Peace River Basin
Resource Management Plan

Florida Department of Environmental Protection
March 2007
Peace River Basin
Resource Management Plan

Florida Department of Environmental Protection

March 2007
# PEACE RIVER BASIN RESOURCE MANAGEMENT PLAN

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>1</td>
</tr>
<tr>
<td>1.0 Introduction</td>
<td>5</td>
</tr>
<tr>
<td>2.0 Geographic Overview of Peace River Basin</td>
<td>11</td>
</tr>
<tr>
<td>3.0 Cumulative Impacts to Water Resources</td>
<td>16</td>
</tr>
<tr>
<td>3.1 Loss of Streams and Floodplains (Impact 1)</td>
<td>18</td>
</tr>
<tr>
<td>3.2 Loss of Wetlands (Impacts 11, 12)</td>
<td>19</td>
</tr>
<tr>
<td>3.3 Alteration of Drainage Patterns (Impacts 7, 19)</td>
<td>21</td>
</tr>
<tr>
<td>3.4 Fisheries (Impacts 13, 16, 18)</td>
<td>23</td>
</tr>
<tr>
<td>3.5 Reduced Base Flow (Impacts 4, 5, 6, 14, 17)</td>
<td>25</td>
</tr>
<tr>
<td>3.6 Reduction in Aquifer Levels (Impacts 10, 22)</td>
<td>28</td>
</tr>
<tr>
<td>3.7 Mineralization (Impacts 2, 3, 15, 21)</td>
<td>30</td>
</tr>
<tr>
<td>3.8 Water Quality (Impacts 8, 9)</td>
<td>33</td>
</tr>
<tr>
<td>3.9 Water Supply (Impact 20)</td>
<td>36</td>
</tr>
<tr>
<td>4.0 Buffer Areas and 100-Year Floodplain</td>
<td>38</td>
</tr>
<tr>
<td>4.1 Environmental Benefits</td>
<td>38</td>
</tr>
<tr>
<td>4.2 Legal Issues</td>
<td>40</td>
</tr>
<tr>
<td>4.3 Economic Impacts</td>
<td>41</td>
</tr>
<tr>
<td>5.0 Addressing Cumulative Impacts – Recommendations</td>
<td>43</td>
</tr>
<tr>
<td>5.1 Summary of Recommendations</td>
<td>43</td>
</tr>
<tr>
<td>5.2 Recommendations – Detail</td>
<td>44</td>
</tr>
<tr>
<td>6.0 Peace River Basin Resource Management Plan Implementation</td>
<td>54</td>
</tr>
<tr>
<td>7.0 References</td>
<td>57</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>60</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1.1 Horse Creek – Comparison of Mean Daily Flow for Three Time Periods
Figure 1.2 Peace at Arcadia – Comparison of Mean Daily Flow for Three Time Periods
Figure 1.3 Charlie Creek – Comparison of Mean Daily Flow for Three Time Periods
Figure 1.4 Karst Features of the Upper Peace Basin

Figure 2.1 Peace River at Bartow Sub-Basin
Figure 2.2 Peace River at Bartow Sub-Basin, 1940s Aerial
Figure 2.3 Peace River at Bartow Sub-Basin, 2004 Aerial
Figure 2.4 Peace River at Zolfo Springs Sub-Basin
Figure 2.5 Peace River at Zolfo Springs Sub-Basin, 1940s Aerial
Figure 2.6 Peace River at Zolfo Springs Sub-Basin, 2004 Aerial
Figure 2.7 Kissengen Spring: 1947
Figure 2.8 Kissengen Spring: June 2006
Figure 2.9 Payne Creek Sub-Basin
Figure 2.10 Peace River at Arcadia Sub-Basin
Figure 2.11 Charlie Creek Sub-Basin
Figure 2.12 Horse Creek Sub-Basin
Figure 2.13 Coastal Lower Peace River Sub-Basin
Figure 2.14 Coastal Lower Peace River Sub-Basin, 1940s Aerial
Figure 2.15 Coastal Lower Peace River Sub-Basin, 2004 Aerial
Figure 2.16 Joshua Creek Sub-Basin
Figure 2.17 Shell Creek Sub-Basin

Figure 3.1 East of the Peace River between Bartow and Fort Meade Comparison
Figure 3.2 1941: North Lake Hancock/Unimpacted South-Central Saddle Creek
Figure 3.3 1952: North Lake Hancock/Channelized South-Central Saddle Creek/Mining
Figure 3.4 1958: North Lake Hancock/Channelized South-Central Saddle Creek/Saddle Creek/Mining/Turbidity Plume
Figure 3.5 1968: North Lake Hancock/Channelized South-Central Saddle Creek/Mining/State Road 540
Figure 3.6 1968: Channelized North-Central Saddle Creek/Mining
Figure 3.7 1968: Channelized Northern Saddle Creek/Mining in Lower Tenoroc Mine
Figure 3.8 Six Mile Creek Wetlands Comparison
Figure 3.9 Bear Creek Wetlands Comparison
Figure 3.10 Payne Creek Wetlands Comparison
Figure 3.11 South Fort Meade Wetlands Comparison
Figure 3.12 Hardee Wetlands Comparison
Figure 3.13 Early 1900s Phosphate Dredge on Upper Peace River
Figure 3.14 1890s Phosphate Mine in Fort Meade
Figure 3.15 Mandatory and Nonmandatory Clay Settling Areas
Figure 3.16 Central Florida Phosphate Gypsum Stacks
Figure 3.17 SWFWMD/SWUCA/Peace River Basin Boundaries Comparison
Figure 4.1 Peace River Tributary Floodplain
Figure 4.2 Peace River Floodplain

Figure 5.1 Integrated Habitat Network
Figure 5.2 Nonmandatory Phosphate Zellars-Williams Parcels
Figure 5.3 Mandatory Phosphate Mines by Mine
Figure 5.4 Mandatory Phosphate Mines by Company
Figure 5.5 Southwest District Group 3 TMDL Waters: Upper Peace River
Figure 5.6 Tenoroc Fish Management Area: Proposed and Existing Habitat and Land Use
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1.1</td>
<td>Developed land uses (acres and %) of major sources of stress by sub-basin during 1940s and 1999</td>
<td>9</td>
</tr>
<tr>
<td>Table 3.1</td>
<td>Identified impacts to water resources of the Peace River basin in relation to sources of stress</td>
<td>16</td>
</tr>
<tr>
<td>Table 3.2</td>
<td>Loss of miles of streams and associated floodplains from 1940s through 1999</td>
<td>18</td>
</tr>
<tr>
<td>Table 3.3</td>
<td>Land use (acres and %) within the Peace River basin: 1940s to 1999</td>
<td>20</td>
</tr>
<tr>
<td>Table 3.4</td>
<td>Estimated ground water use (million gallons per day) by stressors in several counties within the Peace River watershed in 1998 and 1999</td>
<td>26</td>
</tr>
<tr>
<td>Table 3.5</td>
<td>Estimated ground water use (million gallons per day) by sub-basin for four time periods</td>
<td>27</td>
</tr>
<tr>
<td>Table 5.1</td>
<td>Summary of recommendations</td>
<td>44</td>
</tr>
</tbody>
</table>
Peace River Basin Resource Management Plan
Executive Summary

The Peace River is the principal ecological feature connecting central Florida to the southwest coast and consists of nine sub-basins covering approximately 2,350 square miles. In 2000, the population of the area was roughly 366,000 people; by 2020, that number is projected to grow to approximately 480,000, a 31% increase. Agricultural land uses encompass about 80% of the basin while urban and mining each cover roughly 10% of the area.

The river is the major freshwater source entering Charlotte Harbor and its flows are essential to maintaining the overall health and productivity of the estuary. It also is an essential source of drinking water to the coastal population. Changes in Peace River flows have long been observed. The severe drought of 1999-2001 and the resulting extended period of dry riverbed in the upper basin, the southward expansion of phosphate mining, and impacts to water supplies at the populous southern end of the system have focused more attention on this unique natural resource.

Cumulative Impact Study

In 2003, the Florida Legislature directed the Florida Department of Environmental Protection (DEP) in consultation with the Southwest Florida Water Management District, to study the cumulative effects of major changes in “landform and hydrology” in the Peace River basin (Chapter 2003-423, Laws of Florida). The DEP contracted with Post, Buckley, Schuh & Jernigan, Inc., an environmental and engineering consulting firm, to complete the Peace River Cumulative Impact Study, with the objectives of evaluating:

- Cumulative impacts of activities on surface and ground waters, wetlands, fisheries, aquatic and
estuarine habitats, and water supplies before and after state regulatory and reclamation programs;

- Effectiveness of existing programs in avoiding, minimizing, mitigating, or compensating for cumulative impacts; and
- Benefits and implications of establishing buffer areas within the 100-year floodplain of major surface waters in the basin.

The study focused on the major causes of stress to the ecology and hydrology of the basin, including rainfall, groundwater withdrawals, and land use changes associated with urban growth, agriculture, mining, and other activities. Preliminary results of the *Cumulative Impact Study* were presented to the public at a series of workshops throughout the basin. The final study was published January 26, 2007 and is available from the DEP’s website at [www.dep.state.fl.us/water/mines/prcis.htm](http://www.dep.state.fl.us/water/mines/prcis.htm).

**Major Findings of the Cumulative Impact Study**

There is no single, predominant cause of impacts to water resources in the Peace River basin. Urban development, agricultural operations and mining have all contributed to the basin’s decline. Evidence of these impacts can be seen through many indicators:

- Approximately 343 miles of streams and associated floodplains were lost in the basin during the study period from the 1940s through 1999.
- During this same period, the basin sustained a 38.5% reduction in wetland acres, a loss of about 136,000 of the original 355,000 acres.
- Approximately 31,000 wetland acres were lost after 1979 despite the existence of more stringent regulations.
- Native upland habitats declined from more than 834,000 acres in the 1940s to fewer than 243,000 acres in 1999, a 71% decrease.
- Floridan aquifer levels in the area have declined by 20 to 50 feet.
- Surface water augmentation from mineralized groundwater (high in dissolved salts) used for irrigation and freeze protection has adversely affected Punta Gorda’s public water supply.
- The impacts of phosphate mining on landform and hydrology are found in the four sub-basins in the northern basin where mining occurs.
- Urbanization had the heaviest impacts in the northernmost and southernmost sub-basins and is expected to expand.
- Agricultural activities caused significant impacts on water resources throughout the Peace River basin; these impacts are now mostly noted in the central and upper southern portions of the basin because of the land use changes to mining and urbanization in the upper sub-basins.

As noted earlier, Chapter 2003-423, Laws of Florida, required an evaluation of establishing buffer areas in the basin. Buffers are the most effective means of flood protection because they prevent placement of incompatible land uses within flood-prone areas and ensure that development does not alter natural patterns of water movement and storage. They also provide natural habitat and wildlife corridors and contain wetland areas that serve to filter floodwaters and other runoff, thereby protecting downstream water quality.

In order to secure any buffer area, there are environmental, economic, legal ownership, and land use considerations that must be taken into account. The study discusses the establishment of buffers
both by regulatory means, such as using buffers as mitigation for wetland impacts, as well as non-
regulatory approaches, like land acquisition and dedication of conservation easements.

A summary of the Peace River Cumulative Impact Study as well as a copy of the entire report are
available on DEP’s webpage at http://www.dep.state.fl.us/water/mines/prcis.htm.

Peace River Basin Resource Management Plan

Chapter 2003-423, Laws of Florida, also charges the DEP to prepare this resource management plan
for the Peace River basin, which was developed with assistance from the Southwest Florida Water
Management District and a stakeholder group consisting of representatives from local governments,
regional water suppliers, regional planning councils, the mining industry, agriculture interests,
development groups, environmental organizations, and fishing interests within the basin. The plan
describes the key characteristics of the Peace River basin, summarizes the major impacts to area
water resources along with their causes, describes existing resource management programs, and
recommends actions necessary to avoid, minimize, mitigate or compensate for cumulative impacts in
the basin.

Based on the Cumulative Impact Study, this management plan identifies 22 major impacts to the
surface and ground waters, wetlands, fisheries, aquatic habitats, and water supplies of the Peace
River basin caused by agriculture, phosphate mining, urbanization, and climate. Impacts range from
the more obvious ones noted in the previous section to more subtle changes such as the loss of
spring habitat, reduction in base flow in the upper parts of the river, and shifts in fish species due to
mineralization.

Urban centers (Lakeland, Auburndale, Haines City, Winter Haven, Bartow and unincorporated Port
Charlotte) are currently confined to the northernmost and southernmost parts of the watershed.
However, residential, commercial, and industrial development is spreading slowly but surely
throughout the entire Peace River basin, including the areas of Fort Meade, Zolfo Springs, Bowling
Green, and Arcadia. The infrastructure required to support this development is bringing with it
more stormwater runoff from roads and parking lots, additional wastewater treatment and discharge
or reuse flows, higher demand for public water supply, large-scale clearing of native lands, and other
consequences of growth that threaten the basin’s water resources. Major east-west and north-south
transportation corridors are being planned that could bisect the basin.

Management Plan Recommendations

The Peace River basin still contains significant floodplains that provide habitat for many wildlife
species; natural forest stands; wetland areas that filter runoff and protect water quality; natural
storage and detention of floodwaters; and protection for drinking water supplies. In order to
preserve the remaining critical ecosystem and, equally essential, restore damaged areas vital to
sustaining this growing area, its people and its economy, this management plan recommends specific
actions to improve the environment and quality of life in the Peace River basin.

Among the most important of these recommendations are those to expand or expedite critical
existing programs, like the aquifer recovery strategies in the Southern Water Use Caution Area and
for minimum flows and levels in the basin. Others call for new actions that the DEP and Southwest
Florida Water Management District can undertake immediately under their existing authorities.
Several recommendations call for significant, multi-agency policy shifts. The complete list of
recommendations is set forth in Table 5.1 on page 44 and discussed in detail in Chapter 5. Of these recommendations, five priorities for new efforts stand out:

1. Develop an acquisition plan and funding strategy for the Peace River Basin through collaboration of local, state, and regional conservation land acquisition entities to assure a coordinated and equitable approach.
2. Develop a proposal to ensure adequate funding for the Nonmandatory Mine Reclamation Program to fund reclamation targeted at specific water resource benefits in the basin.
3. Jointly review DEP and Southwest Florida Water Management District environmental resource permitting in the basin to determine whether permitting criteria, special basin rules, or other regulatory strategies should be enhanced to minimize cumulative impacts more effectively.
4. Consider combining the Environmental Resource Permit and Conceptual Reclamation Plan approval processes into a streamlined and more protective, comprehensive phosphate mining authorization to enhance environmental protection and restoration.
5. Work with the Southwest Florida Water Management District and area local governments to evaluate, plan and initiate financing for the necessary environmental infrastructure to assure sustainable water supplies and improved water quality in the Peace River basin.

Management Plan Implementation

The DEP proposes to implement a series of actions, some in conjunction with partner agencies, to address cumulative impacts in the Peace River basin. The actions are set forth according to the timeframe during which they will be undertaken and follow from the recommendations noted above and set forth in Chapter 5.

This implementation plan itself is outlined in Chapter 6. It is, by design, dynamic and intended to be continuously improved as better information about basin hydrology and ecology becomes available. Several of the proposed actions are beyond the resources of any one agency and require collective action by various agencies and stakeholders in the basin. These agencies and stakeholders must effectively coordinate—and hold each other accountable—for implementing the plan's recommendations and action steps; monitoring their progress; and refining, adapting, and developing new actions as circumstances demand.

The Peace River Cumulative Impact Study graphically illustrates the causes of decline in the Peace River basin. This resource management plan sets forth actions necessary to begin reversing the decline and preserving this critical ecological area for future generations. It can only be accomplished through the concerted efforts of all stakeholders in the Peace River basin.
Peace River Basin Resource Management Plan

In 2003, the Florida Legislature directed the Florida Department of Environmental Protection (DEP) in consultation with the Southwest Florida Water Management District, to study the cumulative effects of major changes in “landform and hydrology” in the Peace River basin (Chapter 2003-423, Laws of Florida, as amended). Through a competitive solicitation process, the DEP selected Post, Buckley, Schuh & Jernigan, Inc. (PBS&J) in late 2004 to conduct the evaluation. The contractor published the final Peace River Cumulative Impact Study on January 26, 2007 and the document is available from the DEP’s website at www.dep.state.fl.us/water/mines/prcis.htm.

The law also charged the DEP to prepare this resource management plan. The agency engaged a stakeholder group consisting of representatives from local governments, regional water suppliers, regional planning councils, mining industry, agriculture interests, development groups, environmental organizations, and fishing interests within the basin. Stakeholder meetings were held in the Peace River basin to discuss the Cumulative Impact Study and its implications. The substantive discussions during these meetings and the comments provided by stakeholders have been critical to the development of this plan. (Stakeholder meeting information, summaries and comments received are available on the DEP website at http://www.dep.state.fl.us/water/mines/prcis.htm.)

The plan that follows summarizes the information in the Cumulative Impact Study, identifies major impacts to the water resources and their causes, evaluates the success of existing regulatory and non-regulatory programs, and sets forth recommendations for actions necessary to avoid, minimize, mitigate, or compensate for cumulative impacts in the Peace River basin.

1.0 Introduction

From its beginning at the confluence of the Peace Creek Drainage Canal and the canalized portion of Saddle Creek north of Bartow in Polk County, the Peace River flows approximately 105 miles in a generally southerly direction through Polk, Hardee, and DeSoto counties before emptying into Charlotte Harbor near Punta Gorda in Charlotte County. Covering approximately 2,350 square miles (1.5 million acres) the majority of the Peace River’s watershed is found in the four counties just identified, with small portions located in Hillsborough, Manatee, Sarasota, Highlands, and Glades counties. The river drops over 200 feet in elevation from its headwaters to discharge. The Peace River is the dominant fresh water system entering the Charlotte Harbor estuary. Flows from the river, especially the high flows during the summer months, are essential to the overall health and productivity of the estuarine waters of the Harbor.

The nine sub-basins comprising the Peace River watershed display a variety of hydrologic, geologic, vegetative, and land use characteristics. All nine exhibit varying degrees and types of man-made impacts that affect the basin’s resources, including the surface waters, groundwaters, wetlands, fisheries, aquatic habitats, and water supplies.

A steady, long-term change in Peace River flows has been observed since the early 1960s, the causes of which are complex and multifaceted. Climate variability has played a significant role in the observed changes, as has the presence of karst (very porous, with depressions and sinkholes) hydrogeologic features in the upper sub-basins. Widespread land use changes and the associated
water use, alterations of surficial flow patterns, and direct loss of wetlands and streams are also contributing factors. The effect of agriculture (improved pasture, citrus, row crops, etc.), development (residential, commercial, and industrial), and extraction (primarily phosphate mining) on the available native upland habitat are contributing to reduced low flows and water quality degradation as well as the direct limitation on wildlife.

Florida suffered a drought of historic proportions from 1999-2001. In the Peace River watershed the drought manifested two noteworthy phenomena: the upper portion of the Peace River between Bartow and Fort Meade went completely dry for an extended period of time and the water supply of the City of Punta Gorda was placed in jeopardy because of water quality problems in the Shell Creek Reservoir. Both these phenomena have root causes that extend back prior to the drought.

Recent studies have established the influence of long-term rainfall patterns on stream flow in the Peace River watershed (Flannery and Barcelo, 1998; Basso and Schultz, 2003). Long-term records show that annual rainfall during the past 30 years has been about five inches per year lower than the period from 1940-1970 (Basso and Schultz, 2003). This trend appears to be changing with the return of more active tropical weather seasons. A comparison of the flow patterns over time of the Peace River, other rivers in Florida, and other rivers in the southeastern United States has revealed a cyclic pattern of decades-long wetter and drier periods. A theory called the Atlantic Multidecadal Oscillation has been postulated that attributes this cycle to variations in rainfall caused by slight changes in sea surface temperature in the North Atlantic Ocean (Gray, Sheaffer, and Landsea, 1997; Enfield, Mestas-Nunez, and Trimble, 2001). The Atlantic Multidecadal Oscillation theory corresponds well with observed data and fundamentally explains most of the observed changes in the medium and high flows of the Peace River (Figures 1.1 through 1.3). It does not, however, adequately explain the changes in low flows, especially the low flow pattern of the upper river sub-basin.
The upper Peace River has a geology that is unique from the remainder of the watershed. Between Bartow and Fort Meade in Polk County, a number of karstic features occur in the limestone beds that form the river channel and associated floodplain (Figure 1.4). Limestone, with its high calcium carbonate content, is easily dissolved by the weak solution of carbonic acid in rainwater and most natural Florida surface streams. When this acidic water enters the ground and interacts with the limestone, the water dissolves the limestone to form karst topography—a combination of caves, underground channels, and an irregular ground surface. This area of karst creates a direct connection between the river channel and the Floridan aquifer, as demonstrated by the history of Kissengen Spring, which before 1950 supplied the upper Peace River with 15-30 cubic feet per second of spring flow. Kissengen Spring ceased continuous flow by 1950. The karstic section of the Peace River channel was first observed to go dry during unusually dry spring seasons in the 1980s. Following the severe drought of 1999-2001, however, the channel has gone dry every spring except during the above-average rainfall years of 2003-2005.
Historical groundwater withdrawals since the early 1930s for mining, agriculture, and public water supply have lowered the potentiometric surface (generally, the rise of water under pressure) of the Floridan aquifer about 30 to 50 feet in the northern Peace River basin. This drop has effectively caused the river to drain into the karstic features in the riverbed between Bartow and Homeland—technically, it has reversed the hydraulic gradient between the upper Peace River and underlying aquifers, causing induced recharge by gravity. During periods of drought, especially coinciding with the typically low rainfall spring period, the riverbed now goes dry as a result of losses to the aquifer. The effect of the pumping-related drawdowns in the upper Floridan aquifer is the primary cause of the upper Peace River flow disappearing during dry periods in 1999, 2000, 2001, 2002, and 2006 (PBS&J, 2007). The drought revealed the magnitude of this problem and its severe effects on the upper portion of the Peace River.

The City of Punta Gorda uses the combined flows of Shell and Prairie creeks as its sole source of potable water supply. Land use practices in the sub-basin containing these two creeks have steadily shifted to more intensive forms of agriculture, with the associated need for more water for irrigation and freeze protection. Because high-quality fresh groundwater is very limited in this sub-basin,
water of higher mineral content from the upper Floridan aquifer is used to ensure adequate agricultural supply. During the severe drought of 1999-2001, the quality of Punta Gorda’s drinking water declined because agricultural discharges of mineralized groundwater increased the salt content of the surface water supply (PBS&J, 2007). At times, the city’s drinking water was in violation of secondary (aesthetic) water quality standards. The drought has revealed the extent to which the long-term use of mineralized groundwater for agriculture has increased salts in the area’s fresh surface waters and associated surficial aquifer.

Land use and cover patterns in the Peace River watershed have changed dramatically since the 1940s, with most of the documented changes occurring prior to 1979. Developed land uses in the Peace River watershed increased from 13% in the 1940s to 50% by 1979 and to 64% by 1999. In turn, undeveloped land uses decreased from 85% of the watershed in the 1940s to 48% by 1979 and to only 33% by 1999 (PBS&J, 2007). Land uses in several sub-basins throughout the watershed also show these dramatic changes from the 1940s to 1999 (Table 1.1). One of the more striking examples is the increase in improved pasture in the Charlie Creek sub-basin from 1,595 acres in the 1940s to 78,180 acres by 1999, an increase from 1% to 45% of the total acreage in that sub-basin. Phosphate-mined lands in the Payne Creek sub-basin increased from 774 acres in the 1940s (1% of the sub-basin) to 50,238 acres by 1999 (63% of the sub-basin). Urban areas in the Coastal Lower Peace River sub-basin increased from 2% to 27% of the total sub-basin, an increase from 3,222 to 44,072 acres between the 1940s and 1999.

Table 1.1 Developed land uses (acres and %) of major sources of stress, by sub-basin, during 1940s and 1999

<table>
<thead>
<tr>
<th>Sub-Basin</th>
<th>Improved Pasture</th>
<th>Intensive Agriculture</th>
<th>Phosphate Mining</th>
<th>Urbanization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1940s</td>
<td>1999</td>
<td>1940s</td>
<td>1999</td>
</tr>
<tr>
<td>Peace River @ Barlow (233,761 ac)</td>
<td>5,889</td>
<td>34,054</td>
<td>44,682</td>
<td>31,919</td>
</tr>
<tr>
<td>Peace River @ Zolfo Springs (197,668 ac)</td>
<td>8,794</td>
<td>43,360</td>
<td>23,115</td>
<td>29,428</td>
</tr>
<tr>
<td>Payne Creek (79,561 ac)</td>
<td>1,821</td>
<td>6,527</td>
<td>5,936</td>
<td>7,799</td>
</tr>
<tr>
<td>Peace River @ Arcadia (128,186 ac)</td>
<td>3,027</td>
<td>45,836</td>
<td>10,457</td>
<td>25,376</td>
</tr>
<tr>
<td>Charlie Creek (173,573 ac)</td>
<td>1,595</td>
<td>78,180</td>
<td>7,148</td>
<td>32,318</td>
</tr>
<tr>
<td>Horse Creek (128,435 ac)</td>
<td>1,380</td>
<td>47,903</td>
<td>4,672</td>
<td>12,303</td>
</tr>
<tr>
<td>Coastal Lower Peace River (154,571 ac)</td>
<td>4,756</td>
<td>25,263</td>
<td>6,885</td>
<td>14,411</td>
</tr>
<tr>
<td>Joshua Creek (77,391 ac)</td>
<td>3,431</td>
<td>31,941</td>
<td>3,918</td>
<td>23,947</td>
</tr>
<tr>
<td>Shell Creek (213,357 ac)</td>
<td>301</td>
<td>52,331</td>
<td>8,946</td>
<td>66,284</td>
</tr>
</tbody>
</table>

Peace River Cumulative Impact Study (PBS&J, 2007)
Many parts of the watershed have undergone considerable alteration to natural drainage patterns in order to facilitate agricultural and residential/urban development, including ditching and interconnecting poorly drained wet prairies and isolated wetlands to improve water conveyance and lower the water table. Total wetland acreage in the basin decreased from approximately 25.4% to 15.6% by 1999, with the majority of the losses occurring before regulatory programs took effect. Historical phosphate mining practices altered not only drainage patterns but also the structure of the landscape (PBS&J, 2007).

While groundwater has historically served the majority of consumptive uses of water in the basin, surface water for public supply has become increasingly important in the southern basin, and declining flows during drought periods have at times impeded public supply. The Peace River Manasota Regional Water Supply Authority withdraws an average of 32.7 million gallons per day (mgd) from the Peace River to supply citizens in Charlotte, DeSoto, Manatee, and Sarasota counties. The river is anticipated to provide additional supply for growth in the future. Water quality is another critical factor for water supply. Drinking water treatment facilities are designed to treat the quality of water from the supply source; thus, declines in source water quality may threaten public water supplies and increase the cost of drinking water treatment.

The severe statewide drought was a wake-up call to the problems facing the water resources of the Peace River basin. In recognition of these growing concerns, the Florida Legislature in 2003 directed the Florida Department of Environmental Protection (DEP) to conduct a cumulative impact study and prepare a management plan for the Peace River watershed in consultation with the Southwest Florida Water Management District. DEP was charged to conduct an objective assessment of the individual and collective impacts of man-induced and natural stresses on the Peace River basin and its water resources. This management plan is to identify regulatory and non-regulatory means to minimize future impacts and mitigate past impacts.
2.0 Geographic Overview of Peace River Basin

The study area includes nine sub-basins, which are described in this chapter. More detailed descriptions can be found in the Peace River Cumulative Impact Study-Summary.

Upper Peace River

Peace River at Bartow Sub-Basin (233,761 acres)

Located in the northernmost portion of the Peace River basin, the Peace River at Bartow is the largest of the nine sub-basins, covering 17% of the watershed (Figure 2.1). This sub-basin encompasses Lakeland, Winter Haven, and Bartow and contains the greatest area of urban development of all the sub-basins. In the 1940s, this sub-basin was predominantly (61%) undeveloped wetlands and native uplands; by 1999, the land uses were predominantly (63%) urban, improved pasture, intensive agriculture, and mined lands. The major permanent streams and surface drainage systems associated with the Peace River at Bartow are the headwaters in the Green Swamp, Peace Creek, Saddle Creek, and Bear Branch. All of these systems have been severely and adversely modified through urbanization, including flood control, along with mining and agriculture—few natural functions or habitat remain. Figures 2.2 and 2.3 illustrate the dramatic changes that have occurred in this sub-basin over the last 60 years.

Peace River at Zolfo Springs Sub-Basin (197,668 acres)

This basin includes the Peace River south of Bartow in Polk County to Zolfo Springs in Hardee County (Figure 2.4). The towns of Fort Meade, Bowling Green, Wauchula, and Zolfo Springs are along this portion of the river. Numerous creeks drain to the Peace River between Fort Meade and Zolfo Springs, including Little Charlie, Whidden, and Bowlegs creeks and Sink Branch. Agriculture and phosphate mining have structurally modified the majority of the natural drainage systems in this sub-basin. Six Mile Creek, formerly one of the larger Peace River tributaries in this sub-basin, was totally eliminated as a natural system by phosphate mining. Little Charlie and Bowlegs creeks remain the most intact systems. Figures 2.5 and 2.6 illustrate the changes in this sub-basin between the 1940s and 2004.

Along the Peace River upstream of Fort Meade, the terrain and geology are of karst origin; large sinks and solution features occur and during periods of low flows the river has flowed into the crevices of the streambed. Kissengen Spring near Bartow was a significant feature until it ceased flowing in the early 1950s, attributable primarily to groundwater withdrawals (Figures 2.7 and 2.8). Seventy-seven percent of the Peace River at Zolfo Springs sub-basin is developed, with mining comprising 33% of the land use. Improved pasture (22%), intensive agriculture (15%), and urban areas (7%) make up the remainder of developed land uses.
Payne Creek Sub-Basin (79,561 acres)

Payne Creek and its large tributary, Little Payne Creek, are the defining water features in this sub-basin. Payne Creek enters the Peace River from the west, upstream of Wauchula (Figure 2.9).
Although it is the second smallest sub-basin, the Payne Creek sub-basin has been heavily mined for phosphate and contains 41% of the mined lands within the entire Peace River basin. Agriculture makes up only 18% of the Payne Creek sub-basin but in 2002 used 4.83 million gallons per day compared to the 3.82 million gallons per day used by phosphate mine operations (Basso, 2006). The conversion of 90% of the native upland habitat, from approximately 52,000 acres in the 1940s to some 5,200 acres by 1999, represents the largest change in land use in the Payne Creek sub-basin. Wetlands experienced similar dramatic losses, decreasing from 24% of the basin in the 1940s to only 9% by 1999 (PBS&J, 2007).

**Middle Peace River**

**Peace River at Arcadia Sub-Basin** (128,186 acres)

The Peace River at Arcadia sub-basin, located almost directly in the center of the watershed, extends from Zolfo Springs in Hardee County south into mid-DeSoto County (Figure 2.10). Arcadia is the only municipality in this sub-basin, with the smaller community of Brownville located upstream. Troublesome, Hickory, and Oak creeks are among the main tributaries in this sub-basin. The majority of the principle natural streams remain intact, although most headwater areas have been modified to accelerate drainage. Large areas of native upland habitats have been converted to agricultural land uses, typical of the watershed in general. Agricultural lands account for 56% of the basin, while native upland and wetland habitats still comprise 41%. Urban land use is negligible, covering only 3% of the total area. There has been only a minimal amount of phosphate mining in the extreme northwestern portion of the Peace at Arcadia sub-basin, with outfall drainage to Payne Creek in the Payne Creek sub-basin. Additional mining planned in the Troublesome Creek watershed will also drain to Payne Creek.

**Charlie Creek Sub-Basin** (173,573 acres)

Nearly all of the Charlie Creek sub-basin is located in Hardee County, with smaller portions situated in Polk, Highlands, and DeSoto counties (Figure 2.11). Charlie Creek is the largest tributary, by discharge volume, of the Peace River, joining the river from the east just north of the Hardee-DeSoto county line, near Gardner. This sub-basin is dominated by agricultural uses, with improved pasture encompassing 45% and intensive agriculture, primarily citrus, comprising 19%. Undeveloped wetlands and native uplands make up an additional 35% of the area, while urban land use is limited and no phosphate mining has occurred.

**Horse Creek Sub-Basin** (128,435 acres)

With its headwater areas in Hillsborough, Polk, and Manatee counties, Horse Creek is second only to Charlie Creek as a tributary in the amount of discharge to the Peace River watershed. Horse Creek extends southwesterly through Hardee and DeSoto counties, paralleling the western border of the Peace River. While Horse Creek extends into southwestern DeSoto County prior to joining the Peace River just north of the State Road 761 bridge near the town of Fort Ogden, the Horse Creek sub-basin is truncated at the State Road 72 bridge in west-central DeSoto County because of the lack of long-term gages south of this point (Figure 2.12).
Undeveloped wetlands and native uplands cover 54% of this sub-basin, while urban development (1%) and intensive agriculture (10%) have expanded toward the southern end in DeSoto County. Improved pasture, covering 37% of the sub-basin, is the predominant developed land use in this sub-basin. Most of the alterations to drainage patterns in the Horse Creek sub-basin have been due to historical agricultural modifications of the headwater streams and wetlands. For example, the West Fork of Horse Creek within Manatee County has been canalized since the mid-1950s. Other wetland areas, such as the ultimate headwater streams of Horse Creek north of State Road 37, have been eliminated by phosphate mining and reclaimed as a wetland flow-way. Phosphate mining, covering 6% of the lands in the Horse Creek sub-basin, has been present since the mid-1980s at three mines in the northern portion: the Four Corners and Fort Green mines, both owned by Mosaic Fertilizer, L.L.C.; and the South Pasture Mine, owned by C.F. Industries. Although phosphate companies own land south of State Road 64, existing and proposed phosphate mining has been exclusively north of this boundary.

**Lower Peace River**

**Coastal Lower Peace River Sub-Basin** (164,571 acres)

This sub-basin includes parts of Charlotte, DeSoto, and Sarasota counties and contains the transition area of the Peace River from a freshwater system to an estuarine system (Figure 2.13). The Coastal Lower Peace River sub-basin is one of only two sub-basins in the watershed with large urban land use components, with Port Charlotte and Punta Gorda both located near the mouth of the Peace River as it enters Charlotte Harbor. The sub-basin is bisected by the Peace River, with Horse Creek entering the river from the west side and Joshua Creek and the tidal portion of Shell Creek entering the river from the east. Urban development, improved pasture and intensive agriculture make up 51% of the sub-basin, with urban areas expected to extend northward along the river corridor in the future. No phosphate mining has occurred or is anticipated in this sub-basin. Undeveloped wetlands and native uplands comprise 45% of the area. Figures 2.14 and 2.15 illustrate the dramatic changes that have occurred in this sub-basin between the 1940s and 2004.

**Joshua Creek Sub-Basin** (77,391 acres)

The Joshua Creek sub-basin, the smallest in the watershed, is located in the southeastern portion of the Peace River basin entirely within DeSoto County (Figure 2.16). Hawthorne Creek and Hog Bay flow into the lower reaches of Joshua Creek immediately upstream of its confluence with the Peace River, downstream of Arcadia. This sub-basin has no phosphate mining and limited amounts of urban development. In 1999, approximately 73% of the land use was agriculture, with 29% of that in citrus. The amount of land devoted to intensive agriculture with its heavy use of more mineralized groundwater is at least part of the cause of degraded surface water quality in the Joshua Creek sub-basin.

**Shell Creek Sub-Basin** (213,537 acres)

The Shell Creek sub-basin is the second largest in the Peace River watershed, located primarily in DeSoto and Charlotte counties with minor portions in Highlands and Glades counties on the eastern extent (Figure 2.17). Prairie Creek, which drains the north and northeastern portion of the sub-basin, and Shell Creek, which flows more through the southeastern portion, are the two primary
stream channels in the Shell Creek sub-basin. These two creeks merge in the 840-acre Shell Creek reservoir formed by the Hendrickson Dam, which provides drinking water for the City of Punta Gorda and its immediate surroundings. Wetlands and native upland habitats comprise 42% of this sub-basin, while improved pasture and intensive agriculture make up 25% and 31%, respectively. Like the Joshua Creek sub-basin, no phosphate mining has occurred here; also as in the Joshua Creek sub-basin, the use of mineralized groundwater to support agriculture has adversely affected surface water quality.
Figure 2.1

Author: Levi Sciara
Date: November 27, 2006
Path:P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\PeaceRiverStudy_PRB_IndividualSub.mxd

Disclaimer: The information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, agrees to supply the information system (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, expressed or implied, and assume no legal liability or responsibility for the ability of users to fulfill their intended purposes in accessing or using GIS data or metadata for construction or production. The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk. In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, modification, or maintenance of any applications applied to or associated with the data or metadata.
Figure 2.2

Peace at Bartow 1940s Aerial

Historical Aerials obtained from the National Archives.

Author: Braulio Fernandez
Date: December 19, 2006
Path: P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\PeaceatBartow1940Aerial.mxd
P:\Peace_River_Resource_Management_Plan\Subbasin Aerials\PeaceatBartow1940Aerial.jpg
Peace at Zolfo Springs 1940s Aerial

Historical Aerials obtained from the National Archives.

Author: Braulio Fernandez
Date: December 19, 2006
Path: P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\PeaceatZolfoSprings1940Aerial.mxd
P:\Peace_River_Resource_Management_Plan\Subbasin Aerials\PeaceatZolfoSprings1940Aerial.jpg

Figure 2.5
Peace River

Figure 2.9

Payne Creek

Interstates and Routes
City Limits
Lakes
Rivers or Streams

Author: Levi Sciara
Date: November 27, 2006
Path: P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\PeaceRiverStudy_PRB_IndividualSub.mxd

Disclaimer:
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Outdoor Recreation, provides and Publishes information system (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, expressed or implied, and assume no legal liability or responsibility for the ability of users to fulfill intended purposes in accessing or using GIS data or metadata or for omission in content regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, express or implied, to the maximum extent permitted by law for a particular purpose or suit otherwise. Use of the GIS information provided at your own risk. The use of this data or the development, use, or maintenance of any applications explicit in or associated with the data or metadata.
Figure 2.10

Peace at Arcadia

Author: Levi Sciara
Date: November 27, 2006
Path:P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\PeaceRiverStudy_PRB_IndividualSub.mxd

Disclaimer:
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Water Recreation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, expressed or implied, and assume no legal liability or responsibility for the ability of users to fulfill their intended purposes in accessing or using GIS data or metadata or for omissions in content regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, express or implied, to the extent permitted by law, regarding such data or metadata, including but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. The use of the information provided is at your own risk. In creating, using, or modifying any applications applied to or associated with the data or metadata.
Figure 2.11

Charlie Creek

Interstates and Routes
City Limits
Lakes
Rivers or Streams

Declaration:
Information contained herein is provided for informational purposes only.
The State of Florida, Department of Environmental Protection, Bureau of
Geospatial Information Services, provides geographic information systems (GIS) data
and metadata with no claim as to the completeness, usefulness,
or accuracy of its content, positional or otherwise. The State and its officials
and employees make no warranty, expressed or implied, and assume
no legal liability or responsibility for the ability of users to fulfill their intended
purposes in accessing or using GIS data or metadata or for omissions
in content regarding such data. The data could include technical
inaccuracies and typographical errors. The data is presented "as is," without
warranty of any kind, including, but not limited to, the implied warranties
of merchantability, fitness for a particular purpose, or non-infringement.
The user of the information provided is at its own risk, in assessing the data or
metadata, in applying it or in any other use of the information.

Author: Levi Sciara
Date: November 27, 2006
Path: P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\PeaceRiverStudy_PRB_IndividualSub.mxd

Peace River Basin Peace River Study
Peace River Study_PRB_IndividualSub.mxd

0 1.5 3 6 Miles
Figure 2.13

Coastal Lower Peace

Interstates and Routes
City Limits
Lakes
Rivers or Streams

Charlotte Harbor
Charlotte
Sarasota
Bradenton
Punta Gorda
Parrish
Port Charlotte
Nokomis
Englewood
Fort Myers
North Fort Myers
Cape Coral
Ft. Myers Beach
Reading
Sanibel
Captiva
Pine Island
Olde Naples
Boca Grande
Nokomis
Port Charlotte
Brantley
Dubois
North Port
Bradenton
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sarasota
Sara
Coastal Lower Peace River 1940s Aerial

Historical Aerials obtained from the National Archives.

Author: Braulio Fernandez
Date: December 19, 2006
Path: P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\CoastalLowerPeace1940Aerial.mxd
P:\Peace_River_Resource_Management_Plan\Subbasin Aerials\CoastalLower\Peace1940Aerial.jpg

Figure 2.14
Figure 2.16

Joshua Creek

Legend:
- **Joshua Creek**
- **Interstates and Routes**
- **City Limits**
- **Lakes**
- **Rivers or Streams**

**Statement:**

The information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Oil and Gas, provides any printed information system (GIS) data sets and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, expressed or implied, and assume no legal liability or responsibility for the ability of users to fulfill intended purposes in accessing or using such data or metadata. The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided and your creation or use of any applications derived from or associated with this data or metadata is at your own risk. In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, sale, or maintenance of any applications derived in any association with the data or metadata.
Figure 2.17

Shell Creek

Legend:
- Shell Creek
- Interstates and Routes
- City Limits
- Lakes
- Rivers or Streams

Disclaimer:
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Water Resources, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, expressed or implied, and assume no legal liability or responsibility for the ability of users to fulfill their intended purposes in accessing or using GIS data or metadata or for omissions in content regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, including, but not limited to, the implied warranties of non-infringement, fitness for a particular purpose, or merchantability. Users are solely responsible for selecting the data or portion thereof that best suits their intended purpose and for verifying the accuracy and completeness of such data or in the development, sale, or maintenance of any applications derived or associated with the data or metadata.

Author: Levi Sciara
Date: November 27, 2006
Path: P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\PeaceRiverStudy_PRB_IndividualSub.mxd

Peace River Basin Peace River Study
3.0 Cumulative Impacts to Water Resources

PBS&J and several sub-contractors conducted a literature review and collected data to document historical changes that had occurred in the Peace River basin for the period from the early 1940s through 1999, some of which is reflected in the sub-basin summaries in the previous chapter. Rainfall patterns, water quality, consumptive surface water and groundwater use, and land use changes were among the factors studied. More detailed discussions are provided in the Peace River Cumulative Impact Study.

The analyses conducted by PBS&J were used to systematically identify changes to surface waters, groundwaters, wetlands, fisheries, aquatic habitats, and water supplies. Individual and cumulative impacts of certain man-induced and natural causes of stress in the Peace River basin were assessed relative to historical changes in stream flow, ambient water quality, and various ecological indicators. Identified impacts were also identified in relation to the four major sources of stress: urbanization, agriculture, phosphate mining, and climate variability.

The Peace River Cumulative Impact Study identified 22 major impacts to water resources, summarized in the table below. Note that agricultural land uses today comprise approximately 80% of the Peace River basin while urban and mining land uses each cover roughly 10%.

Table 3.1 Identified impacts to water resources of the Peace River basin in relation to sources of stress

<table>
<thead>
<tr>
<th>Water Resources and Impacts</th>
<th>Source of Stress</th>
<th>Agriculture</th>
<th>Mining</th>
<th>Urbanization</th>
<th>Climate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface Waters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Loss of 343 miles of streams and associated floodplains</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>2. Increased mineralization of surface waters in southern sub-basins (Joshua, Shell/Prairie, and Lower Horse creeks)</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Increased conductivity levels (essentially, a reflection of dissolved solids) in Payne Creek</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Reduced base flow in northern sub-basins</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Loss of base flow to river in northern sub-basin (Kissengen Spring)</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Increased color in upper basin causing reduced water clarity</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Alteration of natural drainage patterns in watershed</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Post-regulation water quality improved in upper basin, but nutrients in Lake Hancock contribute to poor water quality downstream</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Many surface water segments in the basin have been verified by DEP to be “impaired” (not meeting water quality criteria) for at least one pollutant or condition</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ground Waters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Decline of 20 to 50 feet in Floridan aquifer level</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>5. Loss of base flow to river in northern sub-basin (Kissengen Spring)</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wetlands</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Loss of 136,000 acres of original 355,000 acres of wetlands in total basin during study period (majority pre-regulation)</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Continuing loss of wetlands (31,000 acres) after 1979 despite regulations, but at slower rate</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Resources and Impacts</td>
<td>Sources of Stress</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Agriculture</td>
<td>Mining</td>
<td>Urbanization</td>
<td>Climate</td>
<td></td>
</tr>
<tr>
<td><strong>Fisheries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Increasing number of exotic fishes and fish species</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>14 Loss of spring fish species</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 Shifts in fish species due to mineralization</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>16 Fish population losses due to loss of stream habitats</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td><strong>Aquatic Habitats</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Loss of 343 miles of streams and associated floodplains</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 Loss of spring habitat</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 Reduction in the amount of time wetted stream channel occurs in upper basin</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>19 Loss of 136,000 acres of wetlands</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 Increase of man-made waterbodies</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Water Supplies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 Peace River Water Supply – changes to seasonal hydroperiod that might cause more days of low river flow</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>21 Impact of mineralization of Shell/Prairie creeks on Punta Gorda water supply</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>22 Limitations on ground water supplies in Southern Water Use Caution Area</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

As seen in Table 3.1, some impacts affect more than one water resource. For clarity of the following discussion and consistency with the *Cumulative Impact Study*, impacts have been grouped into the following general categories:

- Loss of Streams and Floodplains – Impacts of ditching, canalization, channelization, and mining
- Loss of Wetlands – Conversion of wetlands both pre- and post-regulation
- Alteration of Drainage Patterns – Hydrologic changes to the basin caused by changes to land use and landforms
- Fisheries – Changes in fish populations caused by introduction of non-native species and loss of habitat
- Reduced Base Flow – Combined effects that produced loss of flow from Kissengen Spring and changes in its water quality, with related loss of spring habitat and fishes
- Reduction in Aquifer Levels – Combined impacts of extensive groundwater withdrawals for agriculture, industry, phosphate mining, and public supply
- Mineralization – Increases in surface water conductivity (essentially, a reflection of dissolved solids) due to discharge of mineralized groundwater
- Water Quality – Influences due to nutrient inputs from Lake Hancock and accidental or permitted discharges to the river
- Water Supply – Changes in the water quality and quantity of public supplies
3.1 Loss of Streams and Floodplains

- **Impact 1: Loss of 343 miles of streams and associated floodplains**

The first- and second-order streams in the basin associated with natural flatwoods drainage typically exhibited a discharge pattern in which the flow was highest during the summer rainy season, rapidly decreased as the rains ended to form separated pools, and then totally dried up by late winter. (First-order streams are those with no tributaries; second-order streams result from the confluence of two first-order streams.) Often these small streams existed between a series of wetland systems (interrupted streams) prior to becoming more incised (defined) and continuous lower in the watershed. First-order streams associated with seepage areas (bayhead wetlands) had more extended discharges, often well into the early spring, and some were probably perennial. During the occasional rainy winter, a phenomenon now known to be associated with the El Niño weather pattern, the first-order streams often flowed until the following dry season.

Faced with all this water, agricultural operations historically removed it, primarily through the construction of drainage ditches and canals and canalization of small- to mid-sized streams. This increased rate of drainage further shortened the flow patterns of the first-order streams. Eventually the combination of drainage and natural periods of dry weather caused many of smallest first-order streams to be eliminated or reduced to straight ditches as agricultural land practices became more intensive. Agricultural drainage modifications were not limited to the smaller streams and wetlands. Some of the most extensive agricultural drainage of wetlands that occurred in the upper basin was associated with large marshes and prairies west and southwest of Lake Wales. By 1915, Peace Creek was canalized nearly to the junction with Saddle Creek in order to receive the outfall of this wetland drainage. Saddle Creek below Lake Hancock has been canalized since at least 1929.

Mining in the basin has also resulted in elimination and canalization of streams. Most streams lost to mining were first- and second-order systems. On the east side of the Peace River between Peace Creek canal in the north and Rocky Branch to the south, an extensive series of Peace River tributary streams and headwater bayhead wetlands that formerly existed along the west side of the Winter Haven Ridge were totally eliminated and replaced mostly by clay settling areas (Figure 3.1). Saddle Creek north of Lake Hancock was channelized to facilitate mining operations as they expanded northward along the western side of the creek floodplain (Figures 3.2 through 3.7).

Phosphate mining caused the loss of some larger streams in the basin as well as the numerous smaller ones. The elimination of the entire Six Mile Creek drainage area and the majority of Bear Creek as natural systems (Figures 3.8 and 3.9) are dramatic examples of the loss of larger order stream channels and associated floodplains. Other larger order stream impacts have occurred in the Payne Creek sub-basin where substantial lengths of Little Payne Creek and smaller portions of upper Payne Creek were eliminated and replaced by ditches or re-routed ditch drainage (Figure 3.10). Table 3.2 details the loss of stream miles and associated floodplains in each of the nine sub-basins of the Peace River watershed from the 1940s through 1999.
Table 3.2 Loss of miles of streams and associated floodplains from 1940s through 1999

<table>
<thead>
<tr>
<th>Sub-Basin</th>
<th>Length (miles) 1940s</th>
<th>Length (miles) 1999</th>
<th>Approximate Loss (miles)</th>
<th>Approximate Loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peace River at Bartow</td>
<td>95.9</td>
<td>38.1</td>
<td>58</td>
<td>60.3</td>
</tr>
<tr>
<td>Peace River at Zolfo Springs</td>
<td>290.0</td>
<td>240.6</td>
<td>49</td>
<td>17.0</td>
</tr>
<tr>
<td>Payne Creek</td>
<td>128.7</td>
<td>61.7</td>
<td>67</td>
<td>52.1</td>
</tr>
<tr>
<td>Peace River at Arcadia</td>
<td>133.6</td>
<td>115.7</td>
<td>18</td>
<td>13.4</td>
</tr>
<tr>
<td>Charlie Creek</td>
<td>185.6</td>
<td>175.7</td>
<td>10</td>
<td>5.4</td>
</tr>
<tr>
<td>Horse Creek</td>
<td>170.7</td>
<td>140.1</td>
<td>31</td>
<td>17.9</td>
</tr>
<tr>
<td>Coastal Lower Peace River</td>
<td>397.7</td>
<td>320.2</td>
<td>77</td>
<td>19.5</td>
</tr>
<tr>
<td>Joshua Creek</td>
<td>57.9</td>
<td>44.2</td>
<td>14</td>
<td>23.7</td>
</tr>
<tr>
<td>Shell Creek</td>
<td>93.0</td>
<td>74.1</td>
<td>19</td>
<td>20.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,553.2</strong></td>
<td><strong>1,210.5</strong></td>
<td><strong>343</strong></td>
<td><strong>22.1</strong></td>
</tr>
</tbody>
</table>

Peace River Cumulative Impact Study (PBS&J, 2007)

Historically, regulation of the mining industry focused exclusively on reclamation and failed to consistently include stream restoration. Unquestionably, some stream reclamation has been accomplished but most efforts under reclamation standards produced slough-like wetlands, not functional stream channels. In 2006, the DEP completed a revision of the reclamation rules to specifically require stream restoration when a natural stream has been mined.

In the Coastal Lower Peace River sub-basin, stream loss was most directly related to the practice of eliminating first- and second-order streams through extensive canal networks designed to sufficiently lower the water table to allow the widespread use of septic tank wastewater treatment systems in subdivisions. The largest single loss of stream channels in all the sub-basins, 77 miles of mostly first-order streams in the Coastal Lower Peace River sub-basin, was the result of a combination of urban and agricultural land use practices (Table 3.2).

In the upper Peace River basin, the increase of urban areas since the 1940s exacerbated existing land use changes previously initiated by agriculture or mining. The Peace River at Bartow, Peace River at Zolfo Springs, and Payne Creek sub-basins had a total loss of 58, 49, and 67 miles, respectively, of streams and associated floodplains through 1999 (Table 3.2). This 174-mile loss is more than 50% of the total stream miles lost in the entire Peace River watershed; together with the 77 miles of stream lost in the Coastal Lower Peace River sub-basin, these losses accounted for approximately 73% of the total streams and associated floodplains lost within the Peace River basin during the study period.

### 3.2 Loss of Wetlands

- **Impact 11:** Loss of 136,000 acres of original 355,000 acres of wetlands during study period from 25.4% to 15.6% of total basin (majority pre-regulation)
- **Impact 12:** Continuing loss of wetlands (31,000 acres) after 1979 despite regulations, but at a slower rate

The historic conversion of a significant amount of wetland acreage in the Peace River basin to other land uses in the early 1900s reflects the thinking at the time that wetlands were of little value, economic or otherwise. It was common practice in the 1940s to drain property to increase crop...
production; create more upland pastures for increased beef cattle production; prepare land for residential, industrial, and commercial development; strip mine an area for phosphate; and control mosquitoes. Extensive wetland drainage in the upper sub-basin is documented as early as 1915. Following World War II, agricultural expansion accelerated throughout the watershed. Examples of more recent agricultural land use impacts on wetlands that have occurred in the Peace River basin are shown in Figures 3.11 and 3.12.

Since the 1940s, the Peace River basin has sustained a 38.5% reduction in wetland acres. This loss does not account for the earlier land use conversion in the upper sub-basin described above. Table 3.2 reflects that 343 miles of streams and associated floodplains were eliminated or canalized in the Peace River basin through 1999. As shown in Table 3.3, wetland acreage in the Peace River watershed from the 1940s to 1979 was reduced from approximately 354,700 acres to 249,300 acres. Regulation of the filling or draining of freshwater wetlands did not become widespread until the mid-1980s, but even after that, wetland acreage in the basin decreased from 249,300 acres to 218,200 acres, creating a total loss of approximately 10% of the total watershed coverage during the study period. Native uplands suffered an even more drastic reduction, decreasing from 834,300 acres in the 1940s to 242,900 acres in 1999, a reduction from 60% to 17% of the total land use in the approximately 1.4 million-acre basin (PBS&J, 2007). During this same period, developed land uses increased from 12% of the watershed in the 1940s to 64% by 1999.

The analysis of landform changes performed in the Peace River Cumulative Impact Study was developed around three sets of aerial photographs from the 1940s, 1979, and 1999. These photographs provided snapshots of empirical evidence about land uses at those times. While the 1940s aerials represent the earliest available baseline and the 1999 aerials represent a reasonably recent view, the 1979 aerials fall into a period when many regulations were still in the developmental stage. Protection of isolated wetlands in general only became effective in 1987 and those affected by phosphate mining were not protected until 1995.

The Cumulative Impact Study indicates that during this period, phosphate mining, agriculture, and urban land uses apparently contributed to the net loss of approximately 13,400 acres, 13,100 acres,
and 4,100 acres, respectively—a total net loss of approximately 31,000 acres (PBS&J, 2007). The apparent loss of more than 31,000 acres of wetlands during this period when regulation of wetland impacts was evolving must be critically reviewed. There are a number of possibilities:

a) Permitted wetland loss without effective offsetting mitigation;
b) Rules for protection of isolated wetlands not in effect until 1987;
c) Delayed effects of drainage not previously regulated;
d) Illegal activities not detected by enforcement;
e) Use of the agricultural exemption before urban development; and
f) Incorrect aerial interpretation of wetlands in early stages of reclamation and restoration.

3.3 Alteration of Drainage Patterns

- **Impact 7: Alteration of natural drainage patterns in watershed**

Urban development, mining, and agriculture have all adversely affected the hydrology, water quality, and natural habitats in the Peace River basin. Comparisons of land use between the 1940s, 1979, and 1999 indicate the expansion of developed lands throughout the watershed. Results of the *Cumulative Impact Study* indicate that these land use changes have altered natural drainage patterns, affected surface water runoff and infiltration rates, and lowered groundwater levels (PBS&J, 2007). The expansion of agriculture throughout most of the watershed, phosphate mining operations primarily in the three northern sub-basins, and urbanization in the northernmost and southernmost sub-basins have resulted in large losses of wetlands and native upland habitats.

Wetlands drained by ditching and canal construction for agriculture practices result in decreased surface water storage and increased surface water conveyance in the watershed, leading to a decline in water table elevations. Agricultural practices lead to changes in vegetation in floodplains, subsequently altering the historical hydraulic characteristics that may eventually lead to changes in the flood regime. Different crop types can also alter the water budget and affect flow rates during periods of low flow. Agricultural fields in a catchment area may retain floodwaters and reduce downstream flood peaks, but the loss of forest cover may lead to increased surface water runoff. The direction and magnitude of a hydrologic response to agricultural practices is a function of prior and existing land uses as well as soil types and, as a result, the response of a watershed or sub-basin to agricultural practices can be difficult to accurately predict (PBS&J, 2007).

Early phosphate mining in the upper Peace River watershed altered surface drainage patterns and the surface water/groundwater relationships of the river and its tributaries. Although most of the mining in the watershed has occurred since the 1940s, phosphate pebble was mined from the channel of the Peace River during the late 1800s (Figures 3.13 and 3.14) and many lands were mined before Florida first required land reclamation in 1975.
Reclamation philosophies and techniques have evolved considerably during the last two decades with current reclamation efforts now attempting to mimic the pre-mining hydrology. As a result of historical mining and reclamation practices, however, the upper sub-basins now contain a complex mosaic of reclaimed lands with differing hydrologic characteristics (DEP-DWRM, 2006).

Historical phosphate mining activities also altered surface and groundwater hydrology by changing soil and land surface composition and structure, altering the way water flows over and through the land and subsequently affecting the relationship of rainfall to stream flow. These activities have further affected runoff, surface water storage, aquifer recharge, and evapotranspiration (loss of water
to the atmosphere). Clay settling areas (Figure 3.15), while initially increasing seepage runoff, can over time alter the hydrology of mined and adjacent lands by acting as holding ponds, decreasing flows to stream channels, and replacing native wetlands and uplands that may act as natural recharge areas. Historical groundwater withdrawals for mining processes and fertilizer manufacturing facilities (Figure 3.16) have been implicated as an initial cause of altered base flows in the upper Peace River but recent water conservation efforts and changes in mining practices have dramatically reduced groundwater withdrawals (PBS&J, 2007).

Vegetation removal, soil displacement, and site grading prior to the creation of large areas of impervious surfaces in urban developments eliminate much of the natural storage capacity and increase stormwater runoff. Development can dramatically alter the hydrologic regime of an area, increasing impervious surfaces, decreasing rainfall percolation into the ground and subsequently increasing the runoff volume, which may then require the construction of additional impervious surfaces (culverts, curbs, gutters, storm sewers, or lined channels) to convey the excess runoff off-site. Drainage of wetlands by ditching and canal construction for urban development decreases surface water storage and increases surface water conveyance in the watershed, leading to a decline in water table elevations (PBS&J, 2007). Major roadways in the watershed, such as Interstate 4 that extends in an east-west direction through the southern portion of the Green Swamp, or U.S. Highway 17 that stretches in a north-south direction through the basin near the Peace River, interfere with the natural drainage patterns of the watershed. Highways bridges that cross the Peace River can create potential dams if floating vegetation jammed against pilings impedes or halts the flow of water down the river. Two tributaries have flows that are intentionally regulated, including a control structure (P-11) on Saddle Creek south of Lake Hancock and a dam at the city of Punta Gorda’s water supply reservoir on Shell Creek. Water withdrawals are made at the Peace River Manasota Regional Water Supply Authority water plant south of Arcadia (DEP-DWRM, 2006).

- **Impact 19: Increase in man-made waterbodies**

The Peace River Cumulative Impact Study cites an increase in man-made lakes during the 1940s through 1999, with an increase of nearly 10,000 acres in the Lakes and Open Water Land Use class. Approximately 6,000 of these 10,000 acres were created primarily by mining activities in the Peace at Bartow, Peace at Zolfo Springs, and Payne Creek sub-basins and about 1,200 acres were due to increases in agricultural activities in the Shell Creek sub-basin (PBS&J, 2007). These waterbodies are being used in a variety of applications: the Shell Creek in-stream reservoir used by Punta Gorda for its potable water supply; power plant cooling reservoirs; and impoundments created or left as a result of historical phosphate mine reclamation practices, for example. Often these impoundments have been used for residential housing developments or as fish management areas such as the Tenoroc Fish Management Area near Lakeland.

### 3.4 Fisheries

- **Impact 13: Increasing numbers of exotic fishes and fish species**

Fish collection records show that historically there were approximately 142 native freshwater or estuarine/marine species present in the Peace River (Fraser, 2006). Overall, fish fauna data for the Peace River watershed have shown a decline in species based on a habitat index. However, the data
also show that at least six exotic fishes have become established and are reproducing in the Peace River basin (PBS&J, 2007).

Florida has experienced the introduction of numerous foreign fish species. Common methods of introduction include intentional and accidental stocking, release of bait fish, release of unwanted aquarium fish, escape from aquaculture facilities, and discharge of ballast water (USDI, 2002). The introduction of exotic fishes in southwest Florida has occurred primarily because of the tropical fish farm industry that raises foreign fish species; the sub-tropical climate has allowed several of these species to survive once they have escaped or been released. While the aquarium trade is perhaps the greatest source of released exotics, the general public also contributes to the increasing numbers of exotic fish species in the watershed, although the public rarely releases enough individuals of the same species simultaneously to allow successful establishment of the species. The State of Florida has also released some exotic fishes, primarily for nuisance and exotic aquatic plant species control but also through accidental releases. Existing and potential impacts resulting from the introduction and establishment of exotic fish species include competition with native species for food and habitat, reduction of natives by predation, transmission of disease or parasites, and habitat alteration (USDI, 2002). The increasing number of exotic fishes and species goes on with no solution in sight (USDI, 2002; Fraser; 2006).

- **Impact 16: Fish population losses due to loss of stream habitats**
- **Impact 18: Reduction in amount of time wetted stream channel occurs in upper basin**

As already noted, available fish collection data for the Peace River basin show that historically there were approximately 142 native fish species, 45 native freshwater species throughout the river and approximately 97 native estuarine/marine species in the tidal areas (Fraser, 2006). The presence of these species varied spatially and temporally throughout the river system. There were more species recorded in past fish collections for the upper Peace River when compared to recently collected data sets. The data show that the number of native fish species has declined in the Payne Creek sub-basin and, indirectly, for Whidden Creek. By comparison, the native fish fauna appear to have been relatively stable in both the Horse Creek and Lower Peace River sub-basins since 1976. Tidal Peace River native fish fauna data show a decline in the number of species between 1976 and more recent data collections (PBS&J, 2007).

The loss of native fish populations has resulted from the alteration and elimination of native habitats in the watershed. Studies have shown that stressed stream habitats result in a reduction of the number of species. In addition to the changes that resulted from the discharge of mineralized groundwater, habitat alteration in the watershed has also occurred due to the accidental or conscious introduction of exotic flora and fauna, the removal of woody debris from the channel for navigational purposes, the elimination of mangrove shorelines, the construction of dams for water supply purposes, and the increase in sedimentation due to construction activities in adjacent uplands, among other reasons. These alterations likely stressed some fish populations to the extent of elimination.

The loss of first- and second-order streams due to mining, agriculture, and urbanization were definite causal factors in the elimination of fish populations in various tributaries of the river. The loss of an estimated 343 miles of natural streams and associated floodplains through anthropogenic
actions either totally eliminated habitat or removed the essential components of it for many plant and animal species that previously existed there.

In addition to the elimination of spring habitats due to the loss of base flow, the quantity of stream habitat in the upper basin was also adversely affected. The wetted perimeter method for evaluating stream flows—the distance along the streambed and banks at a cross section where there is contact with water—can determine the point at which the water surface recedes from stream banks and fish habitat is lost at an accelerated rate.

The wetted perimeter approach was one of two approaches applied to determine a minimum low flow threshold for the upper Peace River. The other approach was determination of the flow needed to allow for passage or movement of fish across shoals or high points in the stream profile. Maintenance of fish passage flows is expected to ensure continuous flows with the channel or river segment, allow for recreational navigation, improve aesthetics, and avoid or lessen potential negative effects associated with pool isolation, such high water temperatures, low dissolved oxygen concentrations, localized phytoplankton blooms, and increased predatory pressure resulting from loss of habitat or cover. In setting a low flow threshold, the Water Management District uses a conservative approach and selects the higher of the wetted perimeter inflection point or fish passage flow. On the upper Peace River, the wetted perimeter inflection point determined the low flow threshold at the Bartow gage (a 95% exceedance flow of 17 cubic feet per second); while fish passage depth determined the low flow thresholds at the Fort Meade and Zolfo Springs gages (95% exceedance flows of 27 and 45 cubic feet per second, respectively).

Annual 95% exceedance flows have fallen below the wetted perimeter value beginning in the early 1980s at the Bartow stream flow station and below the fish passage threshold during the entire period of record at the Fort Meade station since 1975. This is mostly due to the loss of base flow contribution from the intermediate and upper Floridan aquifers as a result of historic groundwater withdrawals and the large reduction in augmented base flow from mining and domestic wastewater discharges to the river since the early 1980s.

3.5 REDUCED BASE FLOW

- Impact 4: Reduced base flow in northern sub-basins
- Impact 5: Loss of base flow to river in northern sub-basin (Kissengen Spring)
- Impact 6: Increased color in upper Peace River which results in reduced water clarity
- Impact 14: Loss of spring fish species
- Impact 17: Loss of spring habitat

Historically, free-flowing (artesian) conditions within the underlying aquifers occurred in the upper Peace River basin and the dry season potentiometric head (pressure) in the Peace River basin was higher than the riverbed. Groundwater flowed into the river channel even during the dry season, resulting in the upper river having base flow all year long. Groundwater use associated with urbanization, mining, and agriculture has, however, lowered the potentiometric surface of the upper Floridan aquifer by 20 to 50 feet since the early 1930s in the northern sub-basins. Cessation of continuous flow from Kissengen Spring in 1950 is generally attributed to a decline in the hydraulic
potential of the underlying confined aquifers (Kauffman, 1967). The hydraulic potentials of the aquifers, once observed above the riverbed, are now generally tens of feet below the riverbed. This decline, due to increasing groundwater withdrawals, now allows surface flows along a five-mile stretch of riverbed between Bartow and Homeland to drain into the ground during dry periods, a result of the underlying karst geology providing direct connections between the river and the underlying intermediate and upper Floridan aquifers. The United States Geologic Survey estimates that dry season river losses to groundwater range from six to 30 cubic feet per second and average 17 cubic feet per second.

Data indicate that historical discharges from activities related to mining and urbanization (discharges from domestic wastewater facilities) significantly augmented river base flow in the upper Peace River sub-basins through the early 1980s (PBS&J, 2007). This supplementary base flow masked the declines of natural spring discharges that followed reductions in groundwater levels due to increased pumping from the upper Floridan aquifer. It also obscured the impacts caused by the below-average rainfall during that period. The impacts due to loss of base flow on the Peace River between Bartow to Homeland became apparent in the 1985 drought with the loss of perennial flow during the dry season. These impacts became even more apparent during the severe drought of 1999-2001.

Increasing development in the upper basin, with its associated wetland drainage, canal construction, and replacement of natural areas with impervious surfaces, resulted in decreased surface water storage and increased surface water conveyance. This caused a decline in water table elevations and reduced base flows in the upper Peace River. The combination of land use changes in the upper sub-basins all contributed to the decline of groundwater levels. Urban water usage in the upper Peace River sub-basins is higher than in any of the other sub-basins in this watershed. SWFWMD (2004a) estimated that 79.8 million gallons per day was used for public and domestic supply and another 10.0 million gallons per day was used for recreational and aesthetic uses in Polk County in 1999 (Table 3.4).

Table 3.4 Estimated groundwater use (million gallons per day) by stressors in several counties within the Peace River watershed in 1998 and 1999

<table>
<thead>
<tr>
<th>County</th>
<th>Agriculture</th>
<th></th>
<th>Public and Domestic Supply</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Charlotte</td>
<td>13.8</td>
<td>17.5</td>
<td>16.5</td>
<td>16.6</td>
</tr>
<tr>
<td>DeSoto</td>
<td>70.0</td>
<td>75.3</td>
<td>2.9</td>
<td>3.0</td>
</tr>
<tr>
<td>Hardee</td>
<td>60.4</td>
<td>63.2</td>
<td>2.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Highlands</td>
<td>53.7</td>
<td>53.9</td>
<td>10.4</td>
<td>9.4</td>
</tr>
<tr>
<td>Polk</td>
<td>122.4</td>
<td>121.1</td>
<td>80.3</td>
<td>79.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>County</th>
<th>Industry and Mining</th>
<th>Recreational/Aesthetic</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Charlotte</td>
<td>1.4</td>
<td>1.1</td>
<td>2.8</td>
<td>3.3</td>
</tr>
<tr>
<td>DeSoto</td>
<td>0.2</td>
<td>0.2</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Hardee</td>
<td>0.5</td>
<td>4.1</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Highlands</td>
<td>0.9</td>
<td>0.3</td>
<td>4.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Polk</td>
<td>98.2</td>
<td>81.4</td>
<td>8.2</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Southwest Florida Water Management District (SWFWMD, 2004a)
The early loss of base flows in the upper reaches of the Peace River in Polk County reflected historical groundwater withdrawals from the upper Floridan aquifer system predominantly associated with mining. As agriculture, public supply, and mining expanded in the upper watershed, total groundwater withdrawals in Polk County peaked slightly above 400 million gallons per day in the mid-1970s (Basso, 2003). Peek (1951) estimated that groundwater withdrawals for phosphate mining in southwest Polk County were about 22 million gallons per day in the early 1930s. By the mid-1940s, withdrawals had increased to 68 million gallons per day and by 1950 were approximately 90 million gallons per day (Basso, 2003). Stewart (1966) estimated that mining withdrawals comprised approximately 80% of total groundwater use in Polk County in 1959. By 1966, total groundwater withdrawn in Polk County had increased to more than 340 million gallons per day and peaked at 410 million gallons per day in the mid-1970s. By the mid- to late-1990s, groundwater withdrawals in Polk County were about 275 million gallons per day, reflecting water conservation practices instituted over the past 25 years by agricultural and phosphate mine users (Basso, 2003). Groundwater consumption in Polk County in 1999 was estimated to be less than 300 million gallons per day (SWFWMD, 2004a). However, other anthropogenic uses in this and other sub-basins have expanded in recent years.

Groundwater withdrawal volumes during 1997-1999 were estimated to be 151 million gallons per day and 95 million gallons per day in the Peace River at Bartow and Peace River at Zolfo Springs sub-basins, respectively, while in the Lower Coastal sub-basin during that same period only 26 million gallons per day were estimated to have been withdrawn (Table 3.5).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Peace River at Bartow</td>
<td>63</td>
<td>176</td>
<td>156</td>
<td>151</td>
</tr>
<tr>
<td>Peace River at Zolfo Springs</td>
<td>34</td>
<td>102</td>
<td>100</td>
<td>95</td>
</tr>
<tr>
<td>Peace River at Arcadia</td>
<td>7</td>
<td>30</td>
<td>37</td>
<td>40</td>
</tr>
<tr>
<td>Payne Creek</td>
<td>7</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Charlie Creek</td>
<td>11</td>
<td>49</td>
<td>57</td>
<td>62</td>
</tr>
<tr>
<td>Horse Creek</td>
<td>6</td>
<td>27</td>
<td>34</td>
<td>37</td>
</tr>
<tr>
<td>Joshua Creek</td>
<td>9</td>
<td>27</td>
<td>33</td>
<td>36</td>
</tr>
<tr>
<td>Shell Creek</td>
<td>13</td>
<td>44</td>
<td>54</td>
<td>55</td>
</tr>
<tr>
<td>Coastal Lower Peace River</td>
<td>5</td>
<td>20</td>
<td>25</td>
<td>26</td>
</tr>
</tbody>
</table>

These groundwater withdrawals have had significant impacts on the aquifers within the Peace River basin. Spring-fed streams are distinguished from other Florida streams by more constant flow, higher pH (a measure of acidity), more submerged aquatic vegetation, naturally low dissolved oxygen and nutrients, high calcium levels, and remarkable clarity. The plants and animals that comprise the biological communities in springs are adapted to these unique conditions (FSTF, 2000). The populations of some species that exist in springs are particularly vulnerable to changes in water quantity and quality, as well as to natural and man-made catastrophes. The groundwater that feeds the springs that many of these plant and animal species rely upon is also increasingly in demand, with significant withdrawals leading to reductions in spring discharge. Land uses within recharge areas can result in altered spring water quality and a change in the type of plants growing in the
springs. Declines in water levels in the upper Floridan aquifer reduced the potentiometric surface enough so that the flows from Kissengen Spring were reduced from the original average discharge of 30 cubic feet per second to only intermittent discharge in the early 1950s and elimination by 1960 (Basso, 2003). This loss of spring flow and spring-fed aquatic habitat has resulted in both water quality changes and adverse biological consequences.

Water color in the spring-fed reaches of the upper basin was historically low, typically during the dry season. Data analyses suggest that loss of aquifer base flow contributed to changes in the average water color in the upper Peace River sub-basins by allowing a greater influence from naturally tannic surficial runoff. Data comparisons from the river monitoring sites at Bartow, Fort Meade, and Zolfo Springs indicate that the marked increases in water color followed reductions of the historical natural groundwater discharges upstream at Bartow (PBS&J, 2007). Anthropogenic impacts, primarily the discharge of groundwater from agriculture and mining and water from sewage treatment facilities into the upper reaches of the Peace River, further colored the historically clear waters of the river in this portion of the basin.

One of the principal biological impacts in the upper sub-basins has been the loss of eelgrass (*Vallisneria americana*) beds. This native aquatic plant requires clear water and flourishes under spring-fed conditions. Eelgrass beds provide habitat for numerous fish and other aquatic life. The reduction in water clarity and the direct loss of perennial flow has dramatically restricted the amount of eelgrass in the Peace River, which has in turn reduced the presence of dependent aquatic life.

The combination of the steady decline in flows, the change in water quality parameters, and the increasing conversion from native habitats to developed lands within the upper basin eventually led to the destruction of Kissengen Spring and the reduction or elimination of the species dependent on the karstic, clear-water flows at the spring.

### 3.6 Reduction in Aquifer Levels

- **Impact 10: Decline of 20-50 feet in Floridan aquifer level**
- **Impact 22: Limitations on groundwater supplies since Southern Water Use Caution Area rules implemented**

The progressive decline of the potentiometric surface of the Floridan aquifer system as a result of groundwater withdrawals in the Peace River basin is well documented by Peek (1951), Hammett (1990), and Basso (2003). Groundwater withdrawals for agriculture, industry, phosphate mining, public supply, and recreational uses have lowered the potentiometric surface of the upper Floridan aquifer more than 30 feet since the 1930s over much of the Southern West-Central Florida Groundwater Basin, which includes portions of Hardee, Hillsborough, Manatee, and Polk counties.

These declines have resulted in several detrimental impacts to the water resources of the area:

a) Peek (1951) linked these withdrawals to cessation of flow of Kissengen Spring;
b) Geraghty and Miller, Inc. (1980) described the effect of the declining levels on lake levels in the Lake Wales Ridge area, a major recharge area for the groundwater basin that includes the northeastern part of the Peace River watershed;
c) Hammett (1990) attributed withdrawals to some of the reduction in Peace River flows; and

d) Southwest Florida Water Management District (1993) described how the declines contributed to concerns of saltwater intrusion in the coastal areas of Hillsborough, Manatee, and Sarasota counties.

In response to growing demands from public supply, agriculture, mining, power generation, and recreational uses (Tables 3.4 and 3.5), as well as to impacts from climate variation, groundwater withdrawals steadily increased for nearly a century before peaking in the mid-1970s. These withdrawals resulted in declines in aquifer levels throughout the groundwater basin, which in some areas exceeded 50 feet. Although groundwater withdrawals have since stabilized as a result of management efforts, depressed aquifer levels continue to cause saltwater intrusion and contribute to reduced flows in the upper Peace River and lowered lake levels of some of the lakes in the upland areas of Polk and Highland counties (SWFWMD, 2006).

Following intensive studies of water resources and ecology in the areas of greatest concern in its jurisdiction, the Southwest Florida Water Management District Governing Board established the Southern Water Use Caution Area (SWUCA) in 1992 to manage the water resources in the Southern West-Central Florida Groundwater Basin in a comprehensive manner. The SWUCA encompasses approximately 5,100 square miles, including all or part of eight counties in the southern portion of the District (Figure 3.17). Almost the entire Peace River basin lies with the SWUCA.

Nearly all minimum flows and levels being proposed for the SWUCA are not currently being met. This circumstance has necessitated the development of a Recovery Strategy, consistent with section 373.0421, Florida Statutes. The Recovery Strategy is designed to restore minimum flows to the upper Peace River, reestablish minimum levels to priority lakes in Highlands and Polk counties, and slow the inland movement of saltwater intrusion such that withdrawal infrastructure will be at minimal risk of water quality deterioration over the next 50 years. Consistent with statutory direction, the Recovery Strategy ensures that there is sufficient water supply for all existing and projected reasonable and beneficial uses in this eight-county area (SWFWMD, 2006).

There are two major components to the Recovery Strategy: (1) management of groundwater withdrawals throughout the SWUCA such that the Floridan aquifer saltwater intrusion minimum aquifer level can be achieved and sustained; and (2) implementation of a series of water resource development projects that restore minimum flows to the upper Peace River and minimum levels to priority lakes in the Lake Wales Ridge area. Ultimately, these two components are interconnected in that the management of groundwater withdrawals to protect against saltwater intrusion will lessen the extent of water resource development projects needed to reestablish perennial flow in the upper Peace River and lake levels in the Ridge area. Conversely, the water resource development projects will not only improve river flows and lake levels but will enhance recharge to the Floridan aquifer, thereby having a positive impact on management of saltwater intrusion (SWFWMD, 2006).

Table 3.5 depicts the estimated groundwater withdrawal volumes in each of the nine sub-basins of the Peace River watershed during four time periods beginning in the early 1940s through 1999 (PBS&J, 2007). Over the past 20 years, the long-term average annual groundwater withdrawals in the SWUCA have been about 650 million gallons per day, of which nearly 90% is from the Floridan aquifer. Based on the existing distribution of withdrawals, the District has estimated that long-term average annual withdrawals from the Floridan aquifer need to be reduced by 50 million gallons per
day to ensure the saltwater intrusion minimum aquifer level is met. If withdrawals were more optimally distributed (i.e., declines in the most impacted areas and increases in the least impacted areas), the required reduction would be significantly less than 50 million gallons per day. As previously discussed, minimum flows for the upper Peace River and minimum levels for the Lake Wales Ridge area lakes will be primarily achieved through water resource restoration projects. However, a reduction of up to 50 million gallons per day in withdrawals from the Floridan aquifer will enhance restoration efforts for the upper Peace River and the eight minimum level Lake Wales Ridge area priority lakes (SWFWMD, 2006).

Most of the projected water use increases in the SWUCA are for public supply. Fortunately, alternative supplies and additional demand management plans are expected to be able to meet most of these increases. In areas where utilities have limited opportunities to develop alternative supplies, significant quantities needed for growth are anticipated to be met as urban areas expand and use some of the groundwater permitted to the land use they have displaced. The District is undertaking a series of water resource development projects that are anticipated to enhance Floridan aquifer levels. For example, there are a series of projects to provide perennial flow to the upper Peace River. Because the upper river is well connected to the aquifers, a significant percentage of the flow is anticipated to recharge the aquifers. Additionally, there are several potable water aquifer storage and recovery systems in the basin that store water in the Floridan aquifer. As these systems build up reserves, there will be some benefit to the aquifer systems. Several of the projects described above will result in a net benefit in terms of reducing Floridan aquifer groundwater withdrawals. In addition, there are a number of possible projects and activities that can result in a net benefit, including the capturing of high surface water flows to recharge the aquifer with potable-quality water during the wet season and recovering a percentage of that use in the dry season. Net benefit activities are anticipated to play a major role in solving water resource issues in the SWUCA (SWFWMD, 2006).

3.7 Mineralization

- Impact 2: Increased mineralization of surface waters in southern basins (Joshua, Shell/Prairie, and Lower Horse creeks)
- Impact 3: Increased conductivity levels in Payne Creek
- Impact 15: Shifts in fish species due to mineralization
- Impact 21: Impact of mineralization of Shell/Prairie Creeks on Punta Gorda water supply

Specific conductance, or conductivity, is a measure of the capacity of water to conduct electricity and is directly related to the amount of dissolved salts in the water. Changes in conductivity over time typically indicate changes in the mineral content of water. Increases in surface water conductivity measurements are often linked to the increased presence and influence of groundwater from the mineralized aquifers.

The largest documented single change in land use throughout the entire Peace River basin, including the three sub-basins in the southernmost portion, has been the conversion of native upland habitats to improved pasture. The Peace River watershed included 834,311 acres of native upland habitat in the 1940s but by 1999 only 242,849 acres of native upland habitat remained—a loss of almost 600,000 acres. Over 300,000 acres of native uplands were converted to improved pasture and
intense agriculture during this time period (PBS&J, 2007). In many instances, improved pasture is converted further to intensive agriculture, mining, or urban land uses. In the lower Peace River sub-basins, excluding the urbanized portion of the Coastal Lower Peace River sub-basin, the conversions were mainly to intensive agriculture, primarily citrus production.

More intensive agricultural activities typically require the use of more water. The source for the increased demand in the lower Peace River sub-basins has been groundwater. Historical groundwater data collected from monitoring wells near Shell, Prairie, and Joshua creeks in southeastern DeSoto and central Charlotte counties indicate that water quality degrades with depth (SWFWMD, 2004b). This condition is naturally occurring and inherent to the region. Groundwater investigations in the Shell/Prairie Creek sub-basin indicate that mineralized concentrations increase rapidly below depths of 1,200 feet (below land surface) and often exceed specific conductance concentrations of 1,000 microsiemens per centimeter. A review of irrigation well construction records within the sub-basins indicates that approximately 195 wells in the Prairie Creek portion of the sub-basin exceed 1,200 feet in total depth. In the Shell Creek portion of the sub-basin, high mineral concentrations can occur at depths in excess of 450 feet below land surface.

Groundwater withdrawals from mineralized zones used for irrigation contribute to surface water systems through direct runoff or leaching. Typical farming practices for flatwoods soils may help facilitate these contributions. In addition, the use of mineralized groundwater can stress crops and require additional irrigation to overcome evaporative concentrations of salts in soils (Basso, 2003). The lands around Joshua, Shell, and Prairie creeks have little urbanization and no phosphate mining. In Horse Creek, the portion most affected is well downstream from any mining activities. The data are persuasive that the increases in conductivity in these sub-basins are due to the use of mineralized groundwater associated with agricultural land uses.

Mineralized groundwater used for irrigation and freeze protection inevitably entered the surficial aquifer and surface waters, as evidenced by the water chemistry data reported in the Cumulative Impact Study (PBS&J, 2007) in the lower Peace River watershed. Depending on the sub-basin, available long-term water quality data indicate increases in levels of conductivity, pH, total dissolved solids, calcium, magnesium, sodium, potassium, chloride, silica, and sulfate (PBS&J, 2007). Concentrations of many of these water quality parameters were at or near historical highs during the severe 1999-2001 drought. In locations such as Horse Creek at Arcadia and Joshua Creek at Nocatee, trends over time indicate conductance has increased over 50%.

While these reported values are still either entirely (Horse Creek) or predominantly (Joshua Creek) below Florida's water quality standard for the vast majority of surface waters (Class III) of 1,275 microsiemens per centimeter (Rule 62-302.530, Florida Administrative Code, Surface Water Quality Criteria), these dramatic increases are still indicative of developing problems. The specific conductance level has been exceeded on numerous occasions at a number of locations in Joshua, Prairie, and Shell creeks. While only three stream segments to date have been listed by the DEP as "verified impaired" as not meeting water quality standards (DEP-BMR, 2006b), additional segments are under consideration for such listing in the Peace River watershed. Preliminary indications are that while high specific conductance values in Joshua Creek do not affect Class I waters (potable supplies) they are actually representative of exceedingly high levels of other constituents like chlorides and total dissolved solids (PBS&J, 2007).
Contributions of mineralized groundwater from the Shell and Prairie creek areas are directly affecting the ability of Punta Gorda’s surface water treatment facility to meet secondary (aesthetic) drinking water standards for chloride, sulfate, and total dissolved solids during the dry season. Punta Gorda withdraws water from the Shell Creek Reservoir for public water supply. Section 62-550.320, Florida Administrative Code, establishes maximum levels for secondary drinking water standards for “community water systems” like Punta Gorda’s. In April 2001, the DEP authorized an Emergency Final Order (OGC Case No. 01-0467) that allowed Punta Gorda to temporarily exceed secondary drinking water standards in water withdrawn for the reservoir as a result of severe drought conditions.

Increases in surface water conductivity are also observed farther north in the Peace River and long-term changes in water quality in the Payne Creek sub-basin include a significant increase in specific conductance. In this sub-basin, the base flow of Payne Creek also appears to be augmented by groundwater discharges. However, because the water quality of the groundwater is less mineralized, the magnitude of the changes is less than that in the lower sub-basins. In addition, there are potential sources of the groundwater augmentation other than those produced by agriculture.

The Payne Creek sub-basin is unique due to the extent of phosphate mining in the area. Mining activities in the Payne Creek area dominate the land use practices; by 1999, approximately 63% of the Payne Creek sub-basin had been impacted by mining and mining-related activities. The second smallest of the nine sub-basins, this sub-basin includes 41%, or more than 50,000 acres, of the lands that have been mined for phosphate within the Peace River watershed. Only the Peace River at Zolfo Springs sub-basin has more, with over 65,000 acres impacted by mining and mining-related activities (PBS&J, 2007).

Water from Payne Creek enters the Peace River upstream of Wauchula and there is a single long-term U.S. Geological Survey/Southwest Florida Water Management District water quality monitoring station near Bowling Green in the Payne Creek sub-basin. The water quality data from this location indicate comparatively large historical increases in levels of measured total alkalinity, total dissolved solids, sodium and sulfate since the 1940s. Since the 1980s, both total phosphorus and orthophosphate levels in Payne Creek have increased.

Augmentation to Payne Creek appears to occur mainly in the dry seasons, yet permitted discharges from phosphate mining operations and power generation facilities typically occur only during the wet season. Agriculture makes up only 18% of the land use in the Payne Creek sub-basin but averaged 4.83 million gallons per day of groundwater withdrawals compared to the 3.82 million gallons per day used by phosphate mining operations in 2002 (Basso, 2006). The limited data indicate that the increase in conductivity may be due to the increase in agricultural groundwater pumping for irrigation during the spring and for freeze protection during the winter.

Another possible cause for the higher levels of conductivity may be attributed to the geology of the area. Most of Florida was underwater for millions of years and thousands of feet of sedimentary rock deposits (composed of various marine creatures, their excrement, and their remains) accumulated on top of the underlying igneous and metamorphic rocks to build up the land that now exists. One of the ways in which Florida’s phosphate rock deposits are believed to have originated is “precipitation,” a process in which conditions in the seawater caused dissolved phosphate to solidify (precipitate) and settle to the bottom of the shallow coastal waters, becoming part of the sedimentary layers that eventually formed the material, along with the sea life and its remains, that is
mined today (FIPR, 2004). During phosphate mining, this sedimentary material is excavated, the phosphatic material removed, and the overburden and sand tailings used to fill the excavation areas as part of the reclamation process. It is thought that the actual mining process itself may cause a portion of the increased conductivity levels in the surface waters in the Payne Creek sub-basin through this disturbance of the soils. In the Peace River watershed, conductivity values have decreased over time at some locations in the upper Peace River (e.g., Saddle Creek, Peace River at Bartow, Peace River at Fort Meade, and Peace River at Zolfo Springs), while increasing in Payne Creek (PBS&J, 2007). This trend may be due to the reduction in mining activities in most of these locations, which allows materials in previously mined areas to settle and age (leach), while in the Payne Creek sub-basin phosphate mining continues as a major land use.

Changes in the mineral content of the surface water system appear also to have biological implications. Many freshwater fishes in low-order streams in the Peace River watershed are adapted to conditions of very low levels of total dissolved solids (low conductivity) and very low (acidic) pH levels. These conditions posed a barrier to other fish species that required higher conductivity and pH levels. At least 15 fish species in the Peace River appear to prefer conductivities less than the present State standard of 1,275 microsiemens per centimeter and may be susceptible to the higher levels (PBS&J, 2007).

Depending on the basin and availability of data, long-term increases in conductivity, pH, total dissolved solids, calcium, magnesium, sodium, potassium, chloride, silica, and sulfate have been reported in all nine sub-basins in the Peace River watershed, water quality changes that are attributable to mineralized groundwater discharges to the surface waters (PBS&J, 2007). Following the implementation of regulatory measures and changes in phosphate mining practices that eliminated or reduced the discharge of groundwater to surface waters, decreases in the upper river were reported in the levels of specific conductivity, total dissolved solids, calcium, magnesium, sulfate, silica, total phosphate, orthophosphate, fluoride, and strontium. In the lower Peace River watershed, however, elevated concentrations are still being reported in the Joshua, Shell, Horse, and Charlie creek sub-basins. Concentrations of many of these parameters were at or near historical highs during the recent 1999-2001 drought (PBS&J, 2007). Based on the known distribution patterns with conductivity/salinity, it is possible that many of the 15 susceptible fish species may have suffered decreases in populations or disappeared from the creek systems that received these groundwater discharges. In turn, the barrier to some secondary freshwater and marine fishes that was provided by the very low conductivity and acidic pH levels appears to have been removed by the augmentation of mineralized groundwaters to the surface waters, thus allowing the invasion of species more tolerant of mineral content (Fraser, 2006; PBS&J, 2007).

3.8 Water Quality

- **Impact 8: Post-regulation water quality improved in upper basin, but poor water quality (nutrients) in Lake Hancock contributes to poor water quality downstream**

The two main influences on water quality in the northern portion of the Peace River watershed have historically been due to accidental and permitted discharges to the river from phosphate mining and processing and nutrient inputs, primarily from municipal and industrial sources, from the highly eutrophic (rich in minerals and organic materials) Lake Hancock. The Peace River has a naturally high concentration of phosphate due to the presence of phosphorus-enriched sediments in the
riverbed. Large areas of the river bottom in the northern sub-basins were directly mined for pebble phosphate during the late 1800s (FIPR, 2004). By the 1940s, expansion of phosphate strip mining in the uplands had expanded into the upper Peace River watershed. Over time, phosphate mining continued to move south as the phosphate ore reserves in the upper portion of the watershed were reduced (PBS&J, 2007).

Sporadic discharges of materials, sometimes quite substantial, from failures of clay settling area dams, pipeline spills, breaks in perimeter ditches and berms, and failures of erosion control devices resulted in degraded water quality and catastrophic losses of fish and aquatic life downstream. However, increasingly effective environmental regulations dramatically reduced both the frequency and severity of these occurrences. As a result, while dissolved inorganic phosphorus concentrations in the Peace River and upper Charlotte Harbor are high relative to most other rivers and estuaries, peak levels have declined by as much as an order of magnitude since the early 1980s (PBS&J, 2007).

Lake Hancock is a large, shallow, hypereutrophic lake in Polk County that contributes an average of 52 cubic feet per second of flow to the upper Peace River. The current water control structure on Lake Hancock was constructed in the early 1960s and flows from the lake have been regulated ever since. Outflows from the lake currently degrade water quality in the Peace River. The Peace Creek Canal was excavated in the early 1900s to drain wetlands in Polk County as far east and north as Lake Wales and Lake Hamilton. Development in the low areas near the canal has created problems with seasonal flooding, when large areas of standing water may be present for several months during some years. Water control structures on Lake Lulu and Lake Hamilton also affect flows to the Peace Creek Canal and the upper Peace River (DEP-DWRM, 2006).

Eutrophication (and the associated accumulations of organic detrital material) driven by excessive nutrient loadings is the most serious water quality problem in the Peace River at Bartow sub-basin. In addition to Lake Hancock, there are a number of hypereutrophic waterbodies in this sub-basin, including Lake Parker, Banana Lake, Saddle Creek, Stahl Canal, Banana–Hancock Canal, and Lake Lena Run. Natural environmental factors and human activities have combined to produce extremely large phosphorus loadings to surface waters in the Peace River watershed. From 1990 to 1995, the average annual total phosphorus concentration measured at the USGS monitoring site on Saddle Creek at Structure P-11 (immediately south of Lake Hancock) exceeded 0.4 milligrams per liter of phosphorus, placing water quality in this stretch of the river among the poorest 25% of Florida streams. During the same period, the average total nitrogen concentration exceeded 5.2 milligrams per liter of nitrogen, among the poorest 10% of Florida streams. Several other lakes in this sub-basin have received excessive nutrient loadings over several decades and in response have developed extensive deposits of nutrient-enriched organic sediments (DEP-DWRM, 2006).

Reduced point source discharges and recent restoration efforts implemented by the Water Management District, the DEP, and local governments have produced water quality improvements in Lake Parker and Banana Lake. Despite these improvements, however, both waterbodies remain highly eutrophic. At times, Lake Hancock can discharge extremely poor quality water, characterized by high concentrations of phytoplankton and other sources of biological oxygen demand, to Saddle Creek and upper Peace River, which has caused faunal mortality and long-term water quality impacts that extend many miles downstream along the river’s main stem.

These discharges are also a potential factor in the water quality problems experienced periodically at the Peace River Manasota Regional Water Supply Authority drinking water facility on the Lower
Peace River. Elevated dissolved inorganic phosphate concentrations and low ratios of dissolved inorganic nitrogen to dissolved inorganic phosphate contribute to the development of nuisance cyanobacterial (blue-green algae) blooms in fresh waters. These blooms are most likely to occur in lakes and floodplain sloughs, where a combination of high nutrient concentrations and low current velocities allow dense phytoplankton populations to develop and persist. The frequent development of cyanobacterial blooms in many surface waters in the Peace River watershed and episodic complaints of unpleasant tastes and odors in the public water supplies provided by the Peace River Manasota Regional Water Supply Authority are often associated with unnaturally high phosphorus concentrations in the system (DEP-DWRM, 2006).

The degradation of Lake Hancock is attributed to flows from its tributaries, which have received elevated nutrient loadings over several decades from a number of industrial and domestic point sources. Although still extremely high, phosphorus concentrations have shown improving trends in recent decades in some portions of the Peace River watershed. Concentrations of dissolved inorganic phosphate and total phosphate have declined at several long-term U.S. Geological Survey monitoring sites. These improvements appear due to increased oversight by regulatory agencies and increased compliance by regulated industries and local governments, leading to reduced phosphorus loadings from a number of phosphate mining and processing facilities, food processing facilities, and municipal wastewater treatment plants. Despite these trends, however, average annual total phosphate concentrations measured at the Bartow, Homeland, Fort Meade, Zolfo Springs, and Arcadia U.S. Geological Survey gage sites from 1990 to 1995 exceeded 1.0 milligram per liter.

- **Impact 9:** Numerous waterbodies or waterbody segments in upper basin verified impaired for at least one water quality parameter, per Rule 62-303, F.A.C.

Water quality in the upper Peace River watershed has been affected by a number of anthropogenic activities. Historically, these have included point and non-point source discharges from phosphate mining and processing facilities near Lakeland and Bartow, point source municipal and industrial effluents from the cities of Lakeland, Bartow, and Fort Meade, and non-point runoff from urbanized areas and lands used for intensive agriculture, especially in areas in the eastern portion of the upper Peace River watershed.

Lake Hancock water quality has been characterized as “poor” based on the Florida Trophic State Index since at least 1970 and water quality in the lake became a concern as early as the 1950s. The DEP has verified the impaired condition of the lake; its levels of total phosphorus, total nitrogen, and biological oxygen demand all significantly exceeded the State threshold screening values. Until recently, Lake Hancock received nutrient-laden effluent directly from a number of industrial and municipal sources. As a result, the water leaving Lake Hancock is typically characterized by elevated concentrations of blue-green algae, turbidity, and elevated organic content that lead to low dissolved oxygen concentrations in the receiving waters of Saddle Creek and ultimately the Peace River.

Fully 20% of the waterbody segments in the upper Peace River basin are impaired—verifiably not meeting water quality standards—for at least one water quality parameter (Singleton, 2006; Petrus, 2006). Most of the impairments are for Trophic State Indices (nutrients: nitrogen, phosphorus) or dissolved oxygen in lakes located in the Lake Hancock watershed and the Winter Haven Chain of Lakes. There also are impairments related to fecal coliform bacteria in the Peace Creek drainage canal, the Wahmata Farm drain, and the Peace River above Bowlegs Creek (DEP-DWRM, 2006).
For impaired waterbodies that are not meeting their designated uses—whether for drinking water, recreation, or shellfish harvesting, for example—the DEP must develop Total Maximum Daily Load (TMDL) determinations. A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still remain healthy so that all its designated uses are met. Multiple TMDLs have been developed for waters in the Peace River basin and will be adopted in the near future. A TMDL sets pollutant reduction objectives that must be implemented to clean up impaired waterways.

Progress has been made in addressing the water quality impairments identified in the Peace River basin. Some projects are already underway, in advance of TMDL implementation, including:

- Lake Hancock lake level modification and outfall treatment projects, including major land acquisitions;
- Restoration projects in the Lake Hancock watershed, including lakes Parker and Hollingsworth and Banana Lake and canal;
- Restoration projects in the Winter Haven Chain of Lakes, including lakes Howard, Conine, and Smart; and
- The Peace Creek Drainage Canal watershed restoration plan, which will lead to the acquisition of up to 3,000 acres of conservation lands.

A number of other water quality measures in the upper Peace River have improved significantly since the 1960s and 1970s following the implementation of regulatory measures and changes in phosphate mining and processing practices. These measures eliminated direct processing discharges and reduced other phosphate mining-related discharges to surface waters. These changes have resulted in improved water quality, especially concentrations of phosphorus and orthophosphate, in the upper river. The significant reductions in inputs of phosphorus-rich waters directly into the upper river have resulted in significant declines in peak levels of these parameters.

### 3.9 Water Supply

- **Impact 20: Peace River Water Supply – changes for seasonal hydroperiod patterns and volumes that might result in increased number of days of low river flow**

While groundwater has historically provided the majority of consumptive uses of water in the basin, surface water for public supply has become increasingly important in the southern part of the basin. The declining flows during the drought periods have at times impeded public supply demands. The Peace River Facility is owned and operated by the Peace River Manasota Regional Water Supply Authority, a wholesale provider of drinking water to Charlotte, DeSoto, Manatee and Sarasota counties and the City of North Port. The Peace River Facility is located in the lower Peace River basin about 19 miles from the mouth of the river. This public potable water source supplies about 400,000 citizens and is anticipated to provide additional supply for growth in the future (Coates and Stone, 2006). Due to the facility’s downstream location, most activities in the basin that impact water quality or the natural timing and volume of river flow have the potential to impact the viability of this important regional surface water supply, making water quality another critical factor for water supply. Most water treatment facilities are designed to treat the quality of water expected from the
supply source; changes in water quality in the streams that provide source water to public water supply systems can be a threat to public water supplies (PBS&J, 2007).

At present, the Peace River Facility is operating at a 24-million gallon per day capacity. The Peace River Manasota Regional Water Supply Authority is presently permitted to withdraw an average of 32.7 million gallons per day of water from the Peace River. Expansion of treatment capacity at the Peace River Facility to 48 million gallons per day and construction of a 6-billion gallon above ground reservoir is scheduled for completion in 2009. Expansion of the Peace River Facility, within environmentally sustainable limits, may be proposed in the future to meet growing regional water supply needs and aid in regional recovery from over-pumping of groundwater in the Southern Water Use Caution Area (Coates and Stone, 2006).

The four stressors identified in the Peace River Cumulative Impact Study (PBS&J, 2007) are agriculture, mining, urbanization and climate. The stressors within some measure of human control (agriculture, mining, and urbanization) each have potential to adversely affect water quality in the Peace River and change the timing and quantity of water available to meet public water demands. Deterioration in water quality may require the Peace River Facility to modify treatment processes or potentially treat water only at certain times of the year or under certain flow conditions. Changes in the timing of flow, such as increased peak discharge rates at the expense of the duration of discharge events, may require construction of additional intake, storage and treatment capacity to enable harvest of environmentally sustainable quantities while available. In addition to the environmental consequences of water quality deterioration and man-induced changes in flow regime, these impacts may reduce the ability of the Peace River Facility to meet regional drinking water needs and necessitate the development of new drinking water supplies earlier than otherwise required, resulting in an additional cost burden to water customers.
East of Peace River between Bartow and Fort Meade Comparison

1940s Aerial

2004 Aerial

Historical Aerials obtained from the National Archives.
Author: Levi Sciara
Date: December 20, 2006
Path: P:\Projects\ArcGIS\Production\ERS\Studies\PeaceRiver_AerialsComp.mxd
1941 - North Lake Hancock/Unimpacted South-Central Saddle Creek

Figure 3.2

Disclaimer:
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Water Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees disclaim any warranty, expressed or implied, and assume no legal liability or responsibility for the utility of users in fulfilling intended purposes in accessing or using GIS data or metadata or for omissions in content regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented "as is" without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk.

In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of any applications applied to or associated with the data or metadata.

Author: Levi Sciara and Braulio Fernandez.
Date: January 9, 2007
Path: P:\Projects\ArcGIS\Product\FL\RQP\PeaceRiverBasin\PeaceRiverStudy\1941LakeHancockAerial.mxd
1952 Aerial

Figure 3.3

1952 - North Lake Hancock/Channelized South-Central Saddle Creek/Mining

Disclaimer:
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, expressed or implied, by law of action, tort, or otherwise, for the accuracy or completeness of any information or data provided herein. Information contained herein is provided for informational purposes only.

The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk.

In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of any application, applicability, or association with the data or metadata.

Information contained herein is subject to change without notice. The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk.

In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of any application, applicability, or association with the data or metadata.

The image shown above was obtained from the University of Florida website address http://web.uflib.ufl.edu/digital/collections/FL AP/

Author: Levi Sciara and Braulio Fernandez.
Date: January 9, 2007
Path: P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\1952\LakeHancockAerial.mxd
Figure 3.4
1958 Aerial

1958 - North Lake Hancock/Channelized South-Central Saddle Creek/Mining/Turbidity Plume

Disclaimer:
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, publication or otherwise. The BLM and its staff make no warranty, expressed or implied, of any kind to any party utilizing or using the GIS data or metadata, nor shall the GIS data or metadata be considered complete, useful, or accurate by any party using the data or metadata. The user is hereby notified that the State and its officials or employees shall not be responsible for any errors or inaccuracies in the GIS data or metadata or for any actions taken in reliance on the GIS data or metadata. The user is further notified that the State and its officials or employees shall not be responsible for any damages or losses, direct, indirect, or consequential, that may result from the use of this GIS data or metadata. The user is further notified that the GIS data or metadata is provided "as is", without warranty of any kind, express or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. The user is further notified that the user's access to and use of the GIS data or metadata is at the user's own risk.

Author: Levi Sciara and Braulio Fernandez.
Date: January 9, 2007
Path: P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\1958LakeHancockAerial.mxd
Figure 3.5

Disclaimer:
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, expressed or implied, and assume no liability or responsibility for the ability or use of users in USGS data or metadata in any decision or conclusion regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented “as is,” without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk.

In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of interpretations, applications, or associated with the data or metadata.

Authors: Levi Sciarra and Braulio Fernandez.
Date: January 9, 2007
Path: P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\1968_LakeHancockAerial.mxd
Disclaimer:

Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees shall be exempt of any liability or responsibility for any action or inaction, whether or not advised of the possibility thereof, in providing or distributing any GIS data or metadata or the results thereof. The data could include technical inaccuracies and typographical errors. The data is presented "as is" without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk.

In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of any applications, applications or systems associated with the data or variables.

1968 Aerial

1968 - Channelized North-Central Saddle Creek/Mining

Figure 3.6

Author: Levi Sciara and Braulio Fernandez.
Date: January 9, 2007
Path: P:\Projects\ArcGIS\Production\ERS\PeaceRiverBasin\PeaceRiverStudy\1968_ChannelizedSaddleAerial.mxd
1968 - Channelized Northern Saddle Creek/ Mining in Lower Tenoroc Mine

1968 Aerial

Minning in Lower Tenoroc Mine

Saddle Creek Park

Reference Point 2

Figure 3.7

Disclaimer:
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officers and employees are not liable or responsible for the ability of users in fulfilling their intended purposes in accessing or using GIS data or metadata or for unforeseen results from using such data. The data could include technical inaccuracies and typographical errors. The data is presented "as is" without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk. The image shown above was obtained from the University of Florida website address http://web.uflib.ufl.edu/digital/collections/FLAP/.

Author: Levi Sciara and Braulio Fernandez.
Date: January 9, 2007
Path: P:\Projects\ArcGIS\Production\ERS\PeaceRiver\Files\1968c_LakeHancockAerial.mxd
Six Mile Creek Wetlands Comparison

1940s Aerial

2004 Aerial

Historical Aerials obtained from the National Archives.

Author: Levi Sciara
Date: November 6, 2006
Path: P:\Projects\ArcGIS\Production\ERS\Studies\SixMileCreekWetland_AerialsComp.mxd
Layout View: 16000

Figure 3.8
Bear Creek Wetlands Comparison

1940s Aerial

2004 Aerial

Historical Aerial obtained from the National Archives.

Author: Levi Sciara
Date: November 6, 2006
Path: P:\Projects\ArcGIS\Production\ERS\Studies\BearCreekWetland_AerialsComp.mxd
Layout View: 15,443

Figure 3.9
Payne Creek Wetlands Comparison

1940s Aerial

2004 Aerial

Original Location of Natural Channel

Original Location of Natural Channel

Historical Aerials obtained from the National Archives.

Author: Levi Sciara
Date: October 30, 2006
Path: P:\Projects\ArcGIS\Production\ERS\Studies\PayneCreekWetland_AerialsComp.mxd
Layout View: 34,334

Figure 3.10
South Fort Meade Wetlands Comparison

Figure 3.11

1940s Aerial

2004 Aerial

Historical Aerial obtained from the National Archives.

Author: Levi Sciara
Date: October 30, 2006
Path: P:\Projects\ArcGIS\Production\ERS\Studies\SouthFortMeadeWetland_AerialsComp.mxd
Layout View: 14,500
Historical Aerials obtained from the National Archives.

Author: Levi Sciara
Date: October 30, 2006
Path: P:\Projects\ArcGIS\Production\ERS\Studies\Hardee_AerialsComp.mxd
Layout View: 10,168

Figure 3.12
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, express or implied, and assume no legal liability or responsibility for the ability of users to fulfill their intended purposes in accessing or using GIS data or metadata or for omissions in content regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk. In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of any applications applied to or associated with the data or metadata.
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, express or implied, and assume no legal liability or responsibility for the ability of users to fulfill their intended purposes in accessing or using GIS data or metadata or for omissions in content regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk. In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of any applications applied to or associated with the data or metadata.
Peace River Basin
SWUCA Boundary
SWFWMD Boundary

Figure 3.17

Disclaimer:
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information system (GIS) data and metadata with no claims as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, expressed or implied, and assume no legal liability or responsibility for the inability of users to utilize information contained on any GIS data or metadata or for omissions in content regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented “as is,” without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk. In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of any applications applied to or associated with the data or metadata.
4.0 Buffer Areas and 100-Year Floodplain

Chapter 2003-423, Laws of Florida, also requires an evaluation of the environmental benefits, legal issues, and economic impacts of limiting activities on waters and environmentally sensitive areas around waterbodies by establishing a buffer within the 100-year floodplain of major perennial streams within the Peace River basin. The Peace River Cumulative Impact Study was also required to recommend ways in which any buffer areas recommended as prohibited areas could be considered as mitigation under applicable permitting programs. The Cumulative Impact Study suggested several changes, including a legal and economic review of the establishment of floodplain buffers and their effects on the maintenance of water quality, moderation of stream flow extremes, and protection of habitats of water-dependent wildlife (PBS&J, 2007).

4.1 Environmental Benefits

Floodplains are normally dry or semi-dry land areas to which water naturally flows as water levels rise (Figures 4.1 and 4.2). Floodplains typically are located near rivers, lakes, and the coast, but many of Florida’s flood-prone lands are simply low-lying areas or depressions where water naturally collects after rain storms. The 100-year floodplain is the area adjacent to a river, stream, or waterbody that is covered by water in the event of a 100-year flood (a flood having a one percent chance of being equaled or exceeded in magnitude in any given year).

Figure 4.1 Peace River Tributary Floodplain (C. Keenan)
Riparian buffers have been defined as areas vegetated with grasses, shrubs, or trees adjacent to flowing waters that contain both aquatic and terrestrial ecosystems, including surrounding wetlands and estuaries (CRJC, 2000; PENTEC, 2001). Buffers are a key to protecting and preserving rivers, streams, and wetlands, representing a unique position in the landscape as a transition zone between the aquatic and terrestrial habitats. Buffers provide many benefits to these habitats that otherwise might be adversely impacted by anthropogenic uses, such as:

1) Moderating stream flow by reducing large fluctuations in water levels and providing natural storage areas for floodwaters, stream bank erosion is minimized, native vegetation is preserved to provide more beneficial wildlife habitat, and flooding is reduced;
2) Providing wildlife habitat by serving as wildlife corridors, nesting and breeding habitat, and food sources; and
3) Improving water quality through the removal of sediments, nutrients, and pollutants before entering surface waters and by serving as recharge areas for the aquifer, the primary source of drinking water.

An upland buffer within the 100-year floodplain would generally provide benefits to the hydrology and habitat, but the effects of the buffer can be influenced by its overall size, nature of the vegetation, slope, soil type, and land use.

There is no standardized width for regulating all potential impacts on all ecological and hydrological functions provided by buffers. The appropriate width of the buffer is dependent on the desired primary function of the buffer, with the minimum acceptable width being the one that can be
reasonably obtained and maintained while providing the needed level of protection. Buffers intended primarily to maintain water quality and moderate stream flow do not need to be extensive. Vegetated buffers as narrow as 50 feet can stabilize eroding banks, filter sediment and contaminants from runoff, and reduce downstream flooding (CRJC, 2000). However, as the ecological values of, and adverse impacts to, an area of interest increase, buffer widths should be increased accordingly to compensate. In general, the widths of buffers proposed to sustain a full range of wildlife habitat functions need to be greater than those required for water quality or stream flow moderation (CRJC, 2000; PENTEC, 2001).

4.2 Legal Issues

The Agricultural Ground and Surface Water Management program, a cooperative effort by the Southwest Florida Water Management District and the U.S. Department of Agriculture-Natural Resource Conservation Service established in 1991, standardizes the requirements for wetland impact exemptions and permit applications and provides technical standards and assistance needed to meet exemption criteria for temporary, ordinary, and permanent agricultural operations. Operations that do not meet the exemption criteria are required to be permitted pursuant to the same Environmental Resource Permit (ERP) rules that apply to other sectors of the regulated public. Exemption criteria and standards set by this program include:

1. Requiring 50-foot buffers on wetlands;
2. Prohibiting the filling or flow restriction in the 100-year floodplain;
3. Allowing grazing in wetlands at U.S. Department of Agriculture-Natural Resource Conservation Services stocking rates;
4. Requiring a conservation farming plan; and
5. Requiring the implementation of Improved Management Practices that address erosion control, wetland protection, drainage management, and nutrient/pesticide management for each agricultural activity.

Except for mining proposed directly in waters of the State, the mechanisms that allow regulation of phosphate mining or dictate the conditions under which it may occur were established only in 1995 when the Environmental Resource Permit rule went into effect. Most previous phosphate mine regulation by the DEP and its predecessor agencies was for post-mining reclamation. Substantial differences existed between reclamation and phosphate mining regulation under Environmental Resource Permit rules, including:

1. Isolated wetlands are jurisdictional and impacts require mitigation;
2. Minimum flows and levels for surface and groundwaters must be maintained;
3. Cumulative impacts must be avoided;
4. Secondary impacts to wetlands are considered and mitigated;
5. Wetland dependent listed species have to be addressed; and
6. A public interest test must be met.

A Final Order, signed on July 31, 2006, following litigation over an Environmental Resource Permit application for Mosaic Fertilizer’s Altman Tract, clarified the way the DEP now undertakes its review of phosphate mining applications under this program.
A prominent feature of urban development is the intolerance of flooding, historically controlled by local, State, and Federal agencies with land use, building, and stormwater runoff regulations. Local government has zoning authority, applies floodplain building ordinances in conjunction with the Federal Flood Insurance Program, and specifies stormwater regulations. State government, through the DEP, regulates water quality and quantity through delegation to the Southwest Florida Water Management District (PBS&J, 2007). The District controls water quality in much of the Peace River basin through Chapters 40D-4, 40D-6, 40D-40, and 40D-400 of the Florida Administrative Code and also regulates floodplain encroachment by requiring compensating storage for fill placed within the 100-year floodplain.

Legislation enacted in 1996 (Section 373.4137, F.S.) facilitates environmental permitting approval for transportation projects by allowing the Florida Department of Transportation to fund compensatory mitigation in the Peace River basin through the Water Management District. The District can either accept all obligations for compensatory mitigation for specific impacts for a set fee of $75,000 per acre of impact, adjusted annually for inflation; or, in consultation with the Florida Department of Transportation, contract directly with an approved wetland mitigation bank to purchase wetland mitigation credits. Transportation projects still have to reduce or eliminate impacts to wetlands and other surface waters, but the process for compensating for wetland impacts removes at least one impediment to the construction of needed facilities. With an active Section 373.4137, F.S. program in Southwest Florida Water Management District and three permitted wetland mitigation banks in the Peace River watershed, there are ample options to build transportation facilities without incurring cumulative impacts (PBS&J, 2007).

The Cumulative Impact Study determined that the two most effective approaches to floodplain protection are to avoid, wherever possible, situating incompatible land uses within flood-prone areas and to ensure that land development does not alter natural patterns of water movement and storage. This strategy emphasizes harmonizing growth and development with the natural environment. This is, of course, preferable to intentionally altering the natural surface water systems through ditches, canals, dams, and control structures following encroachment into the floodplain—a long, expensive process with significant environmental impacts (PBS&J, 2007).

4.3 Economic Impacts

The Uniform Mitigation Assessment Method (UMAM), adopted by the DEP in February 2004, provides a consistent process or method to assess and quantify the functions of wetlands and other surface waters proposed to be impacted, and to determine the amount of mitigation necessary to offset impacts to those wetlands and other surface waters based on the amount of ecological improvement provided by a specific mitigation plan. As an example, a mitigation proposal to preserve upland habitat in the 100-year floodplain would be evaluated on site-specific characteristics such as buffer width, landscape setting, connectivity, habitat quality, and measures to minimize risk factors. The preservation of upland portions of the 100-year floodplain is an ecologically beneficial activity that has been shown to generate wetland mitigation credit. Though there are potential physical restrictions on the uses of floodplain uplands, they are susceptible to and often used for such activities as cattle grazing, row crops, and phosphate mining. The preservation of a variety of habitat types, whether cleared or intact, would provide beneficial buffering to the floodplain wetland systems in the region. It has been determined that preservation of native upland floodplain habitat could potentially generate 0.42 credits per acre.
Preserving upland habitat in the 100-year floodplain as mitigation has the potential to result in economic value to the landowner. The value of mitigation credits in the Peace River basin has been observed to be approximately $120,000 per credit for forested wetlands mitigation and $72,000 per credit for herbaceous wetland mitigation. Therefore, based on a potential UMAM score of 0.42 credits per acre, a landowner willing to preserve native upland floodplain habitat could receive a value of up to $50,000 per acre. This could be achieved either by sale of this credit to a third party, or in avoided costs if the credit were used to offset wetland impacts proposed by the landowner himself. By comparison, the preservation of pasture (at approximately 0.03 credits per acre) in the floodplain would generate only $3,600 per acre, while the restoration of native cover (at an approximated 0.23 credits per acre) on this same pasture could generate another $27,600 per acre, for a total value of $31,200. Preservation of native floodplain wetlands could generate $14,000 to $18,000 per acre, provided substantial upland buffering is preserved as well. However, wetland preservation without corresponding upland supporting habitat would receive substantially less credit than preservation of a synergistic combination of upland and wetland habitats within the floodplain (PBS&J, 2007).
In 2000, the population of the watershed was roughly 366,000 people; by 2020, it is projected to increase to approximately 480,000. Major urban areas in the watershed currently include Lakeland, Auburndale, Haines City, Winter Haven, and Bartow to the north, as well as unincorporated Port Charlotte at the southern end. Although these urban areas are confined to the northernmost and southernmost sub-basins in the watershed, the impacts of residential, commercial, and industrial development are spreading slowly, but surely, throughout the entire Peace River basin. As urbanization extends throughout the basin, the impacts of the infrastructure needed to support these populations also increase—more stormwater runoff from impervious surfaces, increased demand for public water supplies, and increased water quality issues. The cumulative impacts of these developments are expected to exceed the capacity of the existing infrastructure, leading to decreased water quality, increased water supplies, and increased water demand. The following recommendations were developed to directly confront the causes of decline in the Peace River basin and promote measures to protect area water resources in the future. Since a minimal amount of the watershed is currently in some form of conservation, the need for new conservation efforts stand out.

5.0 Addressing Cumulative Impacts

5.1 Summary of Recommendations

The following recommendations were developed to directly confront the causes of decline in the Peace River basin. These recommendations are designed to support the necessary environmental infrastructure to reverse the effects of urbanization and development on the basin. They include measures to improve water quality, support increased water supply, and decrease water demand. The recommendations are designed to promote more sustainable water management practices, protect water resources, and encourage the development of new conservation programs. The complete list of recommendations is set forth in Table 5.1. Of these recommendations, the following priorities stand out:

1. Develop an acquisition plan and funding strategy for the Peace River basin.

2. Develop a proposal to create a comprehensive, multi-agency effort to address the cumulative impacts of urbanization and development on the basin.

3. Jointly review DEP and Southwest Florida Water Management District programs to evaluate their effectiveness in addressing water quality issues.

4. More effectively enforce regulatory programs to ensure compliance with existing regulations.

5. Address cumulative impacts into a streamlined and more comprehensive, cumulative impact analysis process. Consider combining the Environmental Resource Permitting and Conservation Permitting Plan to improve efficiency and effectiveness.

The Peace River Cumulative Impact Study graphically illustrates the causes of decline in the Peace River basin. These recommendations set forth actions necessary to reverse that decline and preserve this critical ecological area for future generations.
<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Implementing Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td></td>
</tr>
<tr>
<td>Develop an acquisition plan and funding strategy for the Peace River basin through collaboration of local, state, and regional conservation land acquisition entities to assure a coordinated and equitable approach</td>
<td>*</td>
</tr>
<tr>
<td>Determine value of formal Peace River Coordinating Committee</td>
<td>Multiple agencies/ stakeholders</td>
</tr>
<tr>
<td><strong>Stopping Wetland and Stream Losses</strong></td>
<td></td>
</tr>
<tr>
<td>Evaluate environmental resource permitting to determine whether enhanced permitting criteria, special basin rules, or other regulatory strategies should be implemented to minimize cumulative impacts more effectively</td>
<td>*</td>
</tr>
<tr>
<td><strong>Floodplain Protection</strong></td>
<td></td>
</tr>
<tr>
<td>Provide incentives to direct development away from the 100-year floodplain, review Florida’s Uniform Mitigation Assessment Methodology (wetlands) to determine whether preservation of the floodplain would serve as appropriate mitigation offset for development activities</td>
<td>*</td>
</tr>
<tr>
<td>Revise, update and secure funding for Integrated Habitat Network plan and accelerate floodplain mapping modernization</td>
<td>*</td>
</tr>
<tr>
<td><strong>Phosphate Industry Regulation and Reclamation</strong></td>
<td></td>
</tr>
<tr>
<td>Develop a proposal to ensure adequate funding for the Nonmandatory Reclamation Program to fund reclamation targeted at specific water resource benefits</td>
<td>*</td>
</tr>
<tr>
<td>Evaluate combining Environmental Resource Permit and Conceptual Reclamation Plan approval into single phosphate mining authorization</td>
<td>*</td>
</tr>
<tr>
<td><strong>Assist Agricultural Industry</strong></td>
<td></td>
</tr>
<tr>
<td>Promote greater participation in Facilitating Agricultural Resource Management Systems program</td>
<td>*</td>
</tr>
<tr>
<td>Promote greater use of Mobile Irrigation Laboratory program</td>
<td>*</td>
</tr>
<tr>
<td>Develop incentives to increase use of agricultural Best Management Practices</td>
<td>*</td>
</tr>
<tr>
<td><strong>Research and Studies</strong></td>
<td></td>
</tr>
<tr>
<td>Update land use change analysis with 2005 aerial photography and conduct similar analyses every 5 years</td>
<td>*</td>
</tr>
<tr>
<td>Accelerate development of Peace River integrated ground and surface water model</td>
<td>*</td>
</tr>
<tr>
<td><strong>Protecting and Enhancing Basin Hydrology, Water Quality and Quantity, and Public Water Supplies</strong></td>
<td></td>
</tr>
<tr>
<td>Adopt and implement Total Maximum Daily Load determinations and Basin Management Action Plans for impaired surface waters in basin</td>
<td>*</td>
</tr>
<tr>
<td>Develop minimum flows and levels and recovery strategies where needed</td>
<td>*</td>
</tr>
<tr>
<td>Implement Southern Water Use Caution Area recovery strategies</td>
<td>*</td>
</tr>
<tr>
<td>Accelerate and secure funding for Upper Peace River/ Saddle Creek Restoration Project</td>
<td>*</td>
</tr>
<tr>
<td>Monitor Shell Creek and Prairie Creek Watersheds Management Plan to ensure protection of Punta Gorda’s water supply; develop similar plans in other Peace River sub-basins</td>
<td>*</td>
</tr>
<tr>
<td>Work with the Southwest Florida Water Management District and area local governments to improve the use of zoning, land use and comprehensive planning tools to protect water resources in the basin; provide technical assistance to evaluate, plan and initiate financing for environmental infrastructure necessary to assure sustainable water supplies and improved water quality</td>
<td>*</td>
</tr>
</tbody>
</table>
5.2 Recommendations – Detail

Develop an acquisition plan and funding strategy for the Peace River Basin through collaboration of local, state, and regional conservation land acquisition entities to assure a coordinated and equitable approach

The Florida Legislature in 1999 established the Florida Forever program as the successor to earlier land acquisition programs. The Conservation and Recreation Lands (CARL) Trust Fund, under the Florida Forever umbrella, now receives the first $10 million of revenue collected annually from the severance tax on the phosphate mining industry, a substantial portion of which comes from the Peace River basin. The total amount of severance tax revenues that has been distributed to the CARL Trust Fund is approximately $535 million (SWFWMD, 2004c).

With the exception of Charlotte Harbor proper and the Payne Creek historic site, there is a void in statewide conservation lands essentially corresponding to the Peace River basin. No formal, coordinated acquisition plan for the Peace River basin has been developed to date. It is essential, then, to develop such an acquisition plan along with a funding strategy in collaboration with all local, state, and regional conservation land acquisition entities.

Determine value of formal Peace River Coordinating Committee

Because preserving the Peace River basin and minimizing cumulative impacts will require the participation of state, federal and local agencies as well as many other stakeholders, a coordinating committee could prove useful in facilitating communications among responsible parties, continuously evaluate and monitor progress on implementation of the recommendations, help refine existing recommendations or develop new ones as information is gathered. Such a cooperative venture would help make the Peace River Resource Management Plan an active, adaptive document.

Evaluate environmental resource permitting to determine whether enhanced permitting criteria, special basin rules, or other regulatory strategies should be implemented to minimize cumulative impacts more effectively

The Peace River basin has sustained significant losses of water resources. Impacts resulting from fundamental, often permanent land use changes—loss of 343 miles of natural stream channels, loss of some 38.5% of the original wetlands since the 1940s—argue for considering enhanced permitting criteria, special basin rules targeted to the area’s unique systems, improved mitigation measures, and other strategies to protect the remaining wetland and other surface water resources. These natural features are important unto themselves and essential in protecting the area’s public water supply and the Charlotte Harbor estuary.

Impacts to surface water resources are reviewed and permitted under the Environmental Resource Permitting (ERP) program. The resource losses documented in the Peace River Cumulative Impact Study suggest the need for enhancements to the ERP program to better protect remaining water resources of the Peace River. The timeframe from completion of the Peace River Cumulative Impact Study (January 2007) to the deadline for this management plan did not provide adequate opportunity for an evaluation of the pros and cons of such program revisions, which the DEP and Southwest Water Management District propose to undertake now.
Because current regulations require mitigation for wetlands to be evaluated based on effects to wetland functions rather than mere amount of affected acreage, it is impossible to discern or adequately evaluate historical impacts simply through aerial photography. For this reason, a detailed evaluation of historical permitting data must be combined with the information from the *Cumulative Impact Study* for an adequate assessment of the most effective strategies and enhancements.

**To provide an incentive to direct development away from the 100-year floodplain, review Florida's Uniform Mitigation Assessment Methodology (wetlands) to determine whether preservation of the floodplain would serve as appropriate mitigation offset for development activities**

As discussed in the *Cumulative Impact Study* and this plan, local government urban and suburban expansion presents a continuing risk to basin resources. Developing incentives to direct development away from sensitive areas like the 100-year floodplain is essential. Florida’s Uniform Mitigation Assessment Method (chapter 62-345, Florida Administrative Code) provides a standardized procedure for assessing the functions provided by wetlands and other surface waters and the amount of mitigation necessary to offset that loss when authorizing an activity. Mitigation “credits” are awarded based upon the increase in ecological value provided by the restoration, enhancement, preservation, or creation of wetland, upland or surface water habitats. The ecological value of the mitigation site (wetland, upland, or surface water) is the value of the abundance, diversity, and fish and wildlife habitats functions provided by the site. These functions may include providing cover and refuge; breeding, nesting, denning, or nursery areas; corridors for wildlife movement; food chain support; natural water storage; natural flow attenuation; and water quality improvement; and other similar benefits.

Given the documented cumulative impacts in the Peace River basin, the Uniform Mitigation Assessment Method will be reviewed to determine whether greater emphasis on preservation of the 100-year floodplain as a mitigation offset within the basin is warranted and can serve as an effective incentive.

**Revise, update and secure funding for Integrated Habitat Network plan and accelerate floodplain mapping modernization**

The DEP outlined the Integrated Habitat Network (IHN) in 1992 in *A Regional Conceptual Reclamation Plan for the Southern Phosphate District of Florida* (Cates, 1992). Undisturbed lands in the riverine floodplains represent the core lands of the IHN, while a Coordinated Development Area encompasses lands outside the IHN that are planned for intensive or semi-intensive development and use. The IHN is intended as a connected series of natural and reclaimed wetlands and uplands surrounding or abutting a preserved or protected nucleus of unmined or reclaimed riparian habitats. Its main goal is to maximize habitat replacement, protection, connection, and run-off buffering capacity (Figure 5.1). The main goal of the Coordinated Development Area is to encourage the use of areas for more intensive, compatible human use while simultaneously providing areas for the construction, management, and protection of water resources.

The IHN was developed to consider the reclamation of mined lands within phosphate mine boundaries; it did not consider lands within the entire Peace River basin. The DEP proposes secure funding to update and improve the IHN map for the Peace River basin as a template for strategic
and prioritized floodplain and floodplain buffer land acquisition by the State, the water management
district, and local governments. Consideration will be given to promoting conservation lands
dedicated to environmental stewardship.

Develop a proposal to ensure adequate funding for the Nonmandatory Mine Reclamation
Program to fund reclamation targeted at specific water resource benefits

The Nonmandatory Land Reclamation Trust Fund was created in 1978 to promote the reclamation
of lands mined before July 1, 1975, when reclamation by mine owners became mandatory. An
inventory of 149,130 acres of pre-1975 disturbed phosphate lands was established in three Florida
counties (Figure 5.2). There have been various adjustments to that inventory based on subsequent
evaluations of the acreage and the possibility or value of reclamation. Since its inception, the
“Nonmandatory Program” has reimbursed $108.4 million for reclamation of approximately 41,600
acres (ZWI, 1980; DEP-BMR, 2006a). In 2003, the Legislature amended section 378.035, Florida
Statutes, to establish a deadline of January 1, 2005 for applications for nonmandatory land
reclamation.

Applications to reclaim approximately 8,200 acres were received before the January 1, 2005 deadline,
leaving an estimated 15,000 additional acres of nonmandatory lands that could benefit from
reclamation to minimize adverse impacts to water resources of the Peace River basin. The current
Trust Fund balance is insufficient to fund all applications received by the January 1, 2005 statutory
application deadline, let alone fund reclamation of any of the remaining 15,000 acres. Since
February 2001, Trust Fund moneys and supplementary other funds totaling more than $130 million
have been diverted in order for DEP to fund emergency response and ongoing obligations at the
Piney Point and Mulberry phosphogypsum stack systems, including construction, site maintenance,
and management operations to reduce enormous volumes of acidic process water to safely close the
two facilities.

The DEP proposes to develop funding options to enable the completion of remaining critical
reclamation. In conjunction with the funding plan, DEP will develop a specific methodology to
identify those parcels that have the highest potential to benefit basin water resources and a plan to
coordinate acquisition and reclamation.

Evaluate combining Environmental Resource Permit and Conceptual Reclamation Plan
approval into single phosphate mining authorization for better environmental protection

Under Chapter 373, Part IV, F.S., phosphate mining operations must obtain an Environmental
Resource Permit (ERP). The ERP authorizes activities across an entire mine or a portion of a mine
that involve the management and storage of surface waters (stormwater), with additional criteria to
protect wetlands and other surface waters. Mining cannot begin without an ERP and any wetland
mitigation and reclamation activities must be consistent with the ERP.

Under Chapter 378, Part III, F.S., phosphate mining operations must also obtain approval of a
Conceptual Reclamation Plan for the entire mine (Figures 5.3 and 5.4). The conceptual plan is a
general description of reclamation activities to be undertaken across the whole mine, and plan
approval must be secured from DEP before the mine begins reclamation activities (not mining).
Reclamation must be consistent with the DEP approval. Once mining operations have ceased in an
area, reclamation must begin in accordance with specified time constraints and be consistent with the requirements of Chapters 373 and 378, F.S.

The DEP processes the Environmental Resource Permit and Conceptual Reclamation Plan simultaneously, but the different standards for the two actions are not integrated and require constant changes to approved reclamation. This lack of integration results in gaps in environmental protection and an unnecessarily bureaucratic relationship between DEP and the mining operation. Thus DEP proposes to determine whether the two actions can effectively be streamlined into a more effective, comprehensive and environmentally protective phosphate mining authorization.

Promote greater participation in Facilitating Agricultural Resource Management Systems program

The Facilitating Agricultural Resource Management Systems program is a joint effort between the Southwest Florida Water Management District and the Florida Department of Agriculture and Consumer Services developed to implement agricultural Best Management Practices (BMPs) in the Southern Water Use Caution Area. The specific purposes of the BMPs are to improve water quality, reduce Floridan aquifer withdrawals and conserve, restore or augment the area’s water resources and ecology. Projects must be consistent with the Southern Water Use Caution Area Recovery Strategy, the Regional Water Supply Plan and Water Management Plan, and the Shell and Prairie Creek Watersheds Management Plan—Reasonable Assurance Documentation, along with furthering the District’s mission to manage and protect water and water-related resources (SWFWMD, 2005; SWFWMD, 2006).

DEP proposes to work with the other two agencies to increase Facilitating Agricultural Resource Management Systems participation and otherwise work with the agricultural industry to reduce water use by 40 million gallons per day within the Southern Water Use Caution Area by the year 2025.

Promote greater use of Mobile Irrigation Laboratory program

The Florida Legislature in 2001 created section 570.085, Florida Statutes, which directed that Florida Department of Agriculture and Consumer Services to establish an agricultural water conservation program. The program involves water conservation BMPs, cost-share for implementing agricultural water conservation programs, and expansion of the Mobile Irrigation Laboratory program. DEP will work with Florida Department of Agriculture and Consumer Services to seek stable funding for the Mobile Irrigation Laboratory program and expand implementation of water conservation BMPs.

Develop incentives to increase use of agricultural Best Management Practices

The Florida Department of Agriculture and Consumer Services, Office of Agricultural Water Policy was established in 1995 to facilitate governmental and agricultural industry cooperation on water quantity and quality issues. The office works with agricultural producers and industry groups, state agencies, the university system, the water management districts, and other interested parties to develop and implement economically and technically feasible BMPs. These practices are designed to address water quality and conservation on a site-specific, regional, or watershed basis (DACS, 2003).

BMPs are a preferred means of environmental protection within the agricultural community because they also provide benefits to agricultural producers. For example, improving irrigation efficiency results in lower water use, improved crop yields, reduced runoff, improved water quality, and
reduced expenditures (DACS, et al., 2006). The DEP will work with Florida Department of Agriculture and Consumer Services to promote these benefits, and related cost-sharing, to growers throughout the basin, where participation has been lacking in the past. The DEP will also help explore additional incentives to further encourage the development and use of BMPs.

**Update land use change analysis with 2005 aerial photography and conduct similar analyses every 5 years**

Wetland regulations were largely developed and implemented after 1979. That year and 1999 are the dates of the aerial photography sets used in the *Peace River Cumulative Impact Study* to compare land use covers. Losses of wetlands during that time were unexpectedly large and raise questions about the effectiveness of the regulations, especially because the losses cannot definitively be determined to have occurred after isolated wetlands protections were developed. The limitations of aerial photography interpretation in the early stages of reclamation and restoration, the delayed effects of drainage not previously regulated, or illegal activities not detected by enforcement are other factors that may have contributed to the wetland acreage losses.

In addition to the historical permit evaluation the DEP and Southwest Florida Water Management District will conduct, DEP will analyze land use differences between 1999 and the 2005 aerial coverage and will conduct land use comparisons every five years as new aerials are produced. These analyses will enable an assessment of the effectiveness of the *Resource Management Plan* over time and help prevent continuing losses that are not effectively offset by successful mitigation.

**Accelerate development of Peace River integrated ground and surface water model**

The *Peace River Cumulative Impact Study* has documented a history of impairment to the water resources in the Peace River basin. Agriculture, public supply, and mining activities within the basin have altered the hydrology of the river and groundwater withdrawals for these activities have reduced dry-season base flow in the upper basin.

The Peace River Integrated Model project will develop an integrated surface water and groundwater model for the entire Peace River basin. The model will be used to understand the effects of historical changes in the basin on river flows and to simulate the effects of future resource management decisions. The objective is a model that can simulate recent and future conditions and, using best available data, separate the effects of various land uses and climate changes on river flows. The estimated completion date for the Peace River Integrated Model is December 31, 2010 (SWFWMD, 2006).

DEP will promote the development and implementation of research on the hydraulic characteristics of mining operation landforms, reclaimed landforms, and disturbed soils to factor into the integrated computer model.

**Adopt and implement Total Maximum Daily Load determinations and Basin Management Action Plans for impaired surface waters in basin**
Total Maximum Daily Loads (TMDLs) are quantitative analyses of surface waters where one or more water quality standards are not being met, resulting in “impairment” of their beneficial uses, whether as drinking water sources or for fishing and shellfish harvesting or recreation. A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still remain healthy so that all its designated uses are met. In doing so, the TMDL sets the pollutant reductions necessary to clean up the surface water. A TMDL takes into account all sources of the problem pollutants, including industrial plants and wastewater treatment facilities as well as stormwater runoff from farms, forests, urban areas, decaying organic matter, nutrients in the soil, and more. (See Figure 5.5.) The DEP also accounts for future growth and development, to the extent possible, when establishing a TMDL.

Multiple TMDLs have been developed for waters in the Peace River basin and will be adopted in the near future. A TMDL sets pollutant reduction objectives that must be implemented to clean up impaired waterways. DEP proposes to adopt the pending TMDLs and work with local stakeholders to finalize and implement the Basin Management Action Plans necessary to minimizing existing and future adverse cumulative impacts to surface water resources. These plans identify specific infrastructure projects, both local and regional; land acquisition efforts; best management practices; financial options; and other critical components of a restoration program. Progress has already been made in addressing the water quality impairments identified in the Peace River basin. Some projects are underway, in advance of TMDL implementation, including:

- Lake Hancock lake level modification and outfall treatment projects, including major land acquisitions;
- Restoration projects in the Lake Hancock watershed, including lakes Parker and Hollingsworth and Banana Lake and canal;
- Restoration projects in the Winter Haven Chain of Lakes, including lakes Howard, Conine, and Smart; and
- The Peace Creek Drainage Canal watershed restoration plan, which will lead to the acquisition of up to 3,000 acres of conservation lands.

**Develop minimum flows and levels and recovery strategies where needed**

Florida’s five water management districts establish “Minimum Flows and Levels” for surface waters and aquifers in their jurisdictions pursuant to section 373.042, F.S. A “minimum flow” is the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area; a “minimum level” is the level of groundwater in an aquifer or the level of a surface water at which further withdrawals would be significantly harmful to the water and ecological resources of the area (SWFWMD, 2002). Consideration is given to the protection of water resources, natural seasonal fluctuations in water flows or levels, and environmental values associated with coastal, estuarine, aquatic and wetlands ecology. Minimum flows and levels are critical both to the hydrologic requirements of natural systems, to assure they are not jeopardized by excessive withdrawals, and to water supply planning and regulation because they affect how much water is available for withdrawal (SWFWMD, 2002).

The Southwest Florida Water Management District adopted “low” minimum flows and levels for the upper segment of the Peace River and minimum flows and levels for the middle segment of the Peace River in 2005. It is crucial that the recovery strategies for these areas remain on schedule or
are expedited. Recovery strategies include the Lake Hancock lake level modification and water quality treatment projects, Peace Creek restoration project, and the resource development and containment of flow losses through karst features projects upper Peace River.

The DEP will support the Southwest Florida Water Management District as it develops the minimum flows and levels for Lake Hancock and the lower Peace River estuary system, scheduled for adoption in 2007 and development of “middle” and “high” minimum flows for the upper Peace River, scheduled for adoption by 2011.

**Implement Southern Water Use Caution Area recovery strategies**

In response to growing demands from public supply, agriculture, mining, power generation and recreational uses, groundwater withdrawals within the Southwest Florida Water Management District steadily increased before peaking in the mid-1970s. These withdrawals resulted in declines in aquifer levels, in some areas exceeding 50 feet. Depressed aquifer levels caused saltwater intrusion, contributed to reduced flows in the upper Peace River, and lowered water levels of some lakes in the upland areas of Polk and Highlands counties.

The Water Management District Governing Board established the Southern Water Use Caution Area (SWUCA) in 1992. The SWUCA Recovery Strategy was designed to restore minimum flows to the upper Peace River and minimum levels to lakes in Highlands and Polk counties as soon as practical. It is also designed to slow the inland movement of saltwater intrusion to minimize water quality deterioration over the next century and to assure water supply for all existing and projected reasonable and beneficial uses in the eight-county area. (SWFWMD, 2006.)

The DEP will support the Southwest Florida Water Management District in its annual assessment of water resource criteria and cumulative impacts and its review of the recovery strategy at least every five years (most recently completed in March 2006). By promoting this adaptive management strategy, recovery actions can be tailored to meet the recovery objectives.

**Accelerate and secure funding for Upper Peace River/Saddle Creek Restoration Project**

The Saddle Creek watershed, in northern Polk County, is the uppermost watershed in the Peace River at Bartow sub-basin. The upper portion of the Saddle Creek watershed was heavily affected by phosphate mining operations from the early 1950s through the early 1970s. In an evaluation of lands disturbed by phosphate mining before July 1, 1975, Zellars-Williams, Inc. (ZWI, 1980) published a report recommending restoration of several watersheds impacted by mining, including the upper Saddle Creek. The restoration project comprises several parcels of publicly- and privately-owned lands, including the 7,300-acre Tenoroc Fish Management Area (Tenoroc), a fisheries research and recreation area owned by the State and managed by the Florida Fish and Wildlife Conservation Commission.

Situated near the headwaters of the Peace River, the Upper Peace River/Saddle Creek Restoration Project is the linchpin on which other projects depend (Figure 5.6). For all projects to be successful, the Upper Peace River/Saddle Creek Restoration Project must first be successful in restoring the water resources in this portion of the Peace River. Tenoroc is located just south of the Interstate 4 corridor between Lakeland and Auburndale. Rapidly expanding urban and suburban development will soon completely surround the watershed and recreation area. Tenoroc is situated such that
stormwater from adjacent existing and planned housing and commercial development, golf courses, and a university campus must pass through it before entering Lake Parker, Saddle Creek, Lake Hancock, and eventually the Peace River. Thus, water quality and water quantity improvements in this portion of the upper Peace River basin are dependent on the upland, wetland, and drainage improvements to be completed within Teneroc.

Because of its importance, the DEP will pursue acquisition funds, grants, sale of on-site resources, and other potential sources to acquire adjacent properties and enhance and manage lands within the Teneroc to restore flows to the upper basin. DEP will also work with the Florida Fish and Wildlife Conservation Commission to accelerate the amount of work being done and streamline interagency coordination.

Monitor Shell Creek and Prairie Creek Watershed Management Plan to ensure protection of Punta Gorda’s water supply; develop similar plans in other Peace River sub-basins

The Shell-Prairie and Joshua Creek sub-basins, in the southern region of the Peace River basin, comprise approximately 487 square miles or about 20% of the basin. Land use is predominantly agriculture and is composed largely of citrus, improved and semi-improved pasture, row crops, and sod operations. About 89% of the current permitted water use is for agriculture. Surface water quality is currently impaired due to elevated levels of chlorides, total dissolved solids, and specific conductance as a result of the use of mineralized groundwater for irrigation (SWFWMD, 2004b). Punta Gorda obtains its drinking water supply from the Shell Creek in-stream reservoir and is currently authorized to withdraw up to 5.38 million gallons per day of surface water on an annual average daily basis (SWFWMD, 2004b).

A stakeholders group was formed in 2001 and helped develop the Shell Creek and Prairie Creek Watersheds Management Plan to address water quality conditions upstream of the Hendrickson Dam at the reservoir. The plan is comprehensive and includes management plans, practices and projects to address water quality conditions in Shell Creek, Prairie Creek and Joshua Creek watersheds (SWFWMD, 2004b).

The DEP will promote progress of the Shell Creek and Prairie Creek Watersheds Management Plan throughout its full implementation through 2014 to assure protection of Punta Gorda’s water supply and area compliance with water quality standards. The DEP also will assess the value of similar plans for other areas within the Peace River basin.

Work with the Southwest Florida Water Management District and area local governments to improve the use of zoning, land use and comprehensive planning tools to protect water resources in the basin; provide technical assistance to evaluate, plan and initiate financing for environmental infrastructure necessary to assure sustainable water supplies and improved water quality

As documented throughout the Cumulative Impact Study and this report, urbanization is one of the four primary causes of the Peace River basin’s decline. The urban centers of Lakeland, Auburndale, Haines City, Winter Haven, Bartow and unincorporated Port Charlotte lie in the northernmost and southernmost parts of the watershed. These areas are growing. Equally significant, residential, commercial, and industrial development is spreading further in the basin, including into the areas of Fort Meade, Zolfo Springs, Bowling Green, and Arcadia.
The infrastructure required to support this development is bringing with it more stormwater runoff from roads and parking lots, additional wastewater treatment and discharge or reuse flows, higher demand for public water supply, large-scale clearing of native lands, and other consequences of growth that threaten the basin’s water resources. Major east-west and north-south transportation corridors are being planned that could bisect the basin.

If local zoning, land use planning and overall comprehensive planning are not undertaken carefully, the situation will be exacerbated. The opportunity exists to exploit these tools more effectively to assure that development is directed away from the most sensitive environmental resources and that future quality of life for area residents can be preserved. Critical to this effort is the planning, engineering and financing of the infrastructure necessary to promote sustainable public water supplies, provide high-quality centralized wastewater treatment and reuse or disposal, and develop low-impact design stormwater systems that ensure that development impacts are minimized. The DEP and Water Management District will work with area local governments to provide technical assistance and, where possible, grants and low-interest loans to combine with local rates, fees and other charges to help finance the necessary infrastructure.
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, express or implied, and assume no legal liability or responsibility for the ability of users to fulfill their intended purposes in accessing or using GIS data or metadata or for omissions in content regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented “as is,” without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk. In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of any applications applied to or associated with the data or metadata.
Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, express or implied, and assume no legal liability or responsibility for the ability of users to fulfill their intended purposes in accessing or using GIS data or metadata or for omissions in content regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk. In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of any applications applied to or associated with the data or metadata.
"Mandatory Phosphate Mines" does not indicate that the area is required to be mined for phosphate; 'Mandatory' refers to the regulatory status of the land. Land mined for phosphate since July 1, 1975 is 'Mandatory,' and is required by Florida law to be reclaimed (contoured and revegetated). Land mined prior to July 1, 1975 was not required to be reclaimed.

Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, express or implied, and assume no legal liability or responsibility for the ability of users to fulfill their intended purposes in accessing or using GIS data or metadata or for omissions in content regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk. In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of any applications applied to or associated with the data or metadata.
"Mandatory Phosphate Mines" does not indicate that the area is required to be mined for phosphate; "Mandatory" refers to the regulatory status of the land. Land mined for phosphate since July 1, 1975 is "Mandatory," and is required by Florida law to be reclaimed (contoured and revegetated). Land mined prior to July 1, 1975 was not required to be reclaimed.

Information contained herein is provided for informational purposes only. The State of Florida, Department of Environmental Protection, Bureau of Mine Reclamation, provides geographic information systems (GIS) data and metadata with no claim as to the completeness, usefulness, or accuracy of its content, positional or otherwise. The State and its officials and employees make no warranty, express or implied, and assume no legal liability or responsibility for the ability of users to fulfill their intended purposes in accessing or using GIS data or metadata or for omissions in content regarding such data. The data could include technical inaccuracies and typographical errors. The data is presented "as is," without warranty of any kind, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Your use of the information provided is at your own risk. In providing this data or access to it, the State assumes no obligation to assist the user in the use of such data or in the development, use, or maintenance of any applications applied to or associated with the data or metadata.
**Proposed Waterfowl Habitat ~ 118 Acres**

**Proposed Landfill Buffer Herbaceous Non-Forested Wetland ~ 77 Acres**

**Proposed Mixed Forest Wetland ~ 171 Acres**

**Proposed Herbaceous Non-Forested Wetland ~ 24 Acres**

**Existing Upland Habitat ~ 284 Acres**

**Existing Upland Habitat ~ 39 Acres**

**Existing Upland Habitat ~ 43 Acres**

**Existing Upland Habitat ~ 40 Acres**

**Existing Upland Habitat ~ 44 Acres**

**Existing Upland Habitat ~ 12 Acres**

**Existing Upland Habitat ~ 115 Acres**

**Existing Upland Habitat ~ 63 Acres**

**Proposed Upland Habitat ~ 375 Acres**

**Proposed Upland Habitat ~ 273 Acres**

**Proposed Upland Habitat ~ 131 Acres**

**Proposed Upland Habitat ~ 49 Acres**

**Existed Upland Habitat ~ 232 Acres**

**Existing Upland Habitat ~ 85 Acres**

**Existing Upland Habitat ~ 82 Acres**

**Existing Upland Habitat ~ 146 Acres**

**Existing Upland Habitat ~ 311 Acres**

**Proposed Wetland Habitat ~ 115 Acres**

**Proposed Wetland Habitat ~ 86 Acres**

**Proposed Wetland Habitat ~ 46 Acres**

---

**Rivers and Boundaries**
- County Roads
- Local Roads
- US Routes
- State Routes
- Intertates
- Tenoroc Boundary
- Construction and Preconstruction Planning
- Saddle Creek Road

**Lakes**
- Saddle Creek

**Roads**
- US Routes
- State Routes
- Interstates
- County Roads
- Local Roads

**Habitat Status**
- Proposed Upland Habitat
- Proposed Wetland Habitat
- Existing Upland Habitat

**Land Use and Cover Type**
- Herbaceous
- Shrub and Brushland
- Upland Coniferous Forests
- Upland Hardwood Forests
- Mixed Forests Wetland
- Wetland Hardwood Forests
- Wetland Coniferous Forests
- Wetland Mixed
- Herbaceous Wetland

**Figure 5.6**

**Figure 5.6 Text:**

- Saddle Creek
- Nonmandatory Restoration
- Old Combee Road
- Lake Parker Drive
- West Dunlap Road
- Saddle Creek Road
- Roads and Boundaries
- Tenoroc Boundary
- Construction and Preconstruction Planning
- Saddle Creek

**Legend:**
- County Roads
- Local Roads
- US Routes
- State Routes
- Intertates
- Tenoroc Boundary
- Construction and Preconstruction Planning
- Saddle Creek

**Total Acres:**
- Approximately 1460 Acres
- Approximately 828 Acres
- Approximately 637 Acres
- Approximately 4575 Acres
- Approximately 7500 Acres

**Path:** P:\Projects\ArcGIS\Production\ERS\Tenoroc\tenoroc_one_HabitatStatus.mxd

**Author:** Levi Sciarra

**Date:** May 19, 2006
6.0 Peace River Resource Management Plan Implementation

The DEP proposes to implement the following actions, some in conjunction with partner agencies, to address cumulative impacts in the Peace River basin. The actions are set forth according to the timeframe during which they will be undertaken.

This plan is, by design, dynamic and intended to be continuously improved as better information about basin hydrology and ecology becomes available. Several of the proposed actions are beyond the resources of any one agency and require collective action by various agencies and stakeholders in the basin. These agencies and stakeholders must effectively coordinate—and hold each other accountable—for implementing the recommendations and action steps below; monitoring their progress; and refining, adapting, and developing new actions as circumstances demand. Only through concerted effort can cumulative impacts in the Peace River basin be minimized or eliminated.

Ongoing Actions

- Evaluate reclaimed and released mining parcels to better determine their wetland function.
- Monitor progress of the Shell Creek and Prairie Creek Watersheds Management Plan to ensure the goals and objectives are achieved by 2014.
- Promote and expand Department of Agriculture and Consumer Services Mobile Irrigation Laboratory Program.
- Support the Department of Agriculture and Consumer Services efforts to reduce agricultural water use by 40 mgd by 2025 through the Facilitating Agricultural Resource Management Systems program.

Short-Term Actions – Complete within six months to one year

- Adopt Total Maximum Daily Load determinations in the Peace River basin: Banana Lake, Banana Lake Canal, Lake Bonny, Lake Hancock, Lake Lena, Lake Parker, Peace Creek Drainage Canal, Peace River above Bowlegs Creek, Saddle Creek below Lake Hancock, Wahneta Farms Drain Canal, and Winter Haven Chain of Lakes (Southern).
- Develop an acquisition plan and funding strategy for the Peace River Basin through collaboration of local, state, and regional conservation land acquisition entities to assure a coordinated and equitable approach.
- Develop a proposal to ensure adequate funding of the Nonmandatory Reclamation Program to support reclamation targeted at specific water resource benefits.
- Develop a long-term needs analysis for funding from the Nonmandatory Lands Reclamation Trust Fund for the management of conservation lands in the Integrated Habitat Network, and submit legislative budget requests consistent with established fund needs.
- Evaluate the benefits of combining the Environmental Resource Permit and Conceptual Reclamation Plan approval into a single mining authorization as a means of improving resource protection and process streamlining.
- Determine whether a formal Peace River Coordinating Committee should be established to facilitate intergovernmental and stakeholder interactions.
• Expedite, in conjunction with the Southwest Florida Water Management District, the development and implementation of the Final Evaluation of Stream Flow Losses through Karst Features in the Upper Peace River, in conjunction with the U.S. Geologic Survey.

• Develop incentives to increase the use of agricultural Best Management Practices in conjunction with Department of Agriculture and Consumer Services.

**Mid-Term Actions – Complete within two years**

• To provide an incentive to direct development away from the 100-year floodplain, review Florida’s Uniform Mitigation Assessment Methodology (wetlands) to determine whether preservation of the floodplain would serve as appropriate mitigation offset for development activities.

• Complete minimum flows and levels for the lower Peace River estuary system and Lake Hancock, scheduled for adoption in 2007 (Southwest Florida Water Management District).

• Provide the Southwest Florida Water Management District with data needed to complete the Peace River Integrated (computer) Model and assure it accounts for phosphate mining lands.

• Take appropriate corrective measures in all sub-basins where specific conductance (a measure of dissolved solids) in surface waters has been increasing (Southwest Florida Water Management District).

• Adopt Total Maximum Daily Load determinations for Winter Haven Chain of Lakes (Northern).

• Conduct a study of mechanisms to remediate stream losses to in-channel Karst features (Southwest Florida Water Management District).

**Long-Term Actions – Complete within four years**

• Work with the Southwest Florida Water Management District and area local governments to improve the use of zoning, land use and comprehensive planning tools to protect water resources in the basin; provide technical assistance to evaluate, plan and initiate financing for environmental infrastructure necessary to assure sustainable water supplies and improved water quality.

• Complete “middle” and “high” minimum flows for the upper Peace River, scheduled for adoption by 2011 (Southwest Florida Water Management District).

• Evaluate existing regulatory programs in conjunction with the Southwest Florida Water Management District to determine the need for program enhancements or development of special basin rules to protect water resources.

• Revise and update the Integrated Habitat Network and coordinate with Southwest Florida Water Management District to accelerate floodplain mapping modernization.

• Expedite, in conjunction with the Southwest Florida Water Management District, development and implementation of:
  - Lake Hancock Lake Level Modification and Ecosystem Restoration Project.
  - Lake Hancock Water Quality Treatment Project.
  - Peace Creek Restoration Program.
  - Upper Peace River Resource Development Project.
• Complete the Upper Peace River/Saddle Creek Restoration Project.
  o Amend Tenoroc Fish Management Area project area lease to include DEP-Division of Water Resource Management as co-manager with the Florida Fish and Wildlife Conservation Commission.
  o Provide partial funding in cooperation with the Florida Fish and Wildlife Conservation Commission for complete upland and wetland restoration, drainage, enhancement, and management of entire project area through the sale of on-site resources.
  o Acquire clay settling areas on adjacent privately-owned property to complete drainage enhancement to Upper Saddle Creek in cooperation with the Southwest Florida Water Management District, Polk County, and Florida Fish and Wildlife Conservation Commission.
  o Request funding from the Southwest Florida Water Management District since water being managed in the Upper Peace River/Saddle Creek Restoration Project will be used in support of the Peace River Minimum Flows and Levels recovery strategies.
7.0 References

http://www.swfwmd.state.fl.us/documents/reports/upperpeace_withdrawals.pdf


http://www.dep.state.fl.us/water/mines/ihn/docs/RegionalConceptual%20Plan_So_Phasphate_District_FL.pdf


http://www.floridaagwaterpolicy.com/PDFs/BMPs/AgWaterConservBMPfinal2006.pdf

http://www.dep.state.fl.us/water/mines/nonman.htm


Fraser, T. May 24, 2006. Historical and Modern Patterns of Fish Species from Freshwater through the Tidal Peace River Continuum. Presentation at Peace River Cumulative Impact Study Meeting, Bartow, FL.


PENTEC Environmental. 2001. Use of Best Available Science in City of Everett Buffer Regulations. Project No. 253-003. Everett, WA.


ACKNOWLEDGEMENTS

The Florida Department of Environmental Protection, Bureau of Mine Reclamation would like to thank the following for their assistance with the development of the Peace River Basin Resource Management Plan:

Ralph Montgomery of Post, Buckley, Schuh & Jernigan, Inc.;

Don Ross of EarthBalance;

Ron Basso and Rand Frahm of the Southwest Florida Water Management District;

Bill Bartnick of the Florida Department of Agriculture and Consumer Services;

Mike Coates and Sam Stone of the Peace River/Manasota Regional Water Supply Authority;

Tom Singleton and Kevin Petrus of the Florida Department of Environmental Protection, Total Maximum Daily Loads Program; and,

All the stakeholders and concerned citizens who attended the Peace River Cumulative Impact Study and Peace River Basin Resource Management Plan meetings to convey their thoughts and concerns on the current and future health and well-being of this watershed.