	0.37	0.35	0.40	0.38	0.45	0.43	0.50
ROMP 30 L ARCA AQ MONITOR	NA	0.65	0.52	0.40	1.03	0.87	0.76	0.58	0.06	1.37	1.10	1.79	1.52	2.46	2.19	3.48
ROMP 43 L ARCA AQ MONITOR	NA	0.62	0.53	0.21	0.96	0.82	0.54	1.00	0.48	2.16	2.05	2.54	2.43	2.99	2.88	3.41
ROMP 5 L ARCA AQ MONITOR	NA	0.25	0.22	0.22	0.43	0.40	0.40	0.40	0.32	0.64	0.59	0.73	0.67	0.88	0.82	1.08
ROMP 59 HTRN AS MONITOR 2	NA	0.69	0.46	0.41	0.94	0.68	0.63	1.37	0.98	1.68	1.56	2.41	2.29	3.00	2.88	3.46
ROMP 9.5 L ARCA AQ MONITOR (MW-2)	NA	0.32	0.28	0.28	0.56	0.50	0.51	0.53	0.42	0.83	0.76	0.94	0.87	1.15	1.09	1.42
ROMP TR 1-2 L ARCA AQ MONITOR	NA	0.06	0.05	0.06	0.11	0.10	0.10	0.10	0.08	0.16	0.15	0.19	0.17	0.23	0.21	0.28
ROMP TR 3-1 L ARCA AQ MONITOR 2	NA	0.23	0.19	0.20	0.40	0.35	0.36	0.39	0.32	0.60	0.55	0.69	0.64	0.85	0.80	1.03
ROMP TR 5-1 L ARCA AQ MONITOR	NA	0.17	0.12	0.15	0.28	0.23	0.26	0.36	0.31	0.47	0.44	0.56	0.53	0.73	0.70	0.87
ROMP TR 7-1 L ARCA AQ INTERFACE MONITOR	8.84%	0.29	0.18	0.26	0.50	0.38	0.45	0.74	0.66	0.91	0.86	1.09	1.03	1.42	1.36	1.63
ROMP TR 9-2 L ARCA AQ MONITOR	NA	0.11	0.06	0.10	0.19	0.13	0.17	0.33	0.30	0.38	0.36	0.46	0.44	0.56	0.54	0.63
SARASOTA 9 DEEP	8.66%	0.55	0.35	0.49	0.94	0.73	0.85	1.31	1.13	1.63	1.51	1.96	1.85	2.64	2.52	3.09

Note:

* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

TABLE 25
Simulated ROMP UFA Target Water Level Change Relative to 2010, Alternatives 2, 3, 4, and 5 (All Users with Agricultural Reduction) Layer 4
Central Florida Phosphate District, FL

		All Users Simulated Water Level Change Relative to 2010 (ft)														
Well	**SWIMAL Weight***	**2015A**	**2015B**	**2015C**	**2019A**	**2019B**	**2019C**	**2020A**	**2020B**	**2025A**	**2025B**	**2036A**	**2036B**	**2047A**	**2047B**	**2049**
COLEY DEEP	NA	0.41	0.37	0.26	0.66	0.61	0.51	0.74	0.56	1.32	1.28	1.47	1.44	1.64	1.60	1.78
FLORIDA POWER FLDN AT PINEY POINT	NA	0.40	0.24	0.36	0.69	0.52	0.62	1.08	0.98	1.31	1.24	1.55	1.48	1.95	1.88	2.21
KIBLER DEEP	14.01%	0.92	0.53	0.80	1.56	1.14	1.39	2.28	1.94	2.73	2.50	3.39	3.16	4.81	4.58	5.68
LAKE ALFRED DEEP AT LAKE ALFRED	NA	0.12	0.11	0.10	0.20	0.18	0.17	0.25	0.21	0.34	0.33	0.40	0.39	0.44	0.43	0.48
ROMP 12 AVPK PZ MONITOR	NA	0.30	0.26	0.26	0.51	0.47	0.47	0.47	0.37	0.76	0.70	0.85	0.79	1.03	0.96	1.26
ROMP 123 HTRN AS/U FLDN AQ MONITOR	9.55%	0.90	0.22	0.75	1.49	0.78	1.25	3.38	3.05	3.59	3.40	4.49	4.30	5.54	5.35	6.27
ROMP 13 AVPK PZ MONITOR	NA	0.23	0.21	0.20	0.40	0.37	0.37	0.37	0.29	0.60	0.55	0.67	0.62	0.80	0.75	0.97
ROMP 14 U FLDN AQ MONITOR (AVPK)	NA	0.07	0.07	0.07	0.13	0.12	0.12	0.12	0.10	0.20	0.19	0.21	0.20	0.25	0.24	0.29
ROMP 15 U FLDN AQ MONITOR MOD	NA	0.34	0.30	0.29	0.58	0.54	0.53	0.52	0.41	0.86	0.79	0.96	0.89	1.14	1.08	1.40
ROMP 17 U FLDN AQ MONITOR (AVPK)	NA	0.34	0.29	0.30	0.59	0.53	0.54	0.54	0.42	0.86	0.79	0.98	0.91	1.19	1.12	1.48
ROMP 19X U FLDN AQ MONITOR (SWNN)	NA	0.35	0.28	0.31	0.61	0.53	0.56	0.65	0.53	0.94	0.86	1.09	1.01	1.39	1.32	1.68
ROMP 20 U FLDN AQ MONITOR (OCAL)	NA	0.27	0.18	0.24	0.46	0.37	0.42	0.60	0.52	0.77	0.72	0.92	0.86	1.21	1.16	1.42
ROMP 25 U FLDN AQ MONITOR	NA	0.84	0.60	0.72	1.41	1.16	1.27	1.15	0.70	1.72	1.39	2.23	1.89	3.36	3.02	4.63
ROMP 28 AVPK	NA	0.13	0.12	0.11	0.22	0.21	0.20	0.23	0.19	0.38	0.36	0.41	0.40	0.46	0.45	0.52
ROMP 30 U FLDN AQ MONITOR	NA	0.65	0.52	0.40	1.03	0.87	0.76	0.58	0.06	1.38	1.11	1.79	1.52	2.46	2.19	3.49
ROMP 31 U FLDN AQ MONITOR	NA	0.73	0.51	0.52	1.16	0.91	0.93	-0.82	-1.79	-0.20	-0.97	0.44	-0.32	1.68	0.91	4.58
ROMP 32 U FLDN AQ MONITOR (AVPK)	NA	1.01	0.50	0.78	1.63	1.07	1.35	1.31	0.47	1.57	0.94	2.70	2.08	5.41	4.79	7.78
ROMP 39 AVPK PZ MONITOR	NA	0.95	0.40	0.81	1.58	1.01	1.38	2.91	2.57	3.25	3.04	4.05	3.84	5.32	5.11	6.14
ROMP 40 U FLDN AQ MONITOR	NA	1.01	-0.17	0.66	1.49	0.27	1.00	4.26	3.51	2.80	2.39	5.76	5.34	7.74	7.32	9.32
ROMP 41 AVPK PZ MONITOR	NA	1.11	0.80	0.41	1.52	1.12	0.78	1.52	0.48	2.72	2.37	3.95	3.60	5.53	5.19	6.83
ROMP 43XX U FLDN AQ MONITOR	NA	0.43	0.40	0.31	0.72	0.68	0.60	0.79	0.64	1.35	1.32	1.47	1.43	1.60	1.57	1.73
ROMP 45 U FLDN AQ MONITOR (AVPK)	NA	1.13	0.86	0.43	1.50	1.15	0.76	1.78	0.86	3.08	2.86	4.15	3.92	5.25	5.03	6.11
ROMP 5 U FLDN AQ MONITOR (SWNN)	NA	0.25	0.22	0.22	0.43	0.40	0.40	0.40	0.32	0.65	0.59	0.73	0.67	0.88	0.82	1.08
ROMP 50 U FLDN AQ MONITOR (SWNN)	13.25%	0.70	0.32	0.60	1.18	0.79	1.04	2.19	1.98	2.48	2.36	3.01	2.89	3.71	3.58	4.17

TABLE 25

Simulated ROMP UFA Target Water Level Change Relative to 2010, Alternatives 2, 3, 4, and 5 (All Users with Agricultural Reduction) Layer 4

Central Florida Phosphate District, FL

		All Users Simulated Water Level Change Relative to 2010 (ft)														
Well	**SWIMAL Weight***	**2015A**	**2015B**	**2015C**	**2019A**	**2019B**	**2019C**	**2020A**	**2020B**	**2025A**	**2025B**	**2036A**	**2036B**	**2047A**	**2047B**	**2049**
ROMP 57 U FLDN AQ MONITOR	NA	0.40	0.35	0.28	0.63	0.56	0.51	0.75	0.59	1.16	1.12	1.34	1.31	1.53	1.49	1.67
ROMP 59 U FLDN AQ INTERFACE MONITOR	NA	0.77	0.52	0.46	1.05	0.76	0.71	1.54	1.10	1.89	1.75	2.70	2.57	3.37	3.24	3.89
ROMP 60X U FLDN AQ MONITOR	NA	0.70	0.44	0.43	0.96	0.68	0.66	1.49	1.10	1.71	1.59	2.49	2.37	3.10	2.98	3.57
ROMP TR 10-2 L ARCA AQ MONITOR	5.41%	0.18	0.07	0.15	0.30	0.19	0.25	0.60	0.54	0.65	0.62	0.83	0.79	0.99	0.96	1.11
ROMP TR 4-1 U FLDN AQ INTERFACE MONITOR	NA	0.20	0.14	0.17	0.33	0.28	0.31	0.42	0.35	0.55	0.51	0.65	0.61	0.85	0.81	1.00
ROMP TR 7-4 U FLDN AQ MONITOR (SWNN)	13.54%	0.48	0.30	0.43	0.82	0.63	0.75	1.21	1.06	1.48	1.38	1.77	1.68	2.34	2.25	2.71
ROMP TR 8-1 AVPK PZ MONITOR	14.08%	0.35	0.21	0.31	0.60	0.46	0.55	0.94	0.84	1.14	1.07	1.35	1.29	1.71	1.65	1.95
ROMP TR 9-3 U FLDN AQ MONITOR (SWNN)	7.17%	0.50	0.26	0.43	0.84	0.60	0.75	1.46	1.32	1.70	1.62	2.04	1.96	2.49	2.41	2.80
SMITH DEEP	NA	0.58	0.50	0.24	0.91	0.78	0.56	0.92	0.47	1.92	1.81	2.25	2.14	2.68	2.57	3.09
VERNA TEST 0-4	5.50%	0.65	0.42	0.58	1.12	0.87	1.01	1.54	1.33	1.92	1.78	2.32	2.18	3.16	3.01	3.71
Simulated Change in SWIMAL, ft		0.58	0.30	0.50	0.98	0.69	0.87	1.63	1.44	1.90	1.78	2.32	2.20	3.01	2.89	3.46

Note:

* If well is used for SWIMAL calculation, the SWIMAL weight is used to calculate simulated change in SWIMAL

In scenario 2019A Mining Only, the monitor well water level changes range from -0.18 to 0.27 foot in Layer 1 (Table 18), 0 to 0.39 foot in Layer 2 (Table 19), 0.01 to 0.73 foot in Layer 3 (Table 20), and 0.01 to 0.71 foot in Layer 4 (Table 21). The 2019A Mining Only with other users at 2010 and no agricultural reduction SWIMAL value increases by 0.10 foot, as shown in Table 21. In scenario 2019B Mining Only with other users at 2010 and no agricultural reduction, the monitor well water level changes range from -0.19 to 0.09 foot in Layer 1, -0.19 to 0.16 foot in Layer 2, -0.13 to 0.22 foot in Layer 3, and -0.77 to 0.36 foot in Layer 4. The 2019B Mining Only with other users at 2010 and no agricultural reduction SWIMAL value decreases by 0.19 foot. In scenario 2019C Mining Only with other users at 2010 and no agricultural reduction, the monitor well water level changes range from -0.19 to 0.08 foot in Layer 1, -0.21 to 0.12 foot in Layer 2, -0.21 to 0.18 foot in Layer 3, and -0.17 to 0.15 foot in Layer 4. The 2019C Mining Only with other users at 2010 and no agricultural reduction SWIMAL value decreases by 0.01 foot.

In scenario 2019A All Users with agricultural reduction, the monitor well water level changes range from -0.16 to 0.75 foot in Layer 1 (Table 22), 0.03 to 1.24 foot in Layer 2 (Table 23), 0.11 to 1.50 foot in Layer 3 (Table 24), and 0.13 to 1.63 foot in Layer 4 (Table 25). The 2019A All Users with agricultural reduction SWIMAL value increases by 0.98 foot. In scenario 2019B, the monitor well water level changes range from -0.17 to 0.65 foot in Layer 1 (Table 22), 0.02 to 0.95 foot in Layer 2 (Table 23), 0.1 to 0.99 foot in Layer 3 (Table 24), and 0.12 to 1.16 foot in Layer 4 (Table 25). The 2019B All Users with agricultural reduction SWIMAL value increases by 0.69 foot. In scenario 2019C, the monitor well water level changes range from -0.16 to 0.42 foot in Layer 1 (Table 22), 0.02 to 1.12 foot in Layer 2 (Table 23), 0.1 to 0.95 foot in Layer 3 (Table 24), and 0.12 to 1.39 feet in Layer 4 (Table 25). The 2019C All Users SWIMAL value increases by 0.87 foot, as shown in Table 25.

6.2.1.3 2010 to 2020

In 2020A under Alternative 2, it is projected that: the Four Corners, Hookers Prairie, and Hopewell Mines will cease operating; the Ona Mine is pumping its drought annual average withdrawal rate of 11.9 mgd; and the South Fort Meade, Wingate, and South Pasture Mines will continue pumping at their 2010 rates of 11.3, 5.8, and 6.39 mgd, respectively. In 2020B, the Ona and South Fort Meade Mines are withdrawing their flexible permit limit of 15 mgd and 15.4 mgd, respectively, which does not exceed the total drought year annual permit capacity of 36.2 mgd for the three Mosaic mines. In both 2020 All Users scenarios, agricultural withdrawals were reduced to 89 percent of their 2010 rates, in line with the SWUCA recovery strategy.

In scenario 2020A Mining Only with other users at 2010 and no agricultural reduction, the monitor well water level changes range from -0.02 to 0.56 foot in Layer 1 (Table 18), -0.36 to 0.73 foot in Layer 2 (Table 19), -0.37 to 1.33 feet in Layer 3 (Table 20), and -1.90 to 3.11 feet in Layer 4 (Table 21). The 2020A Mining Only with other users at 2010 and no agricultural reduction SWIMAL value increases by 0.65 foot as shown in Table 21. In scenario 2020B Mining Only, the monitor well water level changes range from -0.28 to 0.52 foot in Layer 1, -0.84 to 0.38 foot in Layer 2, -0.89 to 0.55 foot in Layer 3, and -2.88 to 2.36 feet in Layer 4. The 2020B Mining Only with other users at 2010 and no agricultural reduction SWIMAL value increases by 0.46 foot.

In scenario 2020A All Users with agricultural reduction, the monitor well water level changes range from 0 to 0.89 foot in Layer 1 (Table 22), 0.04 to 1.72 feet in Layer 2 (Table 23), 0.10 to 2.17 feet in Layer 3 (Table 24), and -0.82 to 4.26 feet in Layer 4 (Table 25). The 2020A All Users with agricultural reduction SWIMAL value increases by 1.63 feet. In scenario 2020B, the monitor wells water level changes range from 0 to 0.67 foot in Layer 1 (Table 22), 0 to 1.47 feet in Layer 2 (Table 23), 0.06 to 1.40 feet in Layer 3 (Table 24), and -1.79 to 3.51 feet in Layer 4 (Table 25). The 2020B All Users with agricultural reduction SWIMAL value increases by 1.44 feet.

6.2.1.4 2010 to 2025

In 2025A under Alternative 2, it is projected that: the South Fort Meade Mine will cease operating; the Desoto Mine is pumping its drought annual average withdrawal rate of 10.7 mgd; and the Ona, Wingate East, and South Pasture Mines will continue pumping at their drought year annual average rates of 11.9, 5.8, and 6.39 mgd, respectively. In 2025B, the Ona Mine is withdrawing its flexible permit limit of 15 mgd, while the other mines remain at their drought year annual rates. By 2025, the SWUCA recovery strategy assumes that agricultural withdrawals will have been reduced by 50 mgd in the All Users scenarios.

In scenario 2025A Mining Only with other users at 2010 and no agricultural reduction, the monitor well water level changes range from 0 to 0.74 foot in Layer 1 (Table 18), -0.09 to 0.92 foot in Layer 2 (Table 19), -0.09 to 0.93 foot in Layer 3 (Table 20), and -1.82 to 1.77 feet in Layer 4 (Table 21). The 2025A Mining Only with other users at 2010 and no agricultural reduction SWIMAL value increases by 0.44 foot, as shown in Table 21. In scenario 2025B Mining Only with other users at 2010 and no agricultural reduction, the monitor well water level changes range from -0.02 to 0.46 foot in Layer 1 (Table 18), -0.32 to 0.81 foot in Layer 2 (Table 19), -0.09 to 0.93 foot in Layer 3 (Table 20), and -2.59 to 1.54 feet in Layer 4 (Table 21). The 2025B Mining Only with other users at 2010 and no agricultural reduction SWIMAL value increases by 0.32 foot, as shown in Table 21. The 2025B Mining Only with other users at 2010 and no agricultural reduction scenarios are also shown graphically in Figures 25 through 28.

In scenario 2025A All Users with agricultural reduction, the monitor well water level changes range from 0 to 1.70 feet in Layer 1 (Table 22), 0.05 to 2.14 feet in Layer 2 (Table 23), 0.16 to 2.16 feet in Layer 3 (Table 24), and -0.20 to 3.59 feet in Layer 4 (Table 25). The 2025A All Users with agricultural reduction SWIMAL value increases by 1.90 feet. In scenario 2025B All Users, the monitor well water level changes range from 0 to 1.62 feet in Layer 1 (Table 22), 0.04 to 2.03 feet in Layer 2 (Table 23), 0.15 to 2.05 feet in Layer 3 (Table 24), and -0.97 to 3.40 feet in Layer 4 (Table 25). The 2025B All Users with agricultural reduction SWIMAL value increases by 1.78 feet, as shown in Table 25. The 2025B All Users scenarios are also shown graphically in Figures 29 through 32.

6.2.1.5 2010 to 2036

For 2036A, it is projected that the Desoto Mine will cease operating and the Ona, Wingate East, and South Pasture Mines will continue pumping at their drought year annual average rates of 11.9, 5.8, and 6.39 mgd, respectively. In 2025B, the Ona Mine is assumed to be withdrawing its flexible permit limit of 15 mgd, while the other mines remain at their drought year annual rates. For the All Users scenarios, agriculture demands are maintained at their 2025 levels, per the SWUCA recovery strategy.

In scenario 2036A Mining Only with other users at 2010 and no agricultural reduction, the monitor well water level changes range from 0 to 1.43 feet in Layer 1 (Table 18), 0.02 to 1.41 feet in Layer 2 (Table 19), 0.01 to 2.69 feet in Layer 3 (Table 20), and -1.18 to 4.04 feet in Layer 4 (Table 21). The 2036A Mining Only with other users at 2010 and no agricultural reduction SWIMAL value increases by 0.86 foot, as shown in Table 21. In scenario 2036B Mining Only with other users at 2010 and no agricultural reduction, the monitor wells water levels changes ranges from 0 to 1.42 feet in Layer 1 (Table 18), -0.05 to 1.18 feet in Layer 2 (Table 19), -0.05 to 2.40 feet in Layer 3 (Table 20), and -1.94 to 3.62 feet in Layer 4 (Table 21). The 2036B Mining Only with other users at 2010 and no agricultural reduction SWIMAL value increases by 0.74 foot, as shown in Table 21.

In scenario 2036A All Users with agricultural reduction, the monitor wells water level changes range from 0 to 1.99 feet in Layer 1 (Table 22), 0.06 to 2.60 feet in Layer 2 (Table 23), 0.19 to 3.95 feet in Layer 3 (Table 24), and 0.21 to 5.76 feet in Layer 4 (Table 25). The 2036A All Users with agricultural reduction SWIMAL value increases by 2.32 feet, as shown in Table 25. In scenario 2036B All Users with agricultural reduction, the monitor wells water level changes range from 0 to 1.91 feet in Layer 1 (Table 22), 0.05 to 2.42 feet in Layer 2 (Table 23), 0.17 to 3.67 feet in Layer 3 (Table 24), and -0.32 to 5.34 feet in Layer 4 (Table 25). The 2036B All Users with agricultural reduction SWIMAL value increases by 2.20 feet, as shown in Table 25.

6.2.1.6 2010 to 2047

For 2047A, it is projected that the Wingate East and South Pasture Mines will cease operating and the Ona Mine will continue pumping at the drought year annual average rate of 11.9 mgd. In 2047B, the Ona Mine is assumed to be withdrawing at its flexible permit limit of 15 mgd. For the All Users scenarios, agriculture demands are maintained at their 2025 levels, per the SWUCA recovery strategy.

FIGURE 25
Simulated Water Change in SAS (Model Layer 1) Water Level (ft) 2010 to 2025B
Alternatives 2, 3, 4, and 5 Mining Only with no Agricultural Reduction
Central Florida Phosphate District, Florida

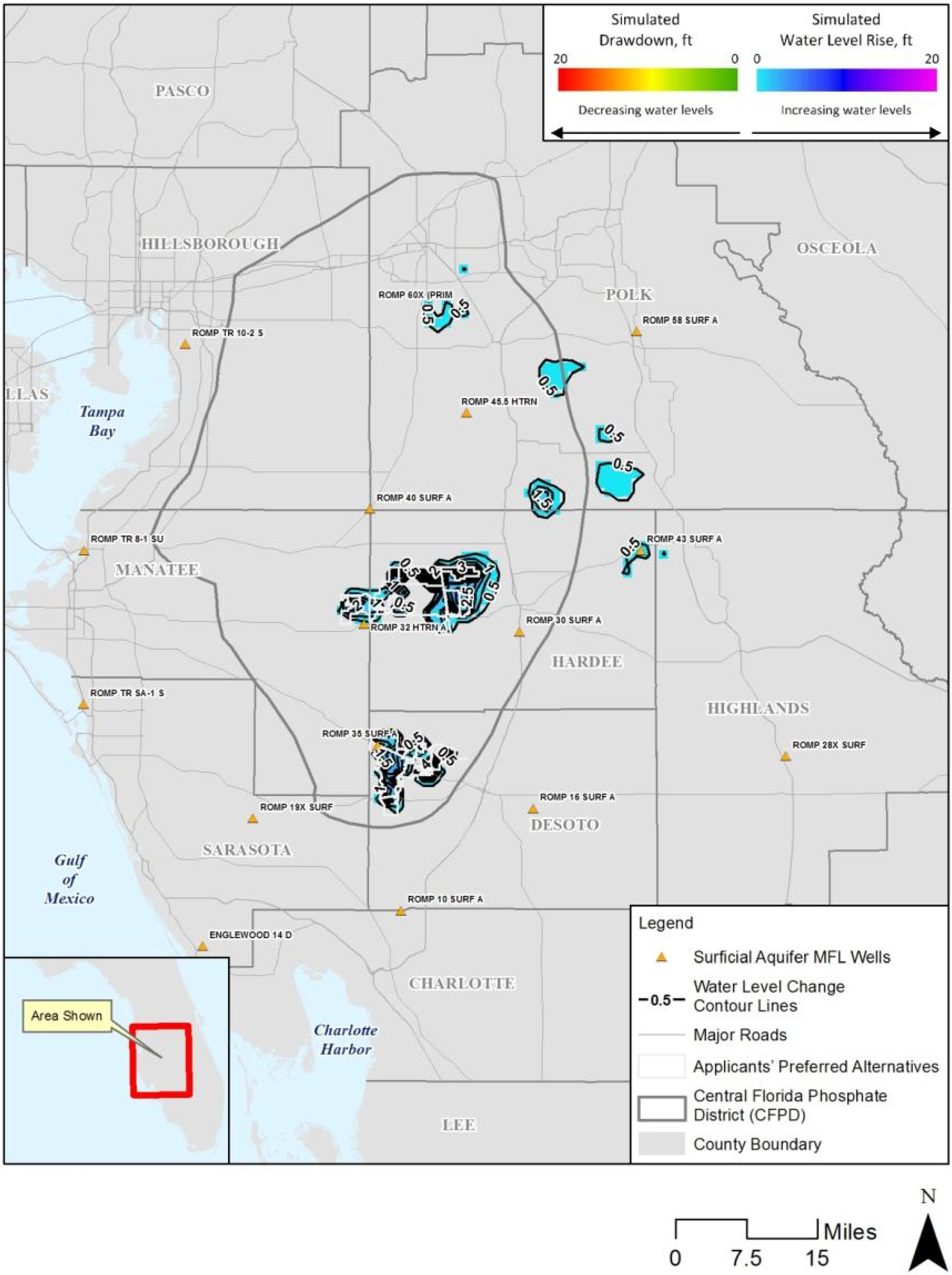


FIGURE 26
Simulated Water Change in IAS Zone 1 (Model Layer 2) Water Level (ft) 2010 to 2025B
Alternative 2, 3, 4, and 5 Mining Only with no Agricultural Reduction
Central Florida Phosphate District, Florida

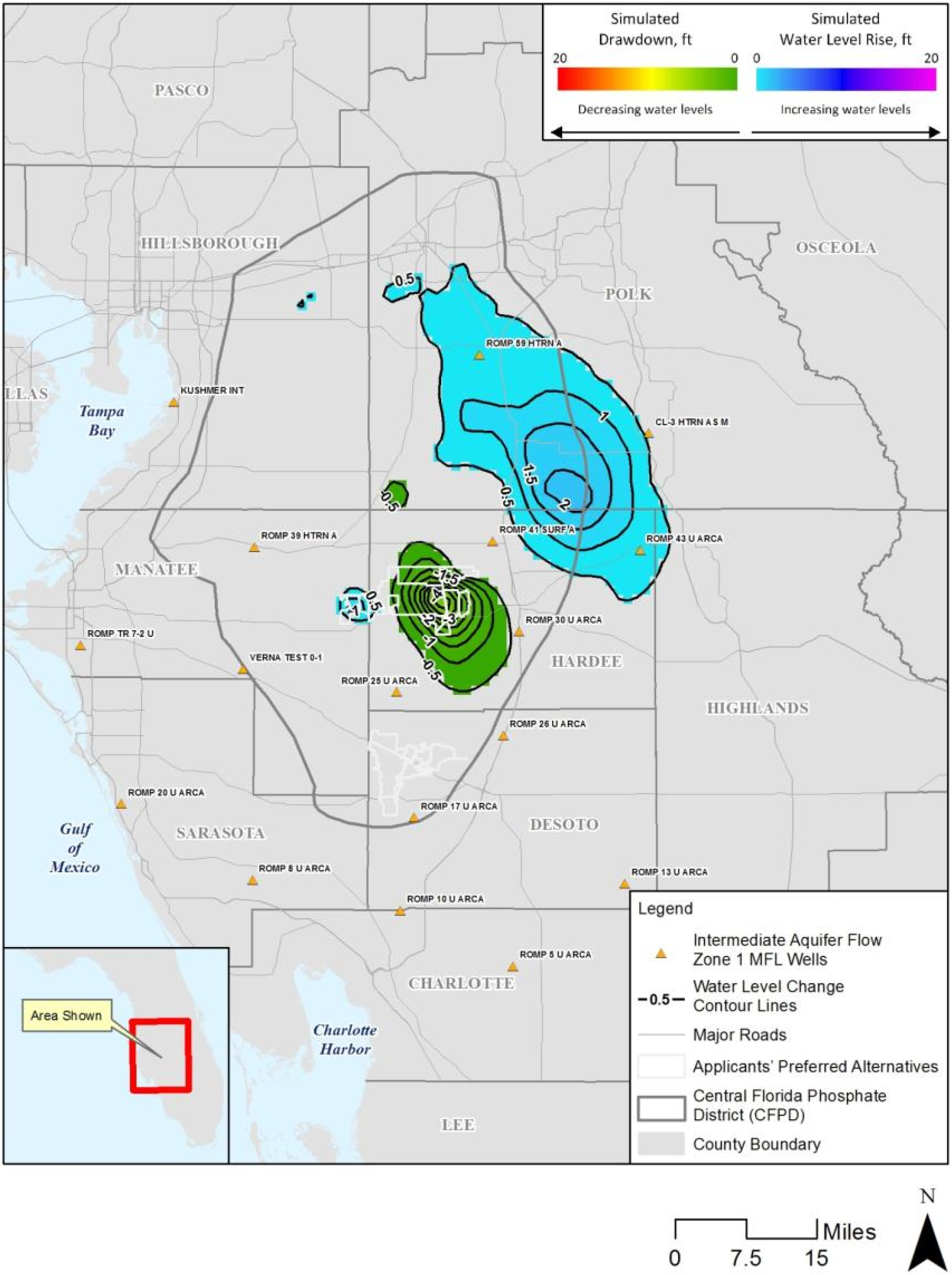


FIGURE 27
Simulated Water Change in IAS Zone 2 (Model Layer 3) Water Level (ft) 2010 to 2025B
Alternative 2, 3, 4, and 5 Mining Only with no Agricultural Reduction
Central Florida Phosphate District, Florida

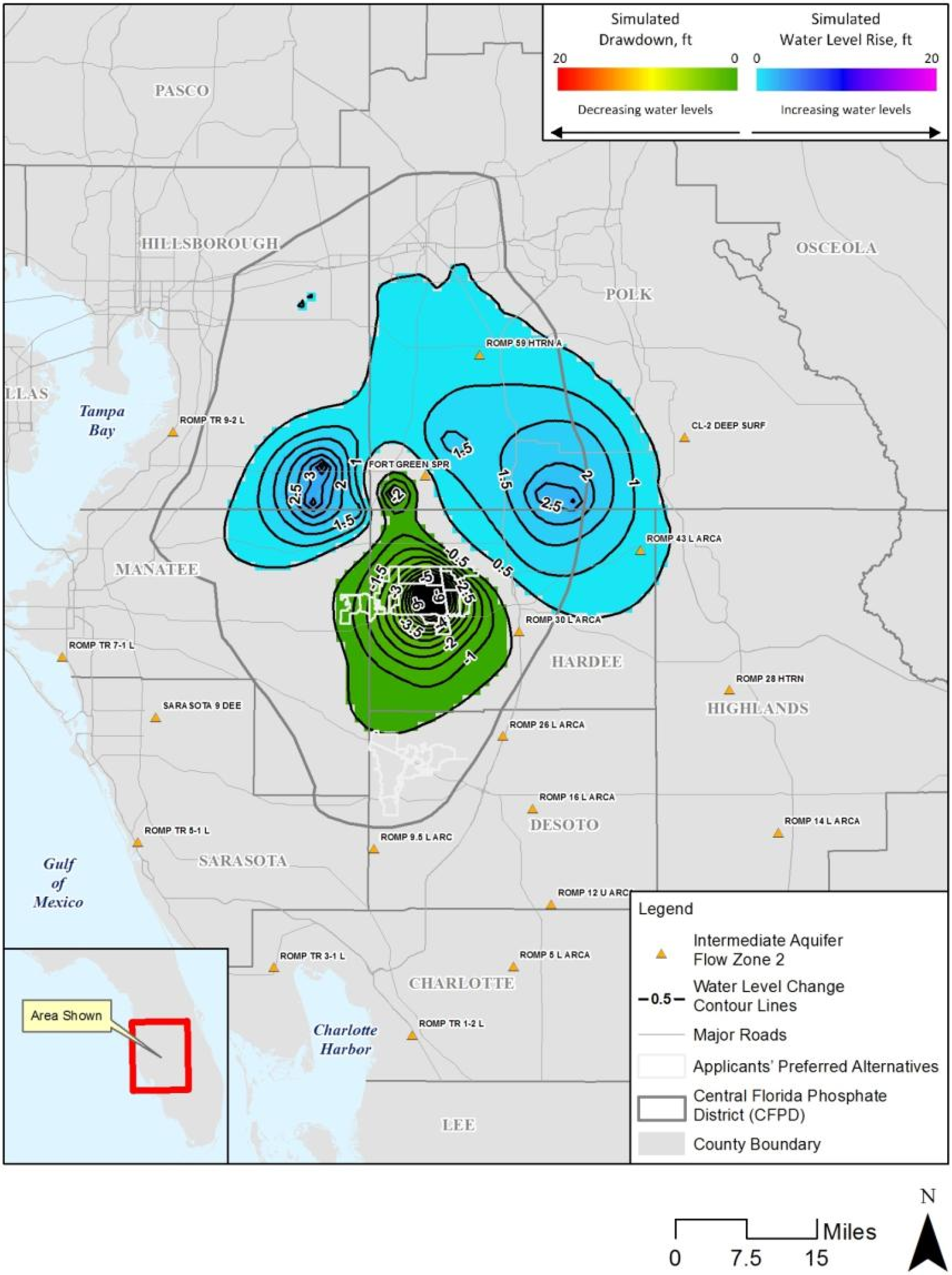


FIGURE 28
Simulated Water Change in the Upper Floridan Aquifer (Model Layer 4) Water Level (ft) 2010 to 2025B
Alternative 2, 3, 4, and 5 Mining Only with no Agricultural Reduction
Central Florida Phosphate District, Florida

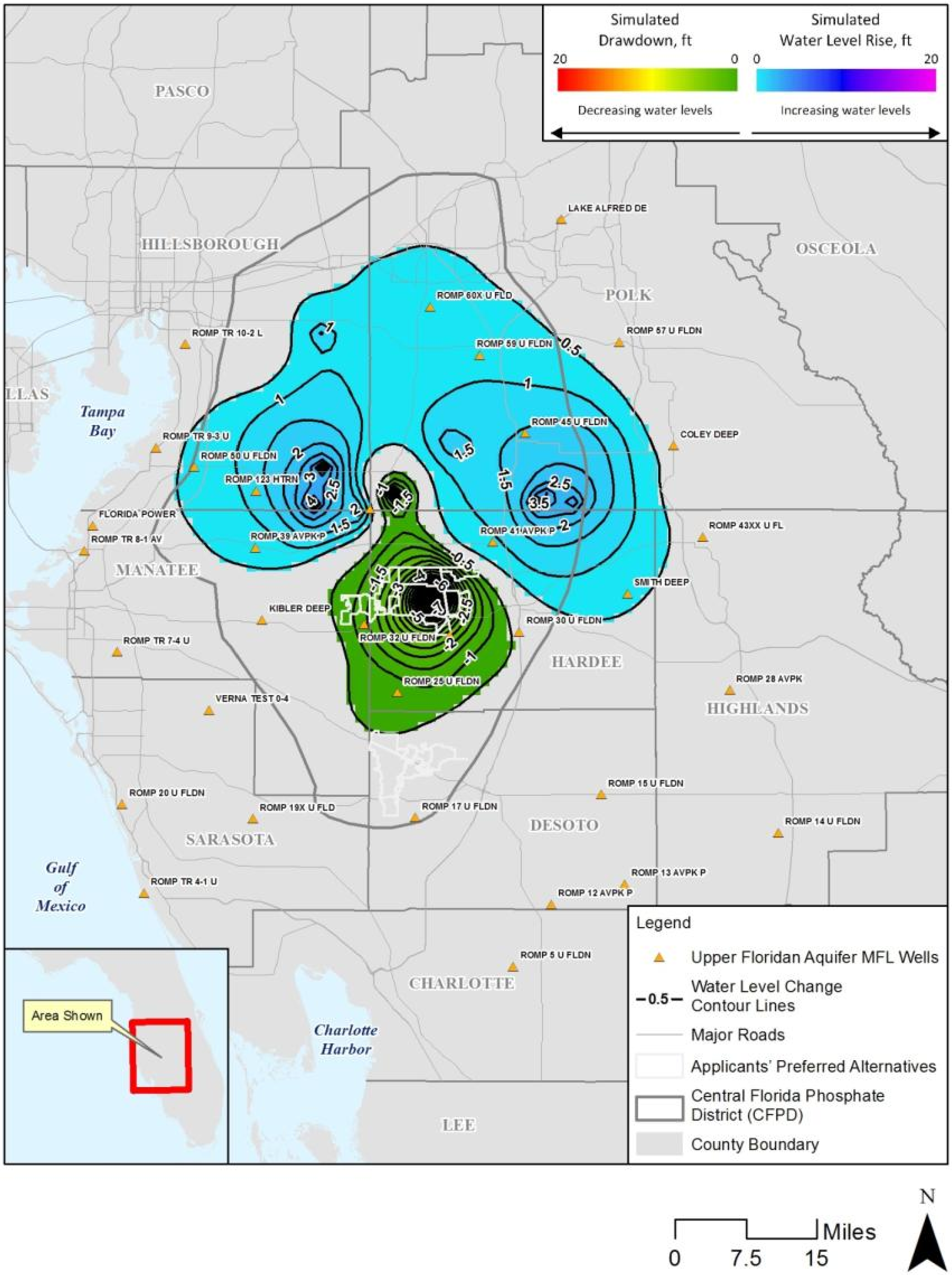


FIGURE 29
Simulated Water Change in SAS (Model Layer 1) Water Level (ft) 2010 to 2025B
Alternative 2, 3, 4, and 5 Mines with All Users with Agricultural Reductions
Central Florida Phosphate District, Florida

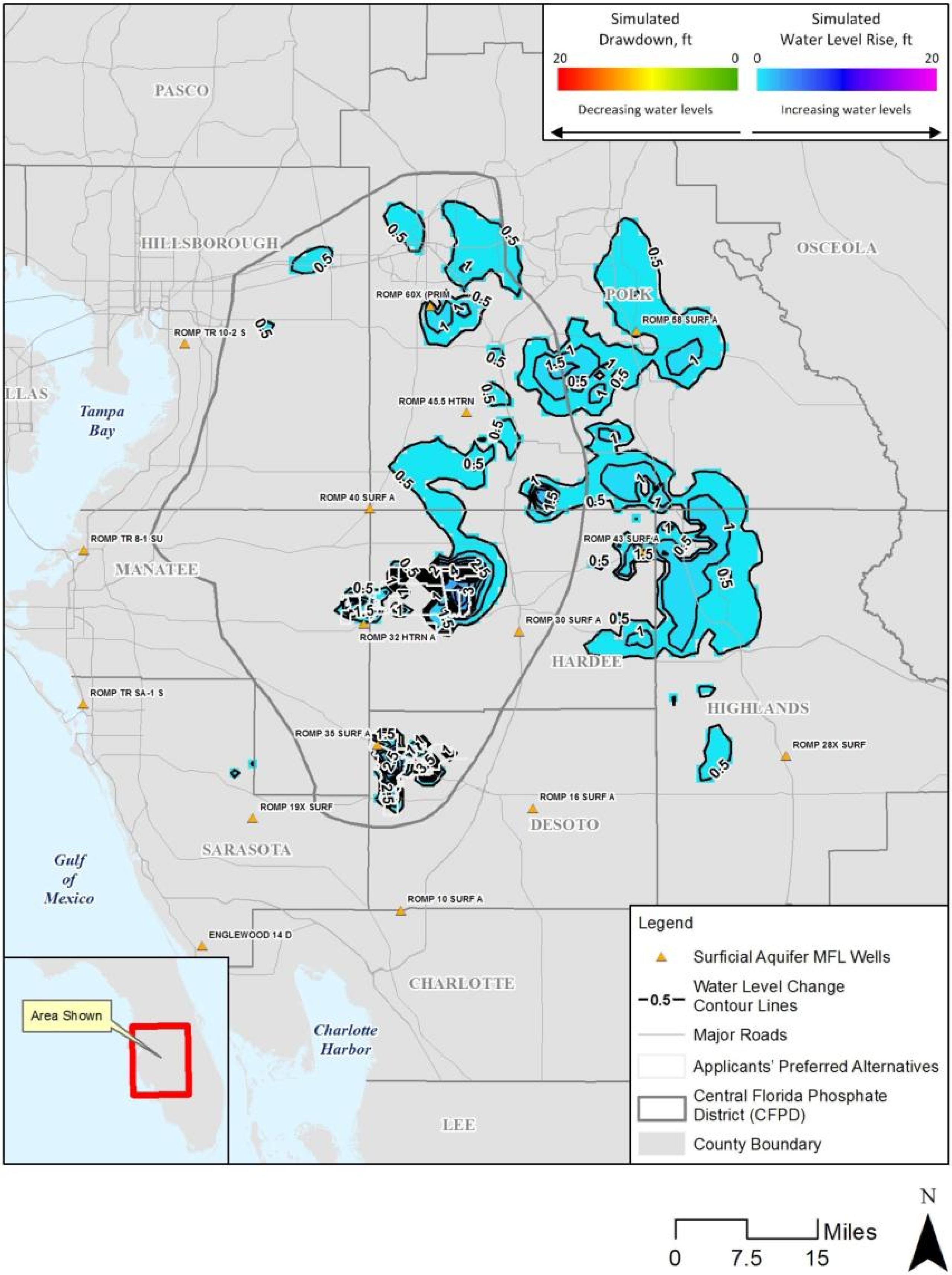


FIGURE 30
Simulated Water Change in IAS Zone 1 (Model Layer 2) Water Level (ft) 2010 to 2025B
Alternative 2, 3, 4 and 5 Mines with All Users with Agricultural Reductions
Central Florida Phosphate District, Florida

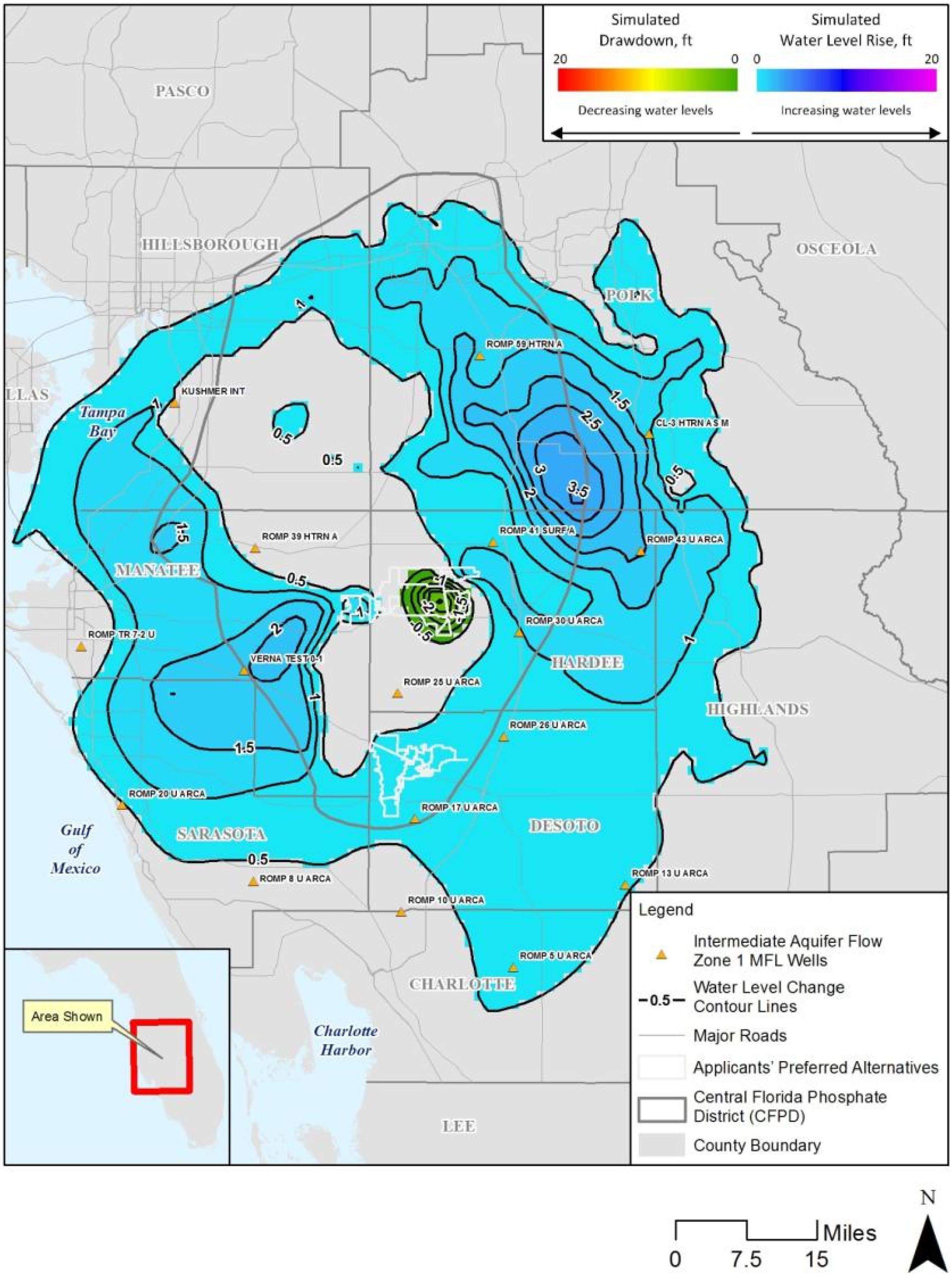


FIGURE 31
Simulated Water Change in IAS Zone 2 (Model Layer 3) Water Level (ft) 2010 to 2025B
Alternative 2, 3, 4, and 5 Mines with All Users with Agricultural Reductions
Central Florida Phosphate District, Florida

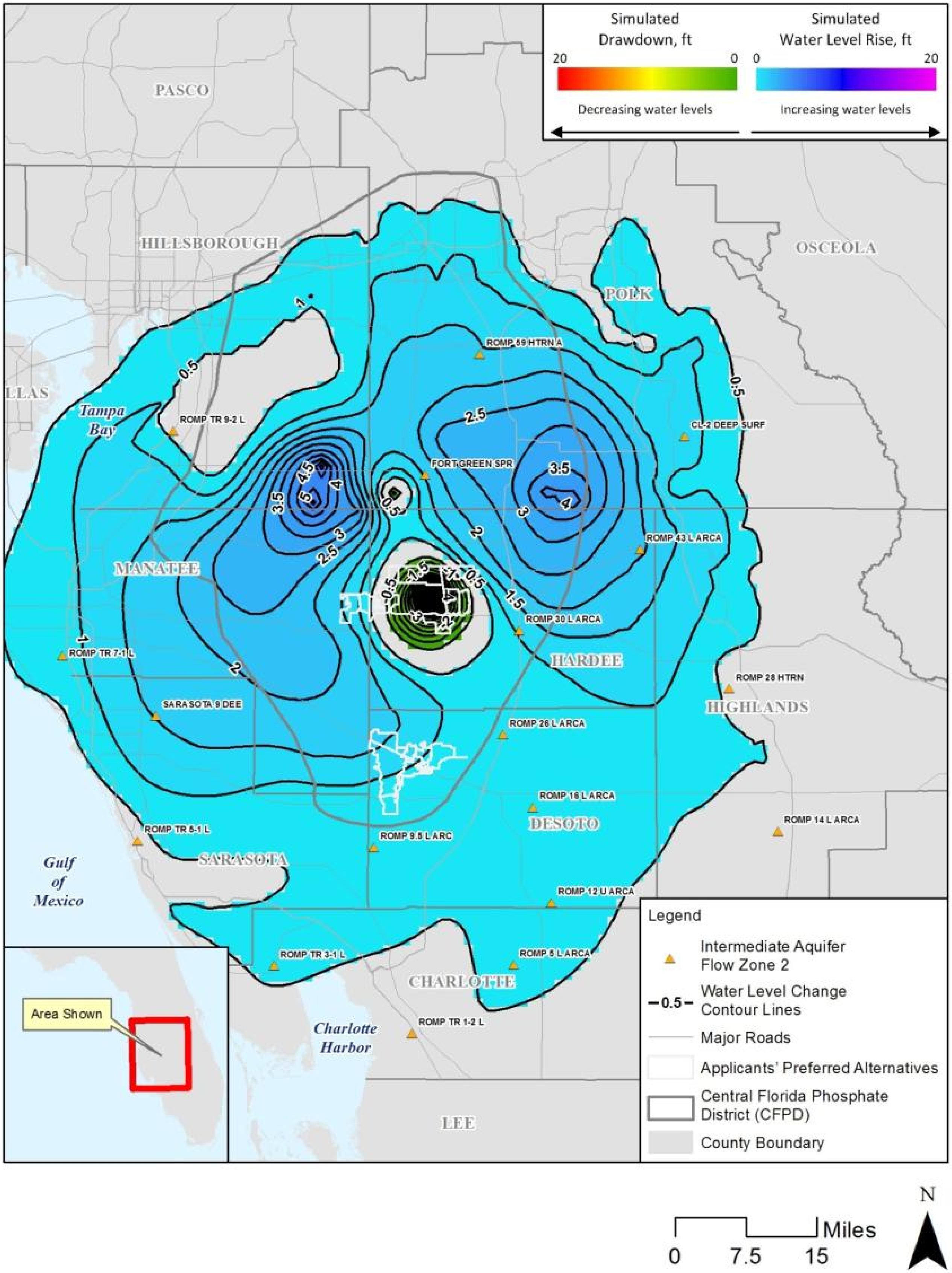
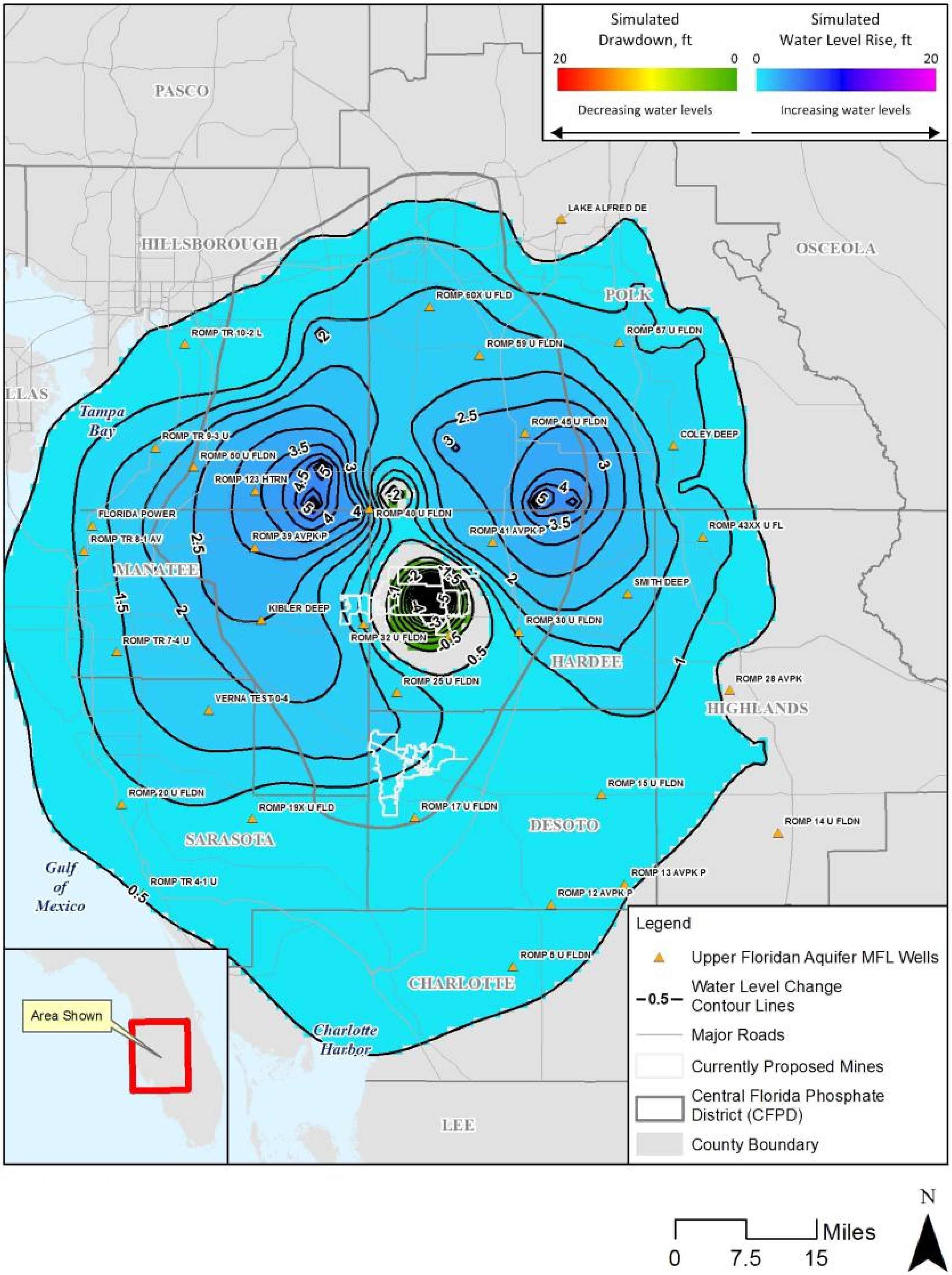


FIGURE 32
Simulated Water Change in Upper Floridan Aquifer (Model Layer 4) Water Level (ft) 2010 to 2025B
Alternative 2, 3, 4, and 5 Mines with All Users with Agricultural Reductions
Central Florida Phosphate District, Florida



In scenario 2047A Mining Only with other users at 2010 and no agricultural reduction, the monitor well water level changes range from 0 to 1.76 feet in Layer 1 (Table 18), 0.03 to 1.94 feet in Layer 2 (Table 19), 0.04 to 4.11 feet in Layer 3 (Table 20), and 0.04 to 6.03 feet in Layer 4 (Table 21). The 2047A Mining Only with other users at 2010 and no agricultural reduction SWIMAL value increases by 1.55 feet, as shown in Table 21. In scenario 2047B Mining Only with other users at 2010 and no agricultural reduction, the monitor wells water levels changes ranges from 0 to 1.75 feet in Layer 1 (Table 18), 0.03 to 1.83 feet in Layer 2 (Table 19), 0.03 to 3.89 feet in Layer 3 (Table 20), and -0.70 to 5.61 feet in Layer 4 (Table 21). The 2047B Mining Only with other users at 2010 and no agricultural reduction SWIMAL value increases by 1.44 feet, as shown in Table 21.

In scenario 2047A All Users with agricultural reduction, the monitor wells water level changes range from 0 to 2.35 feet in Layer 1 (Table 22), 0.07 to 3.61 feet in Layer 2 (Table 23), 0.23 to 5.37 feet in Layer 3 (Table 24), and 0.25 to 7.74 feet in Layer 4 (Table 25). The 2047A All Users with agricultural reduction SWIMAL value increases by 3.01 feet, as shown in Table 25. In scenario 2047B All Users with agricultural reduction, the monitor wells water level changes range from 0 to 2.27 feet in Layer 1 (Table 22), 0.07 to 3.44 feet in Layer 2 (Table 23), 0.21 to 5.09 feet in Layer 3 (Table 24), and 0.24 to 7.32 feet in Layer 4 (Table 25). The 2047B All Users with agricultural reduction SWIMAL value increases by 2.89 feet, as shown in Table 25.

6.2.1.7 2010 to 2049

For 2049, it is projected that all mines will have ceased operating. For the All Users scenarios, agriculture demands are maintained at their 2025 levels, per the SWUCA recovery strategy.

In scenario 2049 Mining Only with other users at 2010 rates and no agricultural reduction, the monitor well water level changes range from 0 to 1.72 feet in Layer 1 (Table 18), 0.05 to 2.38 feet in Layer 2 (Table 19), 0.09 to 5.19 feet in Layer 3 (Table 20), and 0.09 to 7.61 feet in Layer 4 (Table 21). The 2049 Mining Only SWIMAL value increases by 2.01 feet, as shown in Table 21.

In scenario 2049 All Users with agricultural reduction, the monitor wells water level changes range from 0 to 2.68 feet in Layer 1 (Table 22), 0.09 to 4.26 feet in Layer 2 (Table 23), 0.28 to 6.44 feet in Layer 3 (Table 24), and 0.29 to 9.32 feet in Layer 4 (Table 25). The 2049 All Users SWIMAL value increases by 3.46 feet, as shown in Table 25.

6.3 Effect of Aquifer Water Level Changes on Spring Discharge - Alternatives 1, 2, 3, 4, and 5

The model results indicate that for all phosphate mining scenarios simulated, regional water levels in the aquifer layers will increase over most of the model domain as agricultural water use in the SWUCA is curtailed by SWFWMD restrictions. Additionally, the Mining Only results that do not include the agricultural reduction assumption generally show regional water levels increasing in all aquifer layers. As currently operating mines cease withdrawing groundwater from the UFA, localized water level rebound will occur. Localized drawdown (lowering) of the UFA will occur as the pumpage from individual mines is increased or new mines come on-line (for example, Ona Mine). Overall, the net change is positive over the majority of the model domain.

As spring discharge depends on the potentiometric surface of the IAS and/or the UFA, an increase in the potentiometric surface of the IAS and/or UFA can be expected to result in additional spring flow, if the spring already flows and is in an area near mine wellfields where more than a few feet of change is estimated to occur. If the spring does not flow, or is in an area of a few feet or less of water level change associated with the mining withdrawals, no change in spring flow of those particular springs will occur. There are springs, however, that are not expected to recover even if all withdrawals for mining cease. An analysis conducted by SWFWMD in 2006, as part of its SWUCA recovery strategy, estimated that groundwater withdrawals would have to decrease by as much as 450 mgd (or 69 percent of the 650 mgd SWUCA goal) before Kissengen Spring would flow again.

6.3.1 Impact to Other Users – Alternatives 2, 3, 4, and 5 Mining Only

As the withdrawals by the mining industry change in quantity and location, the water levels in the UFA will change in response. In much of the study area, the UFA water levels remain the same or increase leading to no detrimental impact to other well owners. Where increased drawdown in the UFA occurs, other well owners may experience lower water levels during parts of the year. The model was used to estimate the number of other wells that may experience lower water levels by using the well location file in the model and extracting the water level change under steady-state conditions. Table 26 presents the quantity of wells from the model wellfield found within each drawdown contour. The wells are listed by water level changes in 1-foot increments. The numbers in the table are cumulative; for example, Column 1 wells will have 1 foot or greater drawdown. Column 2 shows the number of wells listed in Column 1 that may experience greater than 2 feet of drawdown. Columns 3 and 4 are the number of wells from Column 1 that may experience 3 or 4 feet of drawdown.

Table 26 shows that very few wells are likely to experience more than several feet of drawdown, and then only under certain modeling scenarios. With all users and with mining withdrawals included, the number of wells experiencing drawdown of more than 3 feet is highest in scenario 2020B, which is one of the flexible pumping scenarios. Because the flexible pumping amounts can only be pumped for short periods of time, these water level changes are not likely to occur because it takes weeks or months for water level changes in the UFA to expand outward from the pumping wells. With the mines pumping and all other users at 2010 rates, the two scenarios with the highest number of wells with drawdown of more than 3 feet occur in 2020B and 2025B, both of which are flexible pumping scenarios.

TABLE 26
Quantity of Wells Within Drawdown Contours[1]
Central Florida Phosphate District, Florida

	Greater than 1 ft Drawdown				Greater than 2 ft Drawdown				Greater than 3 ft Drawdown				Greater than 4 ft Drawdown			
	No. of wells in Layer:				No. of wells in Layer:				No. of wells in Layer:				No. of wells in Layer:			
Scenario	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
2015Alt1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020Alt1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025Alt1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2030Atl1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015MonlyAlt1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020MonlyAlt1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025MonlyAlt1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2030MonlyAlt1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015Alt2A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015Alt2B[1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015Alt2C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019Alt2A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019Alt2B[1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019Alt2C[1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020Alt2A	0	2	3	10	0	0	0	5	0	0	0	2	0	0	0	0
2020Alt2B[1]	0	11	14	69	0	3	3	13	0	0	1	6	0	0	0	2
2025Alt2A	0	0	0	5	0	0	0	2	0	0	0	0	0	0	0	0
2025Alt2B[1]	0	2	3	16	0	0	0	7	0	0	0	2	0	0	0	0
2036Alt2A[1]	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
2036Alt2B[1]	0	0	0	6	0	0	0	2	0	0	0	0	0	0	0	0

TABLE 26
Quantity of Wells Within Drawdown Contours[1]
Central Florida Phosphate District, Florida

	Greater than 1 ft Drawdown				Greater than 2 ft Drawdown				Greater than 3 ft Drawdown				Greater than 4 ft Drawdown			
	No. of wells in Layer:				No. of wells in Layer:				No. of wells in Layer:				No. of wells in Layer:			
Scenario	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
2047Alt2A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2047Alt2B[1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2049Alt2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015Alt2AMonly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015Alt2BMonly[1]	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0
2015Alt2CMonly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019Alt2AMonly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019Alt2BMonly[1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019Alt2CMonly[1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020Alt2AMonly	0	11	17	107	0	2	3	13	0	0	0	5	0	0	0	2
2020Alt2BMonly[1]	0	23	32	245	0	11	15	93	0	3	3	16	0	0	1	6
2025Alt2AMonly	0	5	13	76	0	0	1	15	0	0	0	5	0	0	0	2
2025Alt2BMonly[1]	0	10	22	185	0	2	5	35	0	0	1	15	0	0	0	5
2036Alt2AMonly	0	0	1	14	0	0	0	5	0	0	0	2	0	0	0	0
2036Alt2BMonly[1]	0	8	14	65	0	0	1	14	0	0	0	5	0	0	0	2
2047Alt2AMonly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2047Alt2BMonly[1]	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0
2049Alt2Monly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Layer 1 = SAS, Layer 2 = IAS Zone 1, Layer 3 = IAS Zone 2, and Layer 4 = UFA

[1] Because the flexible pumping amounts can only be pumped for short periods of time, these water level changes in nearby ROMP wells are not likely to occur.

6.4 Impact to Surface Waters Used for Public Water Supply

The 2010 SWFWMD Water Supply Plan summarizes the surface water available to help meet public supply demand for each watershed (SWFWMD, 2010). An evaluation of the changes in available surface water was performed using permitted withdrawals from surface waters and the estimated available quantities; both are provided by SWFWMD in the 2010 Water Supply Plan. SWFWMD estimates that there is approximately an additional 80 mgd available from the Peace River, 18 mgd from the Alafia River, 41 mgd from the Myakka River, and 93 mgd from the Withlacoochee River. Table 27 shows the river flow, permitted withdrawals, actual use, and potentially available withdrawals obtained from the SWFWMD.

TABLE 27
Surface Water Available to Meet Public Supply Demand
Central Florida Phosphate District, FL

	SWFWMD Water Supply Plan					Basin-wide Mining Operation Impacts from 2009 to 2050		
Watershed	**Adjusted Annual Average Flow[1] (mgd)**	**Permitted Average Withdrawal[1] (mgd)**	**2003 to 2007 Withdrawal[1] (mgd)**	**2003 to 2007 Unused Permitted Withdrawal[1] (mgd)**	**Unpermitted Potentially Available Withdrawal[1] (mgd)**	**Change in Surface Water Runoff[2] (mgd)**	**Change in Streamflow Contribution from Groundwater[3] (mgd)**	**Total Change in Streamflow Contribution[4] (mgd)**
Peace River	813.0	32.8	14.9	17.9	80.4	62.69	14.52	77.21
Hillsborough River	255.0	113	91.6	21.4	TBD	NC	2.78	NC
Alafia River	261.0	23.6	15.7	7.9	18.5	NC	3.02	NC
Manatee River	117.0	35	30	5	2.2	NC	0.25	NC
Little Manatee River	98.6	8.7	3.7	5	0.2	NC	0.36	NC
Myakka River	163.5	0	0	0	41.7	18.10	1.15	19.25
Withlacoochee River	1002.0	0.5	0.01	0.49	93.2	NC	0.96	NC
Total	2710.1	213.6	155.91	57.69	236.2	80.8	23.0	96.5

Notes:
[1] Values are from SWFWMD 2010 RWSP
[2] Values are from Surface Water Analysis, Appendix G (Only the Peace and Myakka River Basins were assessed for future changes to flow resulting from land use change in the AEIS)
[3] Values are from Groundwater Modeling River Cells for Alternatives 2, 3, 4 and 5 with Agricultural Reduction
[4] Sum of Change in Surface Water Runoff and Change in Streamflow Contribution from Groundwater
NC = Not Calculated

Using the results of the surface water analysis described in Appendix G and the changes in flow from River Cells in the DWRM2.1 model for Alternatives 2, 3, 4, and 5 All Users with Agricultural Reduction, an estimate of the combined changes resulting from mining was prepared. Changes in surface water flow were determined for the Peace and Myakka Rivers, taking into account runoff changes resulting from future land use changes throughout the river basins. Changes in groundwater contribution were calculated for all of the river basins. The last column in Table 27 shows the sum of the two calculations; it demonstrates, in every case where values were determined, that the river flow will increase as a result of mining. The streamflow contribution will increase by 77.21 mgd in the Peace River and 19.25 mgd in the Myakka River from 2009 to 2050, which will substantially increase the amount of surface water available for public supply.

7.0 Transient Modeling to Evaluate Seasonal Impact of Mining

Seasonal variability in withdrawal rates typically results in regional lowering of aquifer levels during the spring dry season and recovery of water levels in the winter. Simulation of monthly changes in water levels required that the DWRM2.1 model be run in transient mode instead of steady state used for all other simulations. Transient mode allows the recharge to change monthly to more accurately simulate seasonal conditions. Pumping can also be varied by month to simulate changes in demand. Both recharge and pumping were varied by month for a hypothetical year, in this case the 2025B Alternatives 2, 3, 4, and 5 All Users with and without Agricultural Reduction.

This evaluation was done by first compiling regional withdrawals for water use types for seven years (from 1996 to 2002) using SWFWMD information. This compilation was used to determine the monthly multipliers applicable to each water use type (i.e., public supply, agriculture, and industrial). Those multipliers were used in the model simulations to develop the seasonal water level changes tables and graphs. Seasonal recharge values were obtained from the DWRM2.1 transient model calibration files and were applied to the future model simulations in the appropriate month of the simulations. Three transient models were set up to evaluate seasonal variations within IAS Zones 1 and 2 and the UFA aquifer layers using 13 stress periods, or time periods. The SAS was not evaluated because the SAS was not calibrated to transient conditions.[1]

The first stress period is a steady-state model with average annual withdrawal amounts followed by 12 monthly transient stress periods as follows:

- Stress Period 2 - January – 31 days non peak withdrawal
- Stress Period 3 - February – 28 days non peak withdrawal
- Stress Period 4 - March – 31 days intermediate withdrawal
- Stress Period 5 - April – 30 days peak month withdrawal
- Stress Period 6 - May – 31 days intermediate withdrawal
- Stress Period 7 - June – 30 days non peak withdrawal
- Stress Period 8 - July – 31 days non peak withdrawal
- Stress Period 9 - August – 31 days non peak withdrawal
- Stress Period 10 - September – 30 days non peak withdrawal
- Stress Period 11 - October – 31 days non peak withdrawal
- Stress Period 12 - November – 30 days non peak withdrawal
- Stress Period 13 - December – 31 days non peak withdrawal

The base year 2010 was modeled along with two models for the year 2025; one representing the change in withdrawal from users with agricultural reduction and the other for the change in withdrawal by mining only with other users at 2010 rates and no agricultural reduction. The mining withdrawal is the same as in Alternative 2, 3, 4, and 5, scenario 2025B with the Ona Mine at its flexible permit withdrawal limit. The transient model peaking factor (included on the last row of Table 17) was applied to Stress Period 5, which represents the month of April (Ona: 1.88, Desoto: 1.88, Wingate: 1.25, and South Pasture: 1.17). An intermediate peaking factor was applied to

[1] The River and Drain Cell elevations were not modified from steady state. As a result, the DWRM2.1 model cannot be used to reliably simulate the SAS under transient conditions.

the month preceding and following April to represent the dry season. The rest of the months were adjusted downward, so that the average withdrawal for the year is the same as the drought year average annual as shown in Table 17. The other users' well withdrawals were adjusted according to well type using the multipliers in Table 28, which were averaged using data from the DWRM2.1 transient calibration as described previously. The DWRM2.1 transient model uses 7 years of actual monthly withdrawals provided by SWFWMD.

TABLE 28

Transient Model Monthly Well Withdrawal Multipliers

Central Florida Phosphate District, Florida

	Monthly Multiplier					
Month	**Agriculture**	**Industrial Commercial**	**Mining Dewatering**	**Public Supply**	**Recreation**	**Unspecified Use**
January	1.06	0.96	0.75	0.93	0.70	0.90
February	1.19	1.00	1.28	1.01	0.86	1.00
March	1.24	1.00	0.76	1.03	0.99	1.18
April	1.59	1.05	1.32	1.12	1.23	1.66
May	1.68	1.03	1.21	1.16	1.41	1.70
June	1.04	1.01	0.95	1.06	1.20	1.21
July	0.47	1.02	0.92	0.96	0.90	0.58
August	0.44	0.97	0.94	0.94	0.92	0.46
September	0.52	0.85	0.81	0.90	0.85	0.49
October	0.81	0.93	1.14	0.97	1.03	0.78
November	1.04	1.11	0.81	0.99	1.08	1.05
December	0.93	1.08	1.13	0.93	0.84	0.97

Note: The Mining Dewatering values are used for mines other than CF Industries and Mosaic

Monthly recharge values were also obtained from the DWRM2.1 transient calibration by averaging the 7 years of recharge data for each month and cell. For the 2025 scenario, the recharge was also increased with the Preferred Alternatives mine footprints using the multipliers presented in Table 4. The total model recharge varies for the monthly stress periods, as shown in Table 29.

TABLE 29

Seasonal Recharge Summary from DWRM2.1 Transient Calibration Files

Central Florida Phosphate District, Florida

	Average Model Recharge (in/year)	
	2010	**2025**
Average Annual	4.05	4.07
January	2.84	2.84
February	2.95	2.96
March	3.71	3.72
April	1.88	1.88
May	1.95	1.96
June	6.66	6.68
July	6.88	6.90
August	6.26	6.27
September	7.08	7.10
October	2.34	2.35
November	2.14	2.14
December	3.97	3.98

Table 30 summarizes the results of the three transient models in the IAS Zone 1 (Layer 2).

Figure 33 presents the IAS Zone 1 ROMP monitoring well water level differences compared to the 2010 base scenario. Figure 33 shows that the water levels are lower in the spring dry season, but recover in the late summer, fall, and winter. The change in water level fluctuation varies by as much as 8 feet above and below the 2010 base conditions but as the chart illustrates, the annual average water level remains stable.

FIGURE 33
Transient 2010 Model Simulated Water Change in the IAS Zone 1 Aquifer (Model Layer 2) Water Level (ft)
Central Florida Phosphate District, Florida

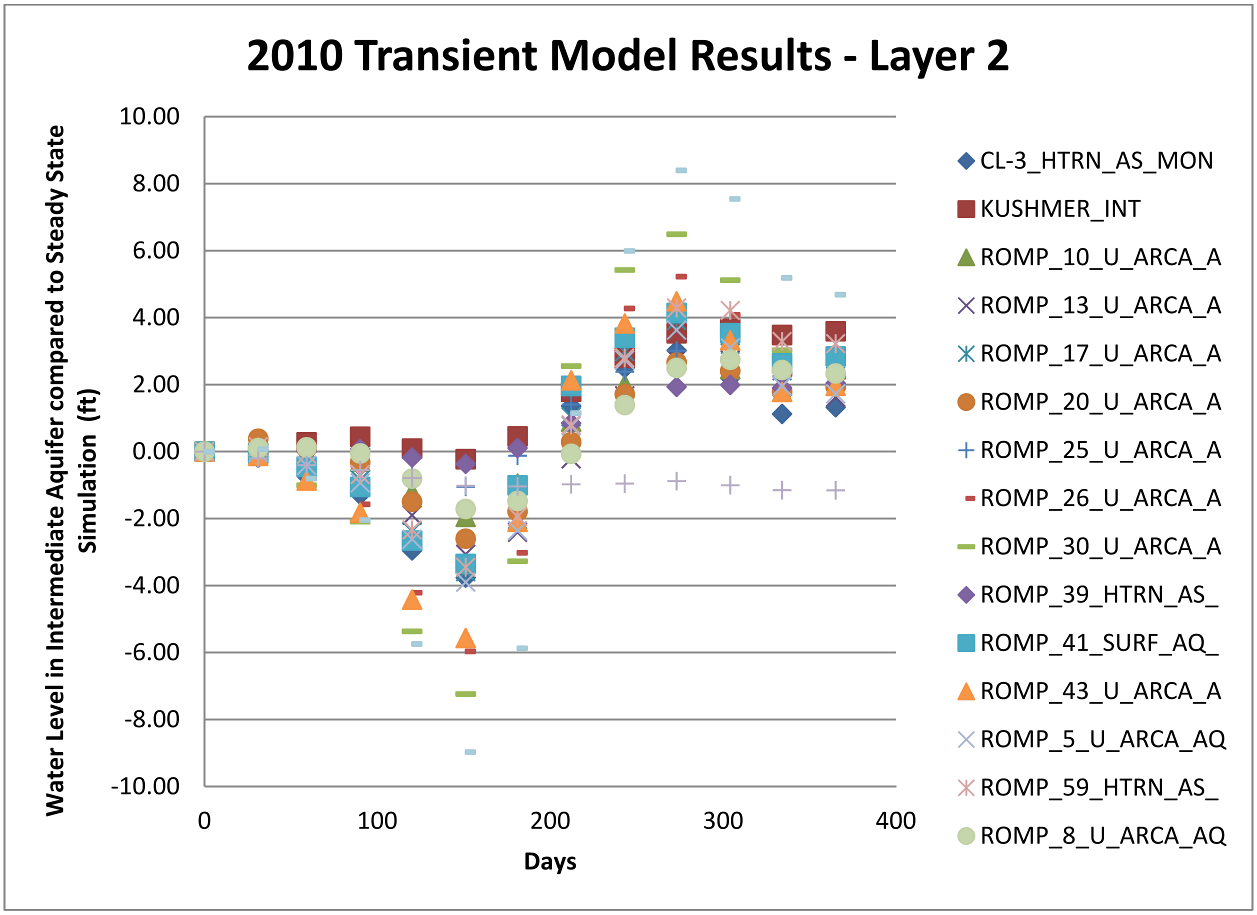


TABLE 30
Transient Model Simulated IAS Zone 1 ROMP Monitor Well Water Levels (Layer 2)
Central Florida Phosphate District, Florida

Well	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Change in Maximum Water Level Change from 2010 (ft)	% Change in Maximum Water Level Change from 2010
	2010 All Users with Mining			**Scenario 2025B Alternatives 2, 3, 4, and 5 All Users with Mining, *with Agriculture Reduction***				
CL-3_HTRN_AS_MON	98.33	91.58	6.75	99.33	93.15	6.18	-0.57	-8.5
KUSHMER_INT	22.60	18.72	3.88	22.92	19.18	3.74	-0.14	-3.7
ROMP_10_U_ARCA_A	22.52	17.83	4.69	22.67	18.11	4.56	-0.13	-2.7
ROMP_13_U_ARCA_A	46.15	40.33	5.82	46.54	41.07	5.47	-0.35	-6.0
ROMP_17_U_ARCA_A	42.09	34.59	7.50	42.56	35.50	7.05	-0.44	-5.9
ROMP_20_U_ARCA_A	13.49	8.23	5.26	13.86	8.91	4.95	-0.32	-6.1
ROMP_25_U_ARCA_A	71.32	67.27	4.05	71.45	67.48	3.97	-0.08	-1.9
ROMP_26_U_ARCA_A	45.20	34.03	11.18	45.75	35.26	10.49	-0.69	-6.2
ROMP_30_U_ARCA_A	55.68	42.11	13.56	56.36	43.40	12.96	-0.60	-4.5
ROMP_39_HTRN_AS_	89.15	86.75	2.40	89.38	87.02	2.36	-0.04	-1.8
ROMP_41_SURF_AQ_	93.39	86.08	7.31	94.25	87.12	7.14	-0.17	-2.4
ROMP_43_U_ARCA_A	81.63	71.68	9.94	83.38	74.38	9.00	-0.94	-9.5
ROMP_5_U_ARCA_AQ	45.25	37.72	7.53	45.64	38.56	7.08	-0.44	-5.9
ROMP_59_HTRN_AS_	94.62	87.02	7.60	95.92	88.82	7.11	-0.49	-6.5
ROMP_8_U_ARCA_AQ	25.64	21.18	4.46	25.96	21.72	4.24	-0.22	-4.9
ROMP_TR_7-2_U_AR	15.91	14.75	1.16	15.95	14.83	1.13	-0.03	-2.4
VERNA_TEST_0-1	25.55	8.24	17.32	26.95	11.04	15.91	-1.41	-8.1

TABLE 30
Transient Model Simulated IAS Zone 1 ROMP Monitor Well Water Levels (Layer 2)
Central Florida Phosphate District, Florida

Well	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Change in Maximum Water Level Change from 2010 (ft)	% Change in Maximum Water Level Change from 2010
	2010 All Users with Mining			**Scenario 2025B Alternatives 2, 3, 4, and 5 All Users with Mining, *without Agriculture Reduction***				
CL-3_HTRN_AS_MON	98.33	91.58	6.75	98.72	92.05	6.67	-0.08	-1.2
KUSHMER_INT	22.60	18.72	3.88	22.71	18.85	3.86	-0.02	-0.5
ROMP_10_U_ARCA_A	22.52	17.83	4.69	22.50	17.79	4.71	0.03	0.6
ROMP_13_U_ARCA_A	46.15	40.33	5.82	46.09	40.21	5.88	0.06	1.1
ROMP_17_U_ARCA_A	42.09	34.59	7.50	42.10	34.51	7.59	0.09	1.2
ROMP_20_U_ARCA_A	13.49	8.23	5.26	13.51	8.22	5.29	0.02	0.4
ROMP_25_U_ARCA_A	71.32	67.27	4.05	71.27	67.10	4.17	0.12	2.9
ROMP_26_U_ARCA_A	45.20	34.03	11.18	45.06	33.69	11.38	0.20	1.8
ROMP_30_U_ARCA_A	55.68	42.11	13.56	55.49	41.44	14.05	0.48	3.6
ROMP_39_HTRN_AS_	89.15	86.75	2.40	89.19	86.78	2.41	0.01	0.4
ROMP_41_SURF_AQ_	93.39	86.08	7.31	93.73	86.30	7.43	0.12	1.6
ROMP_43_U_ARCA_A	81.63	71.68	9.94	82.43	72.66	9.77	-0.17	-1.7
ROMP_5_U_ARCA_AQ	45.25	37.72	7.53	45.18	37.56	7.61	0.09	1.2
ROMP_59_HTRN_AS_	94.62	87.02	7.60	95.30	87.80	7.50	-0.10	-1.3
ROMP_8_U_ARCA_AQ	25.64	21.18	4.46	25.63	21.13	4.50	0.04	0.9
ROMP_TR_7-2_U_AR	15.91	14.75	1.16	15.91	14.77	1.15	-0.01	-0.7
VERNA_TEST_0-1	25.55	8.24	17.32	25.67	8.24	17.44	0.12	0.7

Table 31 summarizes the results of the three transient models in the IAS Zone 2 (Layer 3).

Figure 34 presents the IAS Zone 2 ROMP monitoring well water level differences compared to the 2010 base scenario. Figure 34 shows that the water levels are lower in the spring dry season, but recover in the late summer, fall, and winter. The change in water level fluctuation varies by as much as 7 feet above and below the 2010 base conditions but as the chart illustrates, the annual average water level remains stable.

FIGURE 34
Transient 2010 Model Simulated Water Change in the IAS Zone 2 (Model Layer 3) Water Level (ft)
Central Florida Phosphate District, Florida

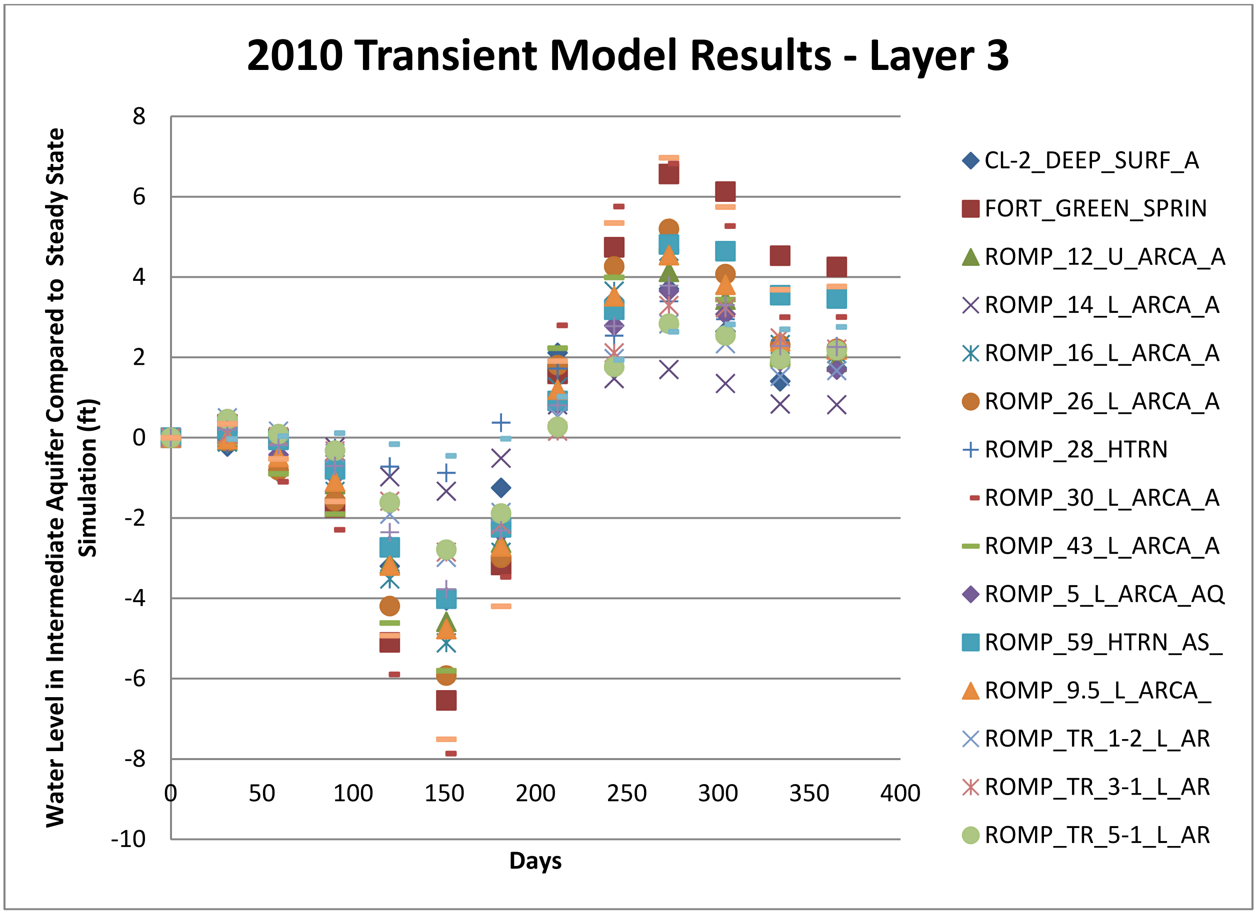


Table 32 summarizes the results of the three transient models in the UFA (Layer 4).

TABLE 31

Transient Model Simulated IAS Zone 2 ROMP Monitor Well Water Levels (Layer 3)

Central Florida Phosphate District, Florida

	2010 All Users with Mining			Scenario 2025B Alternatives 2, 3, 4, and 5 All Users with Mining, *with Agriculture Reduction*				
Well	**Maximum Elevation (ft)**	**Minimum Elevation (ft)**	**Maximum Water Level Change (ft)**	**Maximum Elevation (ft)**	**Minimum Elevation (ft)**	**Maximum Water Level Change (ft)**	**Change in Maximum Water Level Change from 2010 (ft)**	**% Change in Maximum Water Level Change from 2010**
CL-2_DEEP_SURF_A	86.95	79.19	7.76	87.93	80.83	7.11	-0.65	-8.4%
FORT_GREEN_SPRIN	76.38	63.80	12.58	77.83	65.68	12.14	-0.44	-3.5%
ROMP_12_U_ARCA_A	44.78	36.07	8.71	45.24	37.07	8.17	-0.54	-6.2%
ROMP_14_L_ARCA_A	44.28	41.24	3.03	44.40	41.51	2.89	-0.14	-4.6%
ROMP_16_L_ARCA_A	45.63	35.88	9.75	46.13	36.99	9.15	-0.60	-6.2%
ROMP_26_L_ARCA_A	45.26	34.15	11.11	45.81	35.39	10.42	-0.69	-6.2%
ROMP_28_HTRN	74.41	70.14	4.27	74.86	70.64	4.22	-0.05	-1.2%
ROMP_30_L_ARCA_A	54.70	40.19	14.51	55.47	41.65	13.82	-0.70	-4.8%
ROMP_43_L_ARCA_A	81.11	70.76	10.35	82.86	73.50	9.36	-0.99	-9.5%
ROMP_5_L_ARCA_AQ	45.25	37.62	7.63	45.64	38.47	7.18	-0.45	-5.9%
ROMP_59_HTRN_AS_	89.48	80.83	8.65	90.93	82.87	8.06	-0.59	-6.8%
ROMP_9.5_L_ARCA_	42.14	32.83	9.31	42.64	33.93	8.71	-0.60	-6.4%
ROMP_TR_1-2_L_AR	15.84	10.01	5.83	15.97	10.21	5.75	-0.08	-1.3%
ROMP_TR_3-1_L_AR	34.22	28.08	6.14	34.64	28.86	5.78	-0.36	-5.9%
ROMP_TR_5-1_L_AR	13.28	7.64	5.64	13.62	8.25	5.37	-0.27	-4.8%
ROMP_TR_7-1_L_AR	17.76	10.21	7.55	18.39	11.47	6.93	-0.63	-8.3%
ROMP_TR_9-2_L_AR	23.81	20.54	3.27	24.16	21.07	3.09	-0.18	-5.4%
SARASOTA_9_DEEP	20.99	6.53	14.46	22.05	8.75	13.30	-1.15	-8.0%

TABLE 31

Transient Model Simulated IAS Zone 2 ROMP Monitor Well Water Levels (Layer 3)

Central Florida Phosphate District, Florida

Well	2010 All Users with Mining			Scenario 2025B Alternatives 2, 3, 4, and 5 All Users with Mining, *without Agriculture Reduction*				
	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Change in Maximum Water Level Change from 2010 (ft)	% Change in Maximum Water Level Change from 2010
CL-2_DEEP_SURF_A	86.95	79.19	7.76	87.24	79.53	7.71	-0.04	-0.6
FORT_GREEN_SPRIN	76.38	63.80	12.58	76.85	63.86	12.99	0.41	3.3
ROMP_12_U_ARCA_A	44.78	36.07	8.71	44.70	35.88	8.82	0.11	1.2
ROMP_14_L_ARCA_A	44.28	41.24	3.03	44.26	41.21	3.05	0.02	0.5
ROMP_16_L_ARCA_A	45.63	35.88	9.75	45.53	35.65	9.88	0.13	1.3
ROMP_26_L_ARCA_A	45.26	34.15	11.11	45.12	33.82	11.31	0.20	1.8
ROMP_28_HTRN	74.41	70.14	4.27	74.45	70.16	4.29	0.02	0.5
ROMP_30_L_ARCA_A	54.70	40.19	14.51	54.53	39.52	15.01	0.50	3.4
ROMP_43_L_ARCA_A	81.11	70.76	10.35	81.91	71.74	10.17	-0.18	-1.7
ROMP_5_L_ARCA_AQ	45.25	37.62	7.63	45.18	37.46	7.72	0.09	1.2
ROMP_59_HTRN_AS_	89.48	80.83	8.65	90.24	81.71	8.53	-0.12	-1.4
ROMP_9.5_L_ARCA_	42.14	32.83	9.31	42.05	32.63	9.43	0.12	1.3
ROMP_TR_1-2_L_AR	15.84	10.01	5.83	15.83	9.98	5.85	0.02	0.3
ROMP_TR_3-1_L_AR	34.22	28.08	6.14	34.17	27.96	6.21	0.07	1.1
ROMP_TR_5-1_L_AR	13.28	7.64	5.64	13.29	7.62	5.67	0.02	0.4
ROMP_TR_7-1_L_AR	17.76	10.21	7.55	17.87	10.31	7.55	0.00	0.0
ROMP_TR_9-2_L_AR	23.81	20.54	3.27	23.91	20.66	3.25	-0.01	-0.4
SARASOTA_9_DEEP	20.99	6.53	14.46	21.10	6.57	14.52	0.07	0.5

TABLE 32
Transient Model Simulated UFA ROMP Monitor Well Water Levels (Layer 4)
Central Florida Phosphate District, Florida

	2010 All Users with Mining			Scenario 2025B Alternatives 2, 3, 4, and 5 All Users with Mining, *with Agriculture Reduction*				
Well	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Change in Maximum Water Level Change from 2010 (ft)	% Change in Maximum Water Level Change from 2010
COLEY_DEEP	87.72	79.59	8.13	88.81	81.37	7.43	-0.70	-8.6%
FLORIDA_POWER_FL	17.36	6.73	10.63	18.29	8.62	9.67	-0.97	-9.1%
KIBLER_DEEP	23.06	0.09	22.96	24.79	3.78	21.02	-1.94	-8.5%
LAKE_ALFRED_DEEP	124.70	122.30	2.40	125.04	122.72	2.32	-0.08	-3.4%
ROMP_12_AVPK_PZ_	44.78	36.05	8.73	45.24	37.06	8.19	-0.54	-6.2%
ROMP_123_HTRN_AS	29.28	7.14	22.15	31.95	12.21	19.74	-2.41	-10.9%
ROMP_13_AVPK_PZ_	45.23	39.23	6.00	45.63	39.99	5.64	-0.36	-6.0%
ROMP_14_U_FLDN_A	44.26	41.22	3.05	44.39	41.48	2.91	-0.14	-4.6%
ROMP_15_U_FLDN_A	45.48	35.66	9.82	45.99	36.82	9.17	-0.65	-6.6%
ROMP_17_U_FLDN_A	43.30	33.50	9.79	43.81	34.65	9.16	-0.63	-6.5%
ROMP_19X_U_FLDN_	35.33	25.39	9.94	35.94	26.67	9.27	-0.67	-6.7%
ROMP_20_U_FLDN_A	21.94	15.17	6.77	22.48	16.19	6.28	-0.49	-7.2%
ROMP_25_U_FLDN_A	35.34	14.68	20.66	36.15	16.65	19.50	-1.16	-5.6%
ROMP_28_AVPK	73.99	69.69	4.30	74.45	70.21	4.24	-0.06	-1.4%
ROMP_30_U_FLDN_A	54.66	40.13	14.54	55.43	41.59	13.84	-0.70	-4.8%
ROMP_31_U_FLDN_A	50.83	34.79	16.04	49.90	33.10	16.80	0.76	4.7%
ROMP_32_U_FLDN_A	35.99	13.90	22.09	36.56	15.00	21.56	-0.53	-2.4%
ROMP_39_AVPK_PZ_	24.49	1.18	23.31	26.73	5.68	21.05	-2.26	-9.7%
ROMP_40_U_FLDN_A	52.29	33.90	18.39	54.34	36.95	17.39	-1.00	-5.4%
ROMP_41_AVPK_PZ_	72.04	57.03	15.00	74.06	60.05	14.01	-1.00	-6.7%
ROMP_43XX_U_FLDN	88.15	82.47	5.67	89.37	84.15	5.22	-0.45	-7.9%
ROMP_45_U_FLDN_A	78.61	65.17	13.44	81.06	68.91	12.15	-1.29	-9.6%
ROMP_5_U_FLDN_AQ	45.25	37.61	7.64	45.64	38.46	7.18	-0.45	-5.9%
ROMP_50_U_FLDN_A	23.20	4.68	18.52	25.06	8.37	16.69	-1.83	-9.9%

TABLE 32
Transient Model Simulated UFA ROMP Monitor Well Water Levels (Layer 4)
Central Florida Phosphate District, Florida

	2010 All Users with Mining			Scenario 2025B Alternatives 2, 3, 4, and 5 All Users with Mining, *with Agriculture Reduction*				
Well	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Change in Maximum Water Level Change from 2010 (ft)	% Change in Maximum Water Level Change from 2010
ROMP_57_U_FLDN_A	107.75	102.09	5.66	108.78	103.50	5.28	-0.38	-6.6%
ROMP_59_U_FLDN_A	84.18	74.33	9.85	85.79	76.63	9.15	-0.70	-7.1%
ROMP_60X_U_FLDN_	83.98	74.46	9.52	85.46	76.55	8.92	-0.61	-6.4%
ROMP_TR_10-2_L_A	29.25	17.12	12.13	30.26	17.74	12.52	0.39	3.2%
ROMP_TR_4-1_U_FL	22.66	17.69	4.97	23.06	18.41	4.65	-0.32	-6.4%
ROMP_TR_7-4_U_FL	18.76	5.99	12.76	19.74	8.03	11.71	-1.05	-8.2%
ROMP_TR_8-1_AVPK	17.42	8.14	9.29	18.22	9.75	8.46	-0.82	-8.9%
ROMP_TR_9-3_U_FL	19.93	6.17	13.76	21.29	8.80	12.49	-1.28	-9.3%
SMITH_DEEP	75.86	65.27	10.59	77.38	67.72	9.67	-0.93	-8.7%
VERNA_TEST_0-4	21.97	4.93	17.03	23.20	7.55	15.65	-1.38	-8.1%

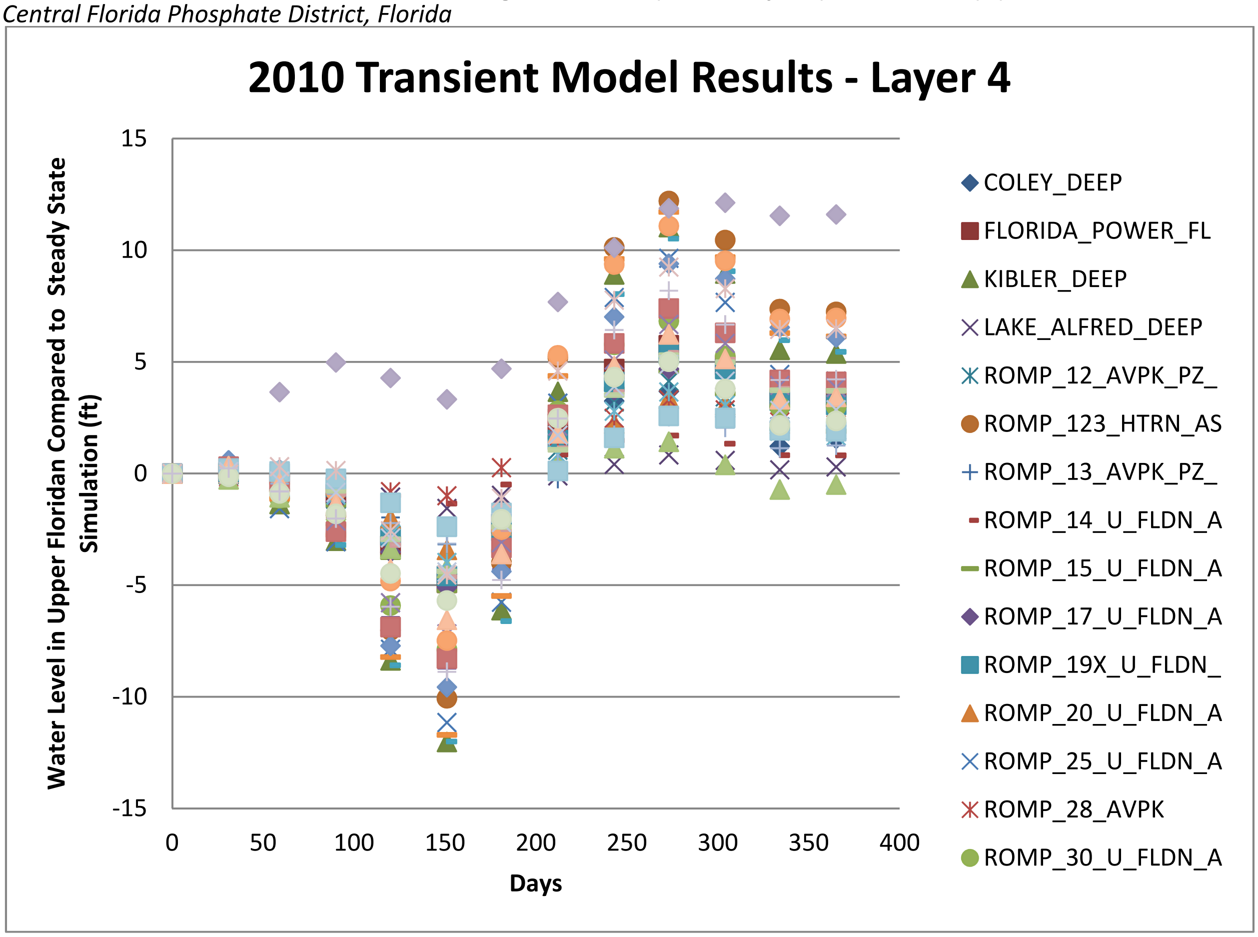
	2010 All Users with Mining			Scenario 2025B Alternatives 2, 3, 4, and 5, All Users with Mining, *without Agriculture Reduction*				
Well	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Maximum Elevation (ft)	Minimum Elevation (ft)	Maximum Water Level Change (ft)	Change in Maximum Water Level Change from 2010 (ft)	% Change in Maximum Water Level Change from 2010
COLEY_DEEP	87.72	79.59	8.13	88.07	80.00	8.07	-0.06	-0.7
FLORIDA_POWER_FL	17.36	6.73	10.63	17.58	6.99	10.59	-0.04	-0.4
KIBLER_DEEP	23.06	0.09	22.96	23.28	0.17	23.11	0.15	0.7
LAKE_ALFRED_DEEP	124.70	122.30	2.40	124.78	122.37	2.41	0.01	0.3
ROMP_12_AVPK_PZ_	44.78	36.05	8.73	44.70	35.86	8.84	0.11	1.2
ROMP_123_HTRN_AS	29.28	7.14	22.15	30.51	8.86	21.65	-0.50	-2.2
ROMP_13_AVPK_PZ_	45.23	39.23	6.00	45.17	39.10	6.07	0.06	1.1
ROMP_14_U_FLDN_A	44.26	41.22	3.05	44.25	41.19	3.06	0.02	0.6
ROMP_15_U_FLDN_A	45.48	35.66	9.82	45.39	35.45	9.94	0.12	1.2
ROMP_17_U_FLDN_A	43.30	33.50	9.79	43.20	33.28	9.93	0.13	1.3

TABLE 32
Transient Model Simulated UFA ROMP Monitor Well Water Levels (Layer 4)
Central Florida Phosphate District, Florida

	2010 All Users with Mining			**Scenario 2025B Alternatives 2, 3, 4, and 5, All Users with Mining, *without Agriculture Reduction***				
Well	**Maximum Elevation (ft)**	**Minimum Elevation (ft)**	**Maximum Water Level Change (ft)**	**Maximum Elevation (ft)**	**Minimum Elevation (ft)**	**Maximum Water Level Change (ft)**	**Change in Maximum Water Level Change from 2010 (ft)**	**% Change in Maximum Water Level Change from 2010**
ROMP_19X_U_FLDN_	35.33	25.39	9.94	35.28	25.23	10.05	0.11	1.1
ROMP_20_U_FLDN_A	21.94	15.17	6.77	21.97	15.17	6.80	0.03	0.5
ROMP_25_U_FLDN_A	35.34	14.68	20.66	34.78	13.37	21.42	0.76	3.7
ROMP_28_AVPK	73.99	69.69	4.30	74.03	69.71	4.32	0.02	0.5
ROMP_30_U_FLDN_A	54.66	40.13	14.54	54.49	39.46	15.03	0.50	3.4
ROMP_31_U_FLDN_A	50.83	34.79	16.04	48.83	30.66	18.17	2.13	13.3
ROMP_32_U_FLDN_A	35.99	13.90	22.09	35.04	11.55	23.48	1.40	6.3
ROMP_39_AVPK_PZ_	24.49	1.18	23.31	25.20	2.05	23.15	-0.16	-0.7
ROMP_40_U_FLDN_A	52.29	33.90	18.39	53.10	34.39	18.72	0.33	1.8
ROMP_41_AVPK_PZ_	72.04	57.03	15.00	73.01	57.90	15.10	0.10	0.7
ROMP_43XX_U_FLDN	88.15	82.47	5.67	88.40	82.73	5.66	-0.01	-0.1
ROMP_45_U_FLDN_A	78.61	65.17	13.44	80.09	67.00	13.09	-0.35	-2.6
ROMP_5_U_FLDN_AQ	45.25	37.61	7.64	45.18	37.45	7.73	0.09	1.2
ROMP_50_U_FLDN_A	23.20	4.68	18.52	23.86	5.56	18.30	-0.22	-1.2
ROMP_57_U_FLDN_A	107.75	102.09	5.66	108.04	102.41	5.64	-0.02	-0.4
ROMP_59_U_FLDN_A	84.18	74.33	9.85	85.03	75.32	9.71	-0.14	-1.4
ROMP_60X_U_FLDN_	83.98	74.46	9.52	84.75	75.35	9.41	-0.12	-1.2
ROMP_TR_10-2_L_A	29.25	17.12	12.13	29.69	17.35	12.34	0.21	1.8
ROMP_TR_4-1_U_FL	22.66	17.69	4.97	22.66	17.67	5.00	0.03	0.6
ROMP_TR_7-4_U_FL	18.76	5.99	12.76	18.91	6.12	12.79	0.02	0.2
ROMP_TR_8-1_AVPK	17.42	8.14	9.29	17.60	8.33	9.27	-0.02	-0.2
ROMP_TR_9-3_U_FL	19.93	6.17	13.76	20.38	6.74	13.64	-0.13	-0.9
SMITH_DEEP	75.86	65.27	10.59	76.48	65.99	10.49	-0.10	-1.0
VERNA_TEST_0-4	21.97	4.93	17.03	22.08	4.95	17.14	0.10	0.6

Figure 35 presents the UFA ROMP monitoring well water level differences compared to the 2010 base scenario. Figure 35 shows that the water levels are lower in the spring dry season, but recover in the late summer, fall, and winter. The change in water level fluctuation varies by as much as 12 feet above and below the 2010 base conditions but as the chart illustrates, the annual average water level remains stable.

FIGURE 35
Transient 2010 Model Simulated Water Change in the UFA (Model Layer 4) Water Level (ft)
Central Florida Phosphate District, Florida



8.0 Summary

The results of the groundwater modeling performed to evaluate relative changes to SAS, IAS and UFA water levels are summarized in this section.

8.1 No Action Alternative

The model results indicate that water levels in the SAS, IAS, and UFA will rise in every year (relative to a simulated 2010 baseline) when currently operating mines cease to pump groundwater as their reserves are exhausted and mining ceases. Table 33 summarizes the average simulated water level change in the SAS, IAS, and UFA relative to 2010 for the year and type of water use. The values in Table 33 were calculated by averaging the simulated water level change for every model cell within the CFPD. As this is an average of the CFPD, the simulated water level changes in the vicinity of the mines will be greater. However, the results illustrate that under the No Action Alternative, the simulated increase in water levels from reductions in groundwater withdrawal at currently operating phosphate mines accounts for more than half of the total projected water level rise in the area.

As water levels are projected to increase throughout the area from the cessation of pumpage for phosphate mines and SWFWMD anticipated reductions in agricultural water use, the overall impact to the hydrogeology of the study area is positive.

TABLE 33

Simulated Water Level Change within CFPD, No Action Alternative

Central Florida Phosphate District, Florida

	Layer 1 - Surficial Aquifer		Layer 2 - Intermediate Aquifer Zone 1		Layer 3 - Intermediate Aquifer Zone 2		Layer 4 - Upper Floridan Aquifer	
	Average Simulated Change:							
Year	Phosphate Mining Only (ft)	All Users (ft)	Phosphate Mining Only (ft)	All Users (ft)	Phosphate Mining Only (ft)	All Users (ft)	Phosphate Mining Only (ft)	All Users (ft)
2015	0.04	0.08	0.14	0.34	0.25	0.65	0.28	0.74
2020	0.19	0.34	0.76	1.21	1.77	2.61	2.02	2.96
2025	0.28	0.46	1.12	1.77	2.39	3.62	2.70	4.09
2030	0.33	0.52	1.34	1.98	2.82	4.05	3.18	4.56

8.2 Applicants' Preferred Alternatives 2, 3, 4, and 5

Table 34 summarizes the average simulated changes in the water levels of the SAS, IAS, and UFA for Applicants' Preferred Alternatives 2, 3, 4, and 5. If only phosphate mining is considered, the average simulated change is a decrease of slightly more than 0.01 foot in scenarios 2015B and 2019B. The average simulated change is positive for all other scenarios. When all users are considered, the average simulated change in the water levels of the aquifers increases every year. By 2049 the simulated rise in the UFA is approximately 4.58 feet.

TABLE 34

Simulated Water Level Change within CFPD, Alternatives 2, 3, 4, and 5

Central Florida Phosphate District, Florida

	Layer 1 - Surficial Aquifer		Layer 2 - Intermediate Aquifer Zone 1		Layer 3 - Intermediate Aquifer Zone 2		Layer 4 - Upper Floridan Aquifer	
	Average Simulated Change:							
Year	Phosphate Mining Only (ft)	All Users (ft)	Phosphate Mining Only (ft)	All Users (ft)	Phosphate Mining Only (ft)	All Users (ft)	Phosphate Mining Only (ft)	All Users (ft)
2015A	0.04	0.03	0.14	0.34	0.25	0.65	0.28	0.74
2015B	0.01	0.05	0.03	0.23	-0.03	0.37	-0.05	0.40
2015C	0.01	0.05	0.01	0.21	0.02	0.42	0.03	0.48
2019A	0.04	0.11	0.15	0.51	0.27	0.99	0.31	1.12
2019B	0.00	0.07	0.01	0.38	-0.05	0.68	-0.06	0.76
2019C	0.00	0.07	0.00	0.36	0.00	0.73	0.01	0.83
2020A	0.09	0.17	0.19	0.59	0.48	1.29	0.62	1.53
2020B	0.03	0.11	-0.06	0.35	0.03	0.84	0.13	1.04
2025A	0.18	0.29	0.27	0.87	0.42	1.62	0.53	1.89
2025B	0.16	0.27	0.16	0.76	0.20	1.40	0.29	1.65
2036A	0.30	0.41	0.62	1.22	1.13	2.33	1.34	2.69
2036B	0.28	0.39	0.51	1.11	0.91	2.11	1.10	2.45
2047A	0.40	0.50	1.03	1.62	2.04	3.23	2.33	3.68
2047B	0.38	0.48	0.92	1.52	1.81	3.01	2.09	3.44
2049	0.45	0.56	1.42	2.01	2.88	4.07	3.23	4.58

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