December 2006

HERBERT HOOVER DIKE
REACHES 2 AND 3

DRAFT ENGINEERING ANALYSIS
AND
DRAFT SUPPLEMENT
TO THE
1999 DRAFT ENVIRONMENTAL IMPACT STATEMENT
PALM BEACH, GLADES AND
HENDRY COUNTIES, FLORIDA

U.S. Army Corps of Engineers
Jacksonville District
Jacksonville, Florida

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ABSTRACT

The Herbert Hoover Dike (HHD) is a component of the Central and Southern Florida (C&SF) Project and consists of a series of levees, gated culverts, and locks located around the perimeter of Lake Okeechobee in south Florida. The Corps constructed the dike for flood protection, water supply, and navigation purposes between 1932 and 1938. Major culvert modifications were accomplished in the 1970s, but, since then, repairs have been made on an as-needed basis. The existing HHD system is approximately 143 miles (230 km) long and is divided into eight segments or "Reaches" for planning purposes. Two southern segments, Reaches 2 and 3, are the focus of the present study.

In recent years, signs of instability in the HDD, such as boils and pipings, indicate that major renovations are now necessary, especially along its southeastern reaches. The purpose of this project is to reconstruct and rehabilitate Reaches 2 and 3 of the HHD to prevent a catastrophic failure of the system and contain the lake waters for flood protection, water supply, and navigation.

Previous designs were developed, evaluated, and modified through the 1999 Draft Environmental Impact Statement (EIS) for the HHD Major Rehabilitation Evaluation Report (MRR) and the 2005 Final EIS, Proposed Rehabilitation of the HHD Major Rehabilitation Report, Reach 1. Designs were further evaluated by a 2002 Value Engineering Study and reviewed in 2005-2006 by an Independent Technical Review Team. The Recommended Plan consists of a seepage cutoff wall placed in the center of the dike and a seepage berm expanded to fill in an existing toe ditch.

Construction would be confined to the structural footprint of the existing Herbert Hoover Dike. Impacts caused by filling wetlands along the toe ditch would be mitigated through compensation. No other long-term adverse effects of the project are anticipated.

If you would like further information on this report, please contact:

Nancy P. Allen
U.S. Army Corps of Engineers, Jacksonville District, Planning Division
P.O. Box 4970
Jacksonville, Florida 32232-0019
Tel: 904-232-3206
Email: nancy.p.allen@usace.army.mil

EXECUTIVE SUMMARY

HERBERT HOOVER DIKE
REACHES 2 AND 3

DRAFT ENGINEERING ANALYSIS
AND
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PALM BEACH, GLADES AND HENDRY COUNTIES, FLORIDA

EXECUTIVE SUMMARY

BACKGROUND

The Herbert Hoover Dike (HHD) consists of a series of levees, gated culverts, and locks that encompass Lake Okeechobee in south central Florida. Construction of the HHD began in 1915. The River and Harbor Act (July 3, 1930), and the Flood Control Act of 1948 authorized the construction of 67.8 miles of levee along the south shore of the lake and 15.7 miles of levee along the north shore. Until recently, only as-needed repairs have been made to the HHD. However, signs of instability, such as boils and pipings, have occurred in recent years that indicate major renovations are now necessary, especially along the southeastern portion. High lake levels in 2003 resulted in severe piping that required several emergency operations to remediate the HHD along the eastern section of Reach 2 and portions of Reach 3. The greatest risk is that an unreliable embankment system could allow for a failure of the system to contain lake waters. Such a failure could result in loss of life, property, and habitat.

The existing HHD is approximately 143 miles long. It is divided into eight segments or "Reaches" for planning purposes. The southern two segments, Reach 2 and Reach 3, are the focus of the present study. Reach 2 is 20.42 miles long and extends from the Caloosahatchee River at Moore Haven to the Miami Canal near Lake Harbor. Reach 3 is 6.70 miles long and extends from the Miami Canal to the Hillsboro Canal in Belle Glade.

A Draft EIS was completed in July 1999 and a Major Rehabilitation Evaluation Report (MRR) was completed in November of 2000 contingent on revisions to the economic evaluation and finalization of the EIS. In 2001, a Value Engineering (VE) Study was initiated for the project in order to reduce real-estate costs and minimize the footprint of the project within functional wetlands.

In 2002 though 2003, emergency repairs to the Dike were undertaken to stop boils occurring in the toe ditch in Reach 1near South Bay. Emergency actions were taken to install the VE solution over a one-mile stretch. Unfortunately, the VE Recommended Plan was unsuccessful due to the effect of additional seepage appearing in the toe ditch. Additional waters were in fact being introduced onto adjacent private properties. This led the Corps to modify the selected alternative described in the MRR and VE and prepare a Draft Supplemental EIS (DSEIS) to evaluate this new design for Reach 1. The DSEIS was circulated during March-May 2005. The Final EIS (FEIS) was noticed in the Federal Register on July 8, 2005, and a Record of Decision (ROD) was signed on September 23, 2005.

The plan for Reach 1 was developed well before Hurricane Katrina's devastating impact on the hurricane protection levees in New Orleans in 2005. Even though construction had begun, it was concluded by the USACE that the lessons learned in Katrina's aftermath should be used to ensure that the HHD would continue to protect lakeside communities. Construction on Reach 1 was halted, and an Independent Technical Review (ITR) panel was convened for further evaluation of the design of the project to determine whether it was consistent with applicable criteria, regulations, and professional standards and practices. A plan recommended by the ITR team involved the incorporation of additional property into an expanded seepage berm of the dike system to provide additional stability and reduce piping. The plan developed through this process for Reach 1 forms the basis for the rehabilitation of Reaches 2 and 3. The local sponsor, SFWMD, would have the responsibility for acquisition of the additional real estate. Because real estate acquisition can be a lengthy process, and because the need to improve the HHD system along Reaches 2 and 3 is of a high priority, the USACE proposes to proceed with those elements of the ITR plan that can be implemented within the footprint of the existing dikes.

PURPOSE

The purpose of this project is to reconstruct and rehabilitate Reaches 2 and 3 of the HHD to prevent a catastrophic failure of the system to retain the waters of Lake Okeechobee. The goal of the USACE is to provide a reliable embankment system around Lake Okeechobee to contain the lake waters for flood protection, water supply, and navigation.

RECOMMENDED PLAN

For Reach 3 and the eastern portion of Reach 2, the Recommended Plan includes the construction of a seepage berm that would extend to the far side of the existing toe ditch at the edge of the existing project right-of-way; the toe ditch would be filled. In addition, a seepage cutoff wall would be installed in the center of the dike.

This design would be modified slightly for the western portion of Reach 2, where, instead of a toe ditch outside the levee, a borrow canal is present. The western portion of Reach 2 is characterized by a clay layer found approximately 20-40 feet below the surface; such a clay layer is not present at Reach 3 or eastern Reach 2. Tying the cutoff wall in western Reach 2 into the clay layer would result in less seepage than would be allowed by the cutoff wall alone. This would enable construction of a smaller seepage berm than is necessary in Reach 3 or eastern Reach 2. The berm would extend only to the canal edge adjacent to the dike; the borrow canal would not be filled.

MAJOR FINDINGS AND CONCLUSIONS

Implementation of the Recommended Plan would cause minimal short-term disturbance to, and displacement of, components of the human and natural environments. These include minimal soil and vegetation disruption during excavation and fill activities. The only long-term adverse impacts would be to wetlands from filling the toe ditch; wetland impacts would be mitigated through compensation. Temporary impacts to aesthetic and recreational resources due to construction activities would occur as well. Once construction ends, conditions would return to pre-project levels. Impacts to private lands would be avoided by constructing the Recommended Plan within the limits of the Federally-owned footprint of the HHD.

TABLE OF CONTENTS

TABLE OF CONTENTS

Section **Page**

TABLE OF CONTENTS (cont'd)

TABLE OF CONTENTS (cont'd)

TABLE OF CONTENTS (cont'd)

Section **Page**

TABLE OF CONTENTS (cont'd)

Section **Page**

LIST OF TABLES

Number **Page**

LIST OF FIGURES

Number **Page**

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HERBERT HOOVER DIKE
REACHES 2 AND 3

DRAFT ENGINEERING ANALYSIS
AND
DRAFT SUPPLEMENT TO THE 1999
DRAFT ENVIRONMENTAL
IMPACT STATEMENT
PALM BEACH, GLADES AND
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1.0 INTRODUCTION

1.1 BACKGROUND

The Herbert Hoover Dike (HHD) consists of a series of levees, gated culverts and locks that encompass Lake Okeechobee. The first embankments of the dike were constructed in 1915 by local interests and were primarily composed of muck, sand, shell, and marl from adjacent borrow canals. During the 1930s, a Federal interest was initiated after hurricane tides of 1926 and 1928 overtopped the original embankment and caused over 2,600 deaths. The River and Harbor Act, approved 3 July 1930, authorized the construction of 67.8 miles (109 kilometers [km]) of levee along the south shore of the lake and 15.7 miles (25.3 km) of levee along the north shore. Constructed by the Corps between 1932 and 1938, the typical crest height of these levees ranged from 32 to 35 feet (9.8 meters [m] to 10.7 m) above the National Geodetic Vertical Datum of 1929 (NGVD). A major hurricane in 1947 prompted the need for additional flood protection work in Florida. In response, Congress passed the Flood Control Act of 1948 authorizing the first phase of a comprehensive plan for flood protection and other water control benefits in central and south Florida. Major culvert modifications were accomplished in the 1970s, but since then, repairs have been made on an as-needed basis.

In recent years, the dike has experienced a high degree of underseepage and seepage through the levee. Signs of instability such as sand boils and pipings have occurred during recent years, indicating that major renovations for HHD are now necessary, especially along the southeastern portion of the dike. Soil piping is a particular form of subsurface soil erosion associated with levee and dam failure; turbulent flow removes soil starting from the mouth of a seep, and subsoil erosion advances through the levee. The term “sand boil” is used to describe the appearance of the discharging end of an active soil pipe. Severe piping has required several emergency operations to remediate the HHD along the eastern section of Reach 2 and portions of Reach 3 (Figure 1).

Areas of vulnerability in the HHD were published in reports by the Jacksonville District in the late 1990s. Since receiving Congressional approval in 2000 to rehabilitate the HHD, a plan for the rehabilitation was developed for Reach 1, and construction was begun in December 2005.

The plan for Reach 1 was developed well before Hurricane Katrina’s devastating impact on the hurricane protection levees in New Orleans in August 2005. Even though construction had begun, it was concluded by the USACE that the lessons learned in Katrina’s aftermath should be used to ensure that the HHD would continue to protect lakeside communities. Therefore, construction was halted, and an Independent Technical Review (ITR) panel was convened for further evaluation of the design of the project to determine if it was consistent with applicable criteria, regulations and professional standards and practices. After the ITR review, a second level of evaluation was conducted. The plan developed through this process for Reach 1 forms the basis for the rehabilitation of Reaches 2 and 3.

1.2 PROJECT AUTHORITY

The Herbert Hoover Dike is a component of the Central and Southern Florida (C&SF) Project. The Flood Control Act (Act), approved by Congress on 30 June 1948, authorized the first phase of a comprehensive plan to provide flood protection and other water control benefits in central and south Florida. The Act included measures for improving control of Lake Okeechobee by constructing or modifying the spillways and other structures, and enlarging the Lake Okeechobee levees to provide the intended flood protection, water storage and water supply. Levee seepage and stability have a direct effect on the capability of the levee to provide the authorized protection. The authorization for levee repairs and modifications of the Act of 1948 justify the proposed renovation of Reaches 2 and 3 of the HHD. Additional authorization for the C&SF Project occurred through the Flood Control Acts of 1954, 1960, 1965, and 1968; the Water Resources Development Acts of 1986, 1988, 1990, 1992, and 1996; and the River and Harbor Act of 1930.

1.3 PROJECT LOCATION

HHD is an earthen embankment system located along the perimeter of Lake Okeechobee, a large freshwater lake with 724 square-miles of surface area in south Florida. The lake is located about 30 miles west of the Atlantic Ocean and 60 miles east of the Gulf of Mexico (Figure 2). The existing HHD system is approximately 143 miles (230 km) long, and comprises five counties: Glades, Hendry, Martin, Okeechobee, and Palm Beach. It is divided into eight segments or "Reaches" for planning purposes. Two southern segments, Reaches 2 and 3, are the focus of the present study. Reach 2 is 20.42 miles long and extends from the Caloosahatchee River at Moore Haven to the Miami Canal near Lake Harbor. Reach 3 is 6.70 miles long and extends from the Miami Canal to the Hillsboro Canal in Belle Glade (Figure 1). Figure 2 depicts the location of Lake Okeechobee within lower peninsular Florida.

1.4 PROJECT NEED AND OPPORTUNITY

The HHD, constructed largely of local material (e.g., mud, muck, sand, shell fragments) and with porous limestone bedrock underlying the levee, has experienced a high degree of underseepage and seepage through the levee. This seepage resulted in several boils and pipings during 1995, 1998 and 2003 high water events. An unreliable embankment system could allow for a failure of the system to contain lake waters. Such a failure could result in loss of life, property, and habitat. A reasonable and effective rehabilitative effort is required to eliminate this possibility.

1.5 PROJECT PURPOSE

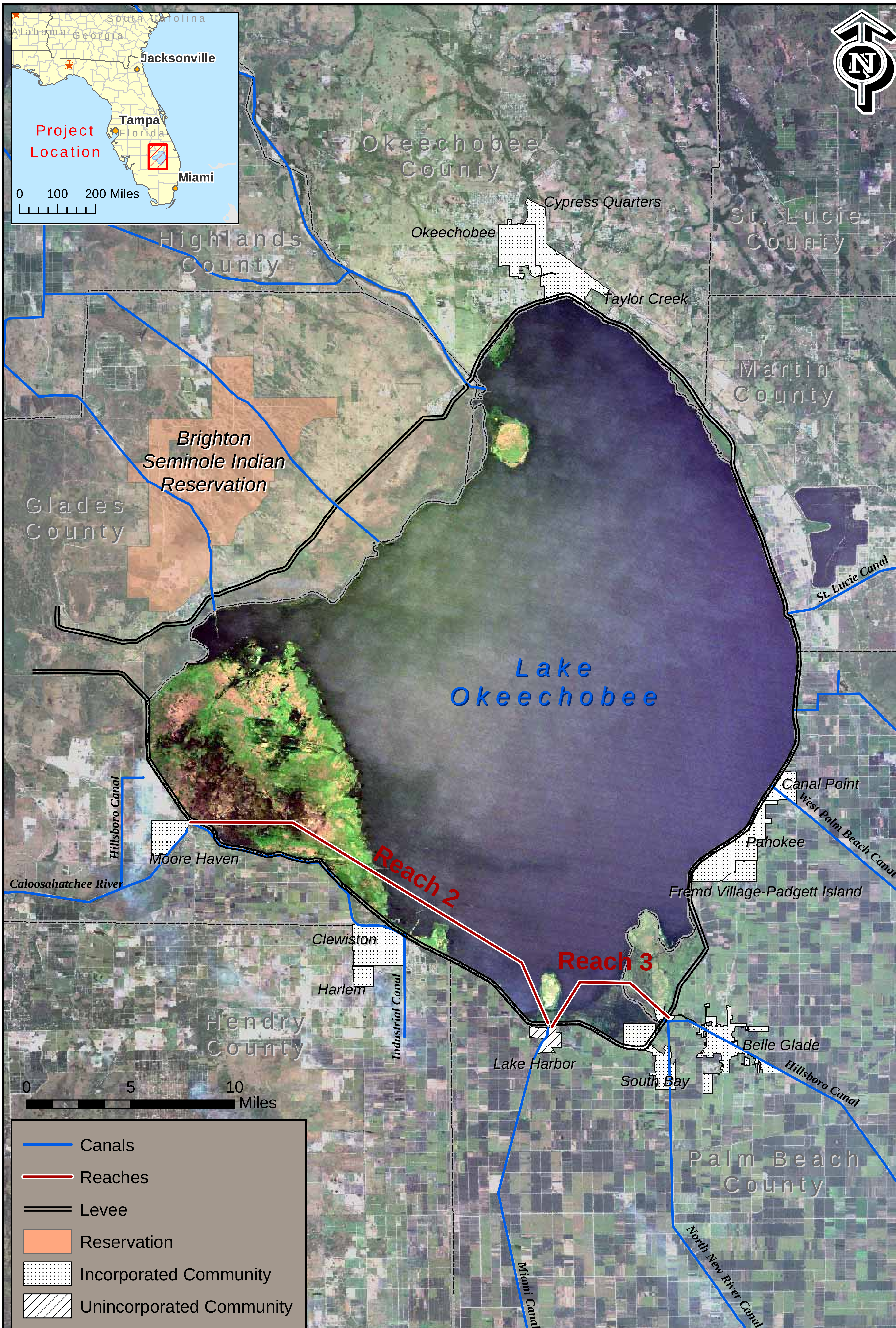
The purpose of this project is to reconstruct and rehabilitate Reaches 2 and 3 of the HHD to prevent a catastrophic failure of the system to retain the waters of Lake Okeechobee. The goal of the USACE is to provide a reliable embankment system around Lake Okeechobee to contain the lake waters for flood protection, water supply, and navigation.

1.6 RELATED PROJECTS AND ENVIRONMENTAL DOCUMENTS

Several previous studies are relevant to the current study.

1.6.1 Herbert Hoover Dike Major Rehabilitation Report (MRR), November 2000

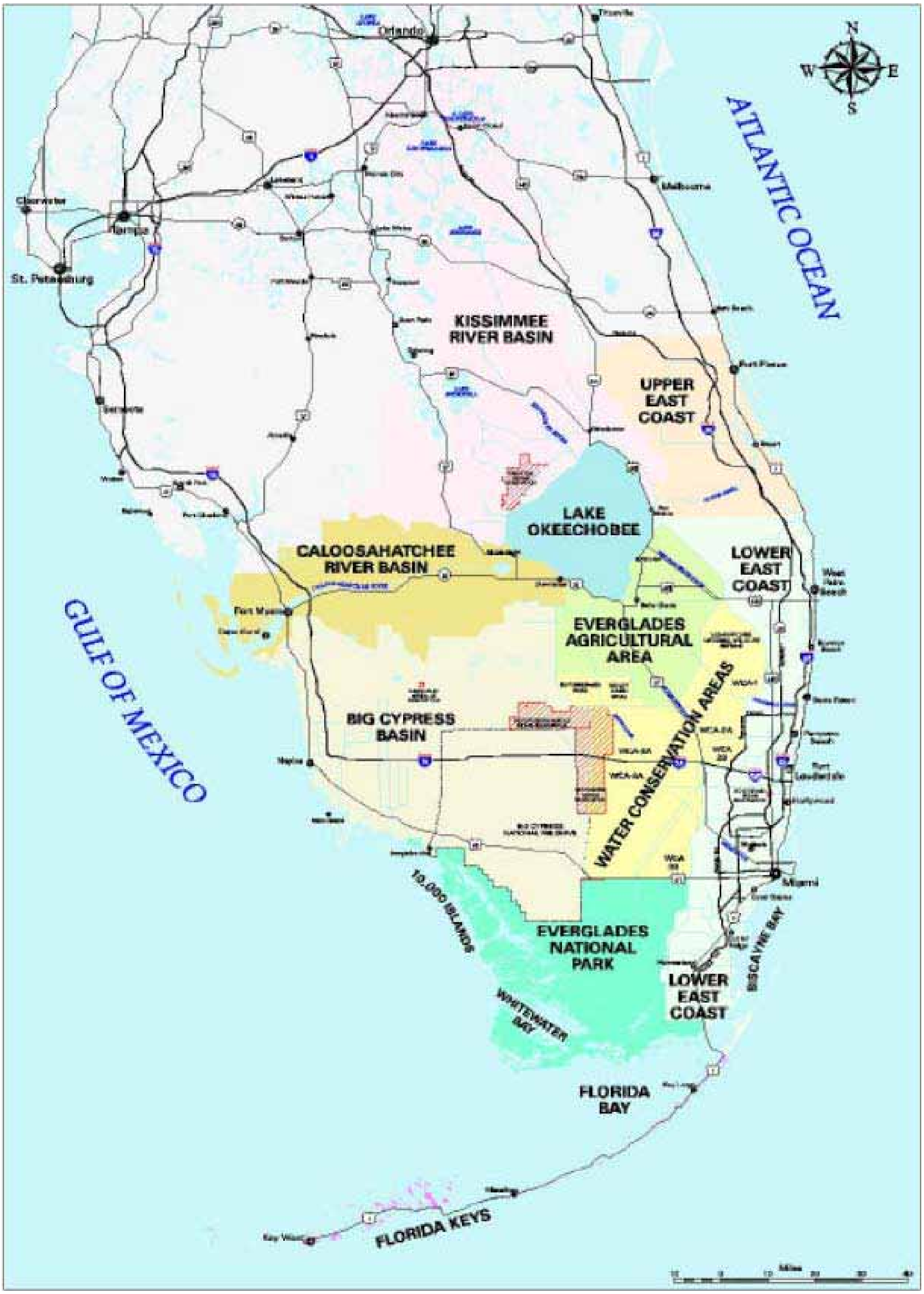
From 1994 to 2000, CESAJ prepared a Major Rehabilitation Evaluation Report (MRR) to quantify the severity of seepage and stability problems along Herbert Hoover Dike. The MRR indicated a very serious risk of dike failure due to piping. This MRR employed a comprehensive approach, with engineering, economic, and environmental analyses performed for the entire Herbert Hoover Dike system. During geotechnical field investigations, more detailed, site-specific information was obtained for the engineering analysis of Reach 1. These analyses



PROJECT LOCATION, REACHES 2 AND 3

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT SATEMENT
REACHES 2 AND 3
HERBERT HOOVER DIKE
MAJOR REHABILITATION EVALUATION REPORT

Figure: 1
Date: November 2006
Scale:1:275,000
Source: USACE
Map Author: D. Shearer



Source: USACE.

Figure 2. Vicinity Map

allowed the USACE to: (a) determine whether or not rehabilitation measures related to seepage and stability problems are warranted; (b) provide economic justification for the rehabilitation measures; (c) address environmental issues related to the proposed rehabilitation; (d) prepare the MRR to serve as a technical supporting document for a comprehensive Project Cooperation Agreement; and (e) allow direct progression into preparation of Plans and Specifications for rehabilitation of Reach 1. The evaluation indicated that rehabilitation efforts were warranted and recommended that a series of additional efforts should be initiated if appropriate funding is available.

1.6.2 Herbert Hoover Dike Major Rehabilitation Report Draft Environmental Impact Statement (MRR DEIS), July 1999

While the MRR 2000 (described above) documented seepage and stability concerns and rehabilitation options for the HHD system, the MRR Draft Environmental Impact Statement (DSEIS) focused specifically on Reach 1. The DSEIS proposed three actions for rehabilitation. The No Action Alternative involved no improvements to the embankment at Reach 1. Alternative No. 1 involved the construction of a stability berm, improvements to existing drainage ditches, and regulation of the water level in the ditch system. Alternative No. 2 proposed the construction of an impervious cutoff wall and landside stability berm. Alternative No. 3, the Preferred Alternative, proposed the installation of a seepage berm with relief trench along the landward toe of the embankment. It was determined that implementation of Alternative No. 3 would cause minimal short-term disturbance to, and displacement of, components of the human and natural environments. These included minimal soil, vegetation, and wetland disruption during excavation and fill activities. Minimal effects to existing water resources, and foraging habitat for wading birds and listed species were expected as well. Implementation of this alternative was expected to improve slope stability and seepage control and reduce the probability of a dike breach within Reach 1.

1.6.3 Herbert Hoover Dike Value Engineering (VE) Study, July 2002

The MRR 2000 (described in Section 1.6.1 above) was approved in November 2000 contingent on revisions to the economic evaluation. To address this need, in 2001 a Value Engineering (VE) study was initiated for the project in order to reduce real-estate costs and minimize the footprint of the project within functional wetlands. The VE study recommended excavating the toe (i.e., the area near the base) of the landward dike and replacing it with a gravel filter, as well as installing a seepage trench similar to the MRR, but lakeward of the toe berm. The existing toe ditch would be used for drainage and conveyance of water, but no regulation of water levels in the ditch would be provided.

1.6.4 Herbert Hoover Dike Major Rehabilitation Report (MRR), Reach 1, Final Environmental Impact Statement (FEIS), July 2005

In 2002 and 2003, emergency repairs to the HHD were undertaken to stop boils occurring in the toe ditch near South Bay. The 2002 VE solution (described above) was implemented over a one-mile stretch in Reach 3. The VE Recommended Plan was unsuccessful due to the effect of additional seepage appearing in the toe ditch and the introduction of water on adjacent private properties. This led the Corps to modify the selected alternative described in the 2000 MRR and 2002 VE and prepare a Draft Supplemental Environmental Impact Statement (DSEIS) to evaluate this new design.

Four actions for reducing the probability of a breach of Reach 1 of the HHD were presented in the FEIS. The No Action Alternative involved making no improvements to the embankment at Reach 1. Alternative No. 1 proposed the construction of a stability berm, improvements to existing drainage ditches, and regulation of the water level in the ditch system. Alternative No. 2 proposed the construction of an impervious cutoff wall and landside stability berm. Alternative No. 3 involved the installation of a seepage berm with relief trench along the landward toe of the embankment. Alternative No. 4, chosen as the preferred alternative, involved a hanging cut-off wall and a relief trench with a French drain system as a toe berm, all within the footprint of the existing HHD. Unlike the other alternatives, this alternative would not significantly impact the resources landward of the existing toe ditch at the HHD's base. In addition, real estate requirements were limited to the HHD's existing footprint.

A Notice of Availability (NOA) was published in the Federal Register on April 1, 2005. The Final Supplement EIS (FEIS) was noticed in the Federal Register on July 8, 2005. A Record of Decision was signed on September 23, 2005.

1.7 DECISION TO BE MADE

This Final EIS will evaluate whether to implement major repairs to improve the structural stability and reduce risks of a breach at Reaches 2 and 3 of the HHD and, if so, evaluate alternatives to accomplish that goal.

1.8 PROJECT PARTNERS

The South Florida Water Management District (SFWMD) is the local, Non-Federal Sponsor for the rehabilitation of HHD. The SFWMD has responsibility for acquiring all lands and easements, rights-of-way, relocations, and dredged material disposal sites required for project implementation. Other agencies participating include the U.S. Fish and Wildlife Service (USFWS) and the Florida Department of Environmental Protection (FDEP).

1.9 NOTICE OF INTENT AND SCOPING LETTER

A Notice of Intent (NOI) to prepare a Second Supplemental Environmental Impact Statement to the Final EIS on Herbert Hoover Dike Major Rehabilitation and Evaluation Report was published in the Federal Register on August 9, 2006 (Appendix E).

A scoping letter was sent on August 10, 2006 to interested federal, state and local agencies, Indian tribes, interested organizations and the public requesting their comments and concerns regarding alternatives for stabilizing Reaches 2 and 3 of the HHD. Comments were received from August 10, 2006 through September 9, 2006 (Appendix E).

1.10 PERMITS

The proposed HHD repairs are subject to Section 402 of the Clean Water Act and would require Water Quality Certification from the FDEP. The FDEP has already issued an exemption for Water Quality Certification for work along Reach 1A. The Section 402(b)(2) NPDES permit will be for construction activities that disturb more than five acres of land. This permit will be acquired prior to the initiation of construction.

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2.0 ALTERNATIVES CONSIDERED

There are two alternatives currently under consideration, including the No Action Alternative and the Recommended Plan. The details of both alternatives as well as the development of the Recommended Plan are presented below.

2.1 NO ACTION ALTERNATIVE

The No Action Alternative is defined as not taking actions or making physical alterations to improve or repair the HHD within Reaches 2 and 3. It would maintain the current condition of the dike. The No Action Alternative would not provide acceptable compliance with current regulation requirements of safety factors relative to dike stability. Without acceptable improvements to Reaches 2 and 3 of the HHD, the safety of the surrounding human and natural environment may be severely impacted with subsequent effects upon the local and regional economies. The continuation of piping and boils occurring in this area would increase the potential for local flooding due to rainfall and runoff. In the event of a total breach, significant impacts to human life, existing soils, vegetation, water resources, habitat, threatened and endangered species, agriculture and property would result. The No Action Alternative does not provide a long-term solution to the seepage and stability problems existing along Reaches 2 and 3.

2.2 ALTERNATIVE ACTIONS

In the evolution of this project, several sets of alternative plans were developed and evaluated to modify, upgrade, and reconstruct the HHD system. This section summarizes the alternative plans and the decisions regarding those alternative plans in the 2000 MRR, 1999 DEIS, and the 2005 FEIS for Reach 1, and subsequent actions taken to develop a Recommended Plan.

2.2.1 2000 MRR and 1999 DEIS

Alternative No. 1. This alternative included increasing the water level in the drainage ditches and the construction of a stability berm at the landside toe of the levee. Culverts with automatic/manual gates and pumps would be installed to control the water level in the ditches. During critical high water periods, the water level in the ditches would be raised to limit the differential head across the levee. Additionally, 3 to 4 feet of peat would be excavated from the landside toe of the levee. Then a 25-foot-wide, 5-foot-deep stability berm would be constructed. The stability berm would allow access to the toe of the embankment and ditches for inspection. This alternative was not selected as the Recommended Plan because it did not provide adequate protection from the seepage and stability problems that threaten critical areas of Reach 1 of the HHD.

Alternative No. 2. Alternative No. 2 involved an impervious cutoff wall and a landside stability berm at the toe of the levee. The cutoff wall would impede groundwater flow. This is the most positive method of underseepage control because it reduces both uplift pressure and through seepage. The wall would consist of a 3-foot-wide, 60-foot-deep excavation filled with soil-bentonite or soil-cement mixture. The top of the wall would be at an approximate elevation of 25 feet. A landside stability berm, as described in Alternative No. 1, would also be constructed. Because of the intensive construction effort, costs, and the effects of the cutoff wall to the local groundwater regime, this action was not selected as the preferred alternative.

Alternative No. 3. Alternative No. 3 included the installation of a seepage berm with a relief trench and a French drain system along the landward toe of the HHD. In areas where the HHD toe rests on a peat layer, construction of the seepage berm would begin with excavation of peat material from the landside toe. No excavation would be performed at higher elevations of the embankment slope. The seepage berm would be constructed along the lower portion of the embankment toe. In areas where a toe ditch now exists, the ditch would be replaced by the proposed seepage berm. The landward side of the berm would contain perforated culvert. A deep relief trench would be excavated immediately below the culvert within the toe ditch and along its entire length. The berm would prevent the piping of sands and silts from the embankment and its foundation. The relief trench would be designed to control uplift pressures and prevent seepage and piping flows from extending landward of the embankment. The perforated culvert system would collect and convey seepage flows to controlled outlets that empty into existing drainage canals. A drainage swale would also be constructed along the landward toe of the berm to collect and convey surface drainage from each side of the drainage berm. Implementation of Alternative No. 3 would improve slope stability and seepage control. Alternative No. 3 was selected as the Recommended Plan in the 2000 MRR

2.2.2 2005 FEIS for Reach 1

The final array of alternative actions evaluated in the 2005 FEIS for Reach 1 were:

Alternative No. 1. Identical to Alternative No. 1 of the 2000 MRR. Again, this alternative was not selected because it would not provide adequate protection from the seepage and stability problems that threaten critical areas of Reach 1 of the HHD.

Alternative No. 2. Identical to Alternative No. 2 of the 2000 MRR. This alternative was again not selected as the Recommended Plan because of the intensive construction effort, costs, and the effects of the cutoff wall to the local groundwater regime.

Alternative No. 3. Identical to Alternative No. 3 of the 2000 MRR, 1999 DEIS. Although this alternative was selected as the Recommended Plan in the 2000 MRR, weaknesses were discovered during an implementation of this alternative on a one-mile stretch of Reach 1. The design demonstrated a lack of ability to control seepages that would resurface on adjacent properties. Therefore, this alternative was not selected as the Recommended Plan for Reach 1.

Alternative No. 4. Alternative No. 4 was selected to be the Recommended Plan for Reach 1. The design included a hanging seepage cutoff wall (a vertically excavated trench filled with a mixture of bentonite and concrete to reduce water seepage through and under the dike) on the landward side of the dike slope and a relief trench with an inverted filter and relief berm at the toe of the landward slope of the dike, terminating at the toe ditch (Figure 3). The cutoff wall would be at an approximate elevation of 26 feet on the HHD slope, with excavation stopping prior to the impervious geologic layer. This would allow groundwater to flow beneath the HHD and underseepage to be collected by the relief trench. The relief trench and inverted filter would be constructed adjacent to the existing toe ditch and within the HHD footprint at the landward toe. An access road would be built on top of the relief trench. The plan is similar to the MRR solution Alternative No. 3, but would not contain a closed culvert system as outlined in the MRR. Further, it utilizes the hanging cut-off wall to prevent piping. The closed culvert system would be replaced with the existing open toe ditch for removal of seepage. Seepage water from the seepage toe berm and relief trench would flow freely into the existing toe ditch. Slight alterations in design were made to accommodate such local structures as a rock quarry and a water filtration plant.

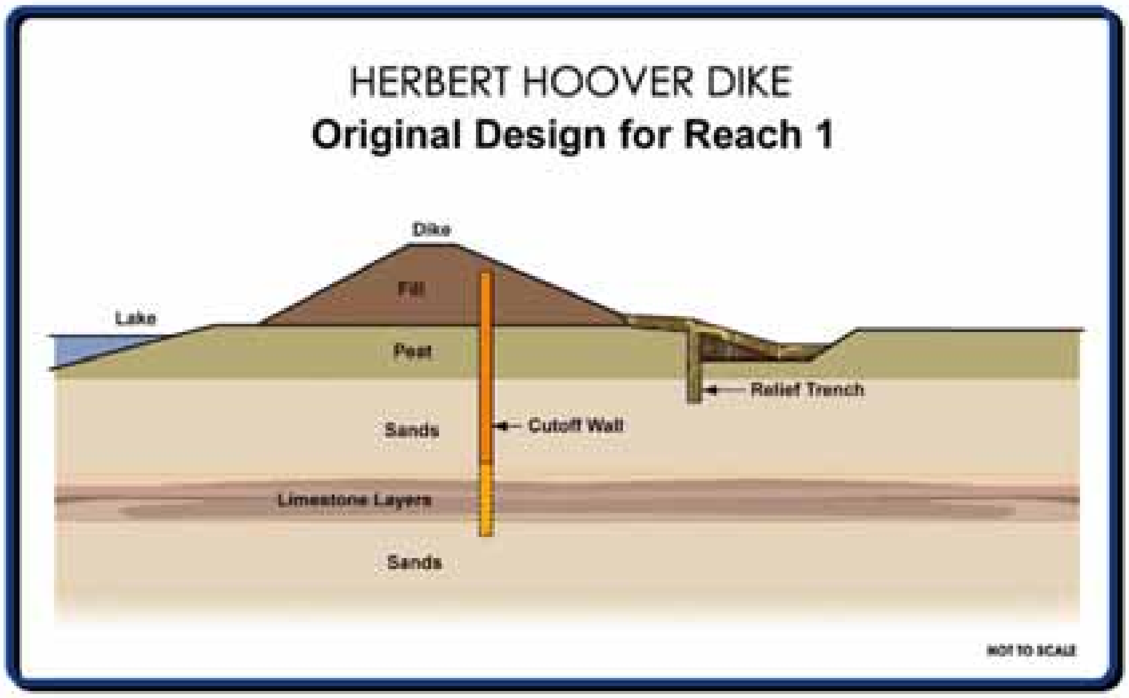

Figure 3. Herbert Hoover Dike, Original Design for Reach 1

2.2.3 Independent Technical Review of the Reach 1 Recommended Plan

The Recommended Plan for Reach 1 was developed well before Hurricane Katrina's devastating impact on the hurricane protection levees in New Orleans in August 2005. Even though construction in Reach 1 was begun in December 2005, it was concluded by the USACE that the lessons learned in Katrina's aftermath should be used to ensure that the HHD would continue to protect lakeside communities. Construction was halted, and an Independent Technical Review (ITR) panel was convened for further evaluation of the design of the project.

The ITR panel included Corps experts from across the nation, as well as participants from the SFWMD. This group evaluated the HHD rehabilitation project design to determine if it was consistent with applicable criteria, regulations and professional standards and practices. After the ITR review, a second level of evaluation was conducted. In early September 2006, the USACE hosted a meeting of about 40 experts to review the ITR findings and to discuss future actions for strengthening the HHD. The new design concept agreed upon by this group included a seepage berm for decreasing piping and a cut off wall for increasing stability (Figure 4). The design approach also incorporated additional protection features, where needed. This design allowed for upgrading, if or when such actions are determined to be necessary.

The plan recommended by the ITR team involved the incorporation of additional property into an expanded seepage berm of the dike system to provide additional stability and reduce piping. The local sponsor, SFWMD, would have the responsibility for acquisition of the additional real estate.

Because real estate acquisition can be a lengthy process, and because the need to improve the HHD system along Reaches 2 and 3 is of high priority, the USACE proposes to proceed with those elements of the ITR plan that can be implemented within the footprint of the existing dikes.

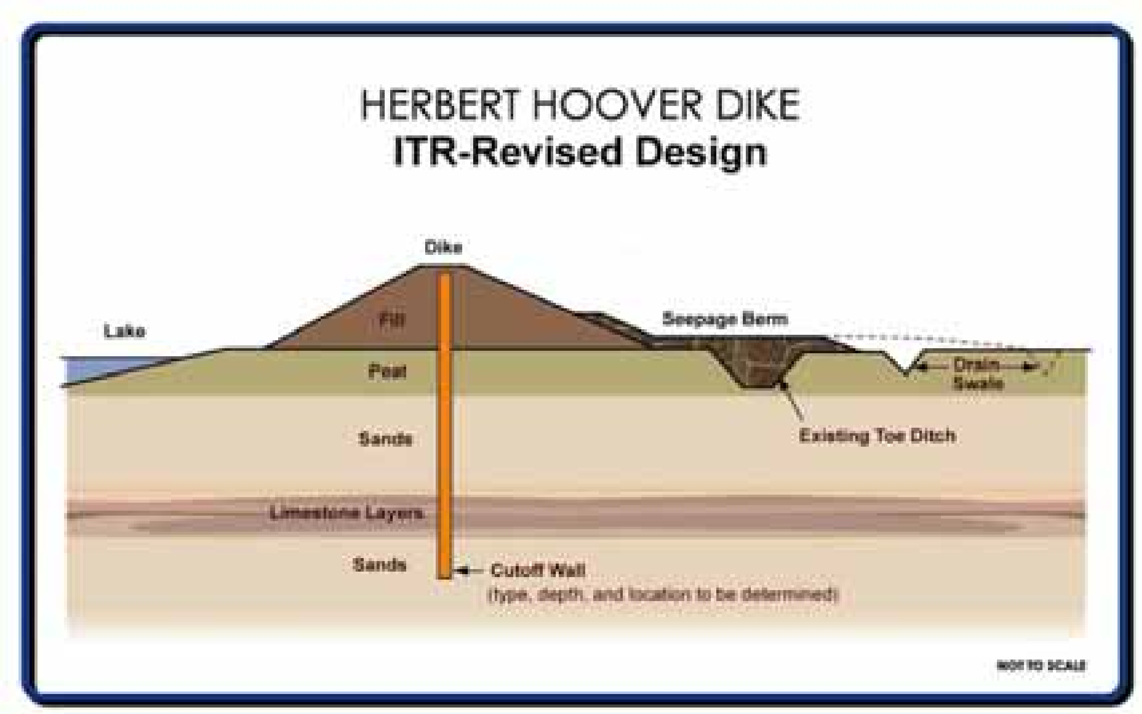

Figure 4. Herbert Hoover Dike, ITR-Revised Design

The plan developed for Reach 1 by the ITR team forms the basis for the Recommended Plan for Reaches 2 and 3.

2.2.4. Recommended Plan

For Reach 3 and the eastern portion of Reach 2, the Recommended Plan includes the construction of a seepage berm that would extend to the far side of the existing toe ditch at the edge of the existing project right-of-way (Figure 5); the toe ditch would be filled. In addition, a seepage cutoff wall would be installed in the center of the dike. For additional details, please see Appendix G.

This design would be modified slightly for the western portion of Reach 2 (Figure 6), where, instead of a toe ditch outside the levee, a borrow canal is present. The western portion of Reach 2 is characterized by a clay layer found approximately 20-40 feet below the surface; such a clay layer is not present at Reach 3 or eastern Reach 2. Tying the cutoff wall in western Reach 2 into the clay layer would result in less seepage than would be allowed by the cutoff wall alone. This would enable construction of a smaller seepage berm than is necessary in Reach 3 or eastern Reach 2. The berm would extend only to the canal edge adjacent to the dike; the borrow canal would not be filled. For additional details, please see Appendix G.

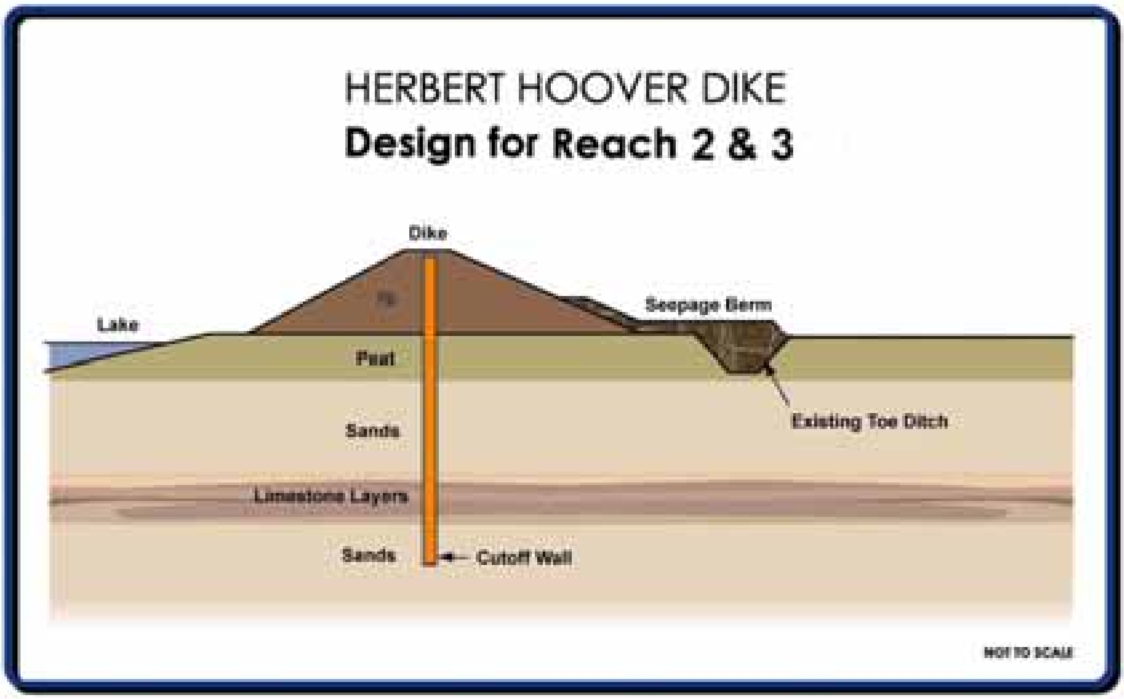

Figure 5. Herbert Hoover Dike, Design for Reaches 2 and 3

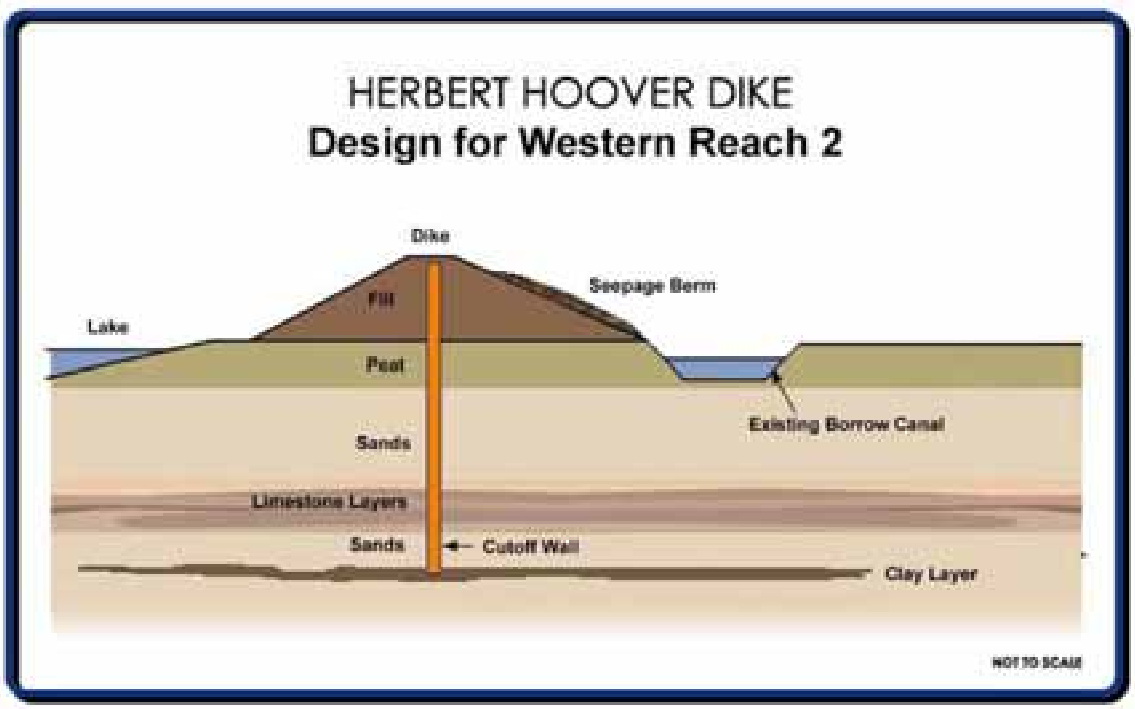

Figure 6. Herbert Hoover Dike, Design for Western Reach 2

2.2.5 Environmental Consequences of the No Action Alternative and Recommended Plan

Table 1. Summary of Environmental Consequences

Resource	No Action Alternative	Recommended Plan
Climate	No Effect	No Effect
Topography	No Effect	No Effect
Geology	No Effect	No Effect
Soils	Potential for displacement of soils nearest dike failure.	No Effect
Prime and Unique Farmlands	No Effect	No Effect
Hydrology	Flooding may affect existing evaporation and recharge regime.	Cutoff wall would affect the principal source of recharge in this area. Impeded groundwater flow would lower water table. Subsurface percolation into permeable sediments would be decreased.
Water Supply	Reduced irrigation water supply at critical times may damage crops.	Cutoff wall could reduce tail-waters, lower water levels in ditches and canals, and reduce irrigation water supply.
Water Quality	Increased sediments and nutrients in surface waters due to flooding.	BMPs during construction will minimize impacts.
Water Management	Flooding would alter management practices.	No Effect
Vegetation	Native vegetation and crops could be damaged by floodwaters.	Filling toe ditch would eliminate wetland plant communities.
Wetlands	No Effect	Filling toe ditch would eliminate wetlands.
Fish and Wildlife	Loss of some wildlife habitat in vicinity of breach.	Habitat provided by toe ditch would be eliminated.
Protected Species	No significant impacts to T& E species expected.	No Effect
Noise	No Effect	Minimal, temporary, and localized effects due to construction activities.
Air Quality	No Effect	Minimal, temporary, and localized effects due to construction activities.
HTRW	No Effect	No Effect
Land Use - Agriculture	Extensive crop damage with flooding.	No Effect
Land Use - Urban Land	Loss property with flooding.	No Effect
Transportation	Flooding may damage roads and railroads.	No Effect
Infrastructure	Flooding may damage electrical and communications networks.	No Effect
Aesthetic Resources	No Effect	Minor short-term impacts to localized areas.
Recreational Resources	No Effect	Temporary/short-term impacts to

Resource	No Action Alternative	Recommended Plan
		park access, bank fishing, bike trail, access to select lake side locations. Moderate impacts to LOST.
Cultural Resources	Potential significant adverse effects in event of dike failure.	Minimal adverse impacts.
Socioeconomics	Flooding may result in loss of property and life.	No adverse consequences expected. Possible beneficial impacts to local economy due to construction.

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3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

The Council on Environmental Quality Regulations requires a description of the affected environment (40 CFR 1502.15):

> *The environmental impact statement shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration.*

This section describes the environment surrounding Reaches 2 and 3 of the HHD and Lake Okeechobee, as it currently exists. The alternative actions are analyzed following each of these conditions in order to determine environmental effects in Section 4.0.

3.2 CLIMATE

Lake Okeechobee is located in a region characterized by a humid subtropical climate. The lake has an area of approximately 720 square miles (1865 square kilometers) with its approximate center near 26° 56′ 55″ north latitude, 80° 56′ 34″ west longitude. Summers are long and warm with frequent afternoon convection storms. Winters are dry and mild with temperatures rarely falling below freezing. Prevailing winds in the area vary from southeast to east-northeast, except during winter when winds are from a northwesterly direction. The annual mean wind speed is 9.4 miles per hour (15 km per hour) (USDA, 1978). The most significant factor affecting the climate of the Lake Okeechobee area is its proximity to large water bodies. Although located on a parallel occupied primarily by arid lands around the world, the maritime effects of the Gulf of Mexico and the Atlantic Ocean on this area result in a significantly modified climate. The lake itself further influences the climate surrounding the lake. Because the lake stays cooler than the surrounding land during warm days and warmer than the land at night, the pressure differences and consequent winds significantly affect the local environment. The cooler lake temperatures during the day have a suppression affect on cloud formation over and near Lake Okeechobee. On remote imagery, the lake often appears as a hole in the cloud cover, sometimes being cloud free when surrounding areas contain significant cloud cover. Consequently, there is generally up to a 30 percent reduction in annual rainfall over and west of the lake compared to surrounding areas (Henry *et al.*, 1994).

3.3 TOPOGRAPHY

The area surrounding Lake Okeechobee can be divided into three physiographic regions: (1) the Western Flatlands to the west and north of the lake which slope gently towards the lake; (2) the Eastern Flatlands to the east of the lake which slope gently towards the lake; and (3) the Everglades Region to the south, southeast, and southwest of the lake that generally slope away from the lake (Klein *et al.*, 1964; Lichtler, 1960). The topography of lands surrounding Lake Okeechobee is flat to gently sloping with an elevation ranging from 10 to 20 ft (3 m to 6 m) NGVD.

Reaches 2 and 3 exist entirely within the Everglades physiographic region with typical surface elevations ranging from 12 to 14 feet (3.6 m to 4.3 m) NGVD. The elevation at the crest of the HHD in Reaches 2 and 3 ranges from 35 to 40 feet.

The mean Lake Okeechobee water surface elevation is 14.5 ft (4.4 m) NGVD, although this level varies from one side of the lake to another depending upon wind speed and direction. Depths of the lake within one mile (1.6 km) of the HHD range from 1 ft (30 cm) to 11 ft (3.4 m) below the mean water level in natural areas, and are approximately 38 ft (11.6 m) below mean water level in the rim canal.

3.4 GEOLOGY

3.4.1 Geology of the Lake Okeechobee Area

Flatlands Regions: In the Western and Eastern Flatlands regions, Pamlico Sand composed primarily of sand and limestone of the Late Pleistocene occurs from 0 to 10 ft (0 m to 3 m) below land surface. The Anastasia Formation occurs below this from 10 ft to 230 ft (3 m to 70 m) below land surface and consists of sand, limestone, and shell beds of the Pleistocene. The layer of material below this is Caloosahatchee Marl, which occurs from 230 ft to 330 ft (70 m to 100 m) below land surface and is made up of shelly sands and shell marl of the Pliocene.

Together, the Anastasia Formation and Caloosahatchee Marl comprise the water table or non-artesian aquifer of this region. Underlying these porous layers, there are a series of formations with lower permeability that act as a confining layer. The uppermost of these layers is the Tamiami Formation, which occurs from 330 ft to 400 ft (100 m to 123 m) below land surface. The Tamiami formation is comprised of marly sand, marl, and shell beds of the Miocene. The Hawthorn Formation occurs from 400 ft to 890 ft (123 m to 271 m) below land surface, and is composed of clayey and sandy marl of the Miocene. The Tampa Formation is located from 890 ft to 940 ft (271 m to 287 m) below land surface and is made up of limestone and some marl of the early Miocene. The Tampa Formation exhibits somewhat higher permeability yielding some artesian water.

The deepest known layers are composed of limestone and yield water under artesian conditions with sufficient pressure to flow to the surface. This principal artesian aquifer (Floridan Aquifer) underlies all of Florida and part of southeast Georgia. The layers of this aquifer are the Suwannee Limestone, Ocala Group, and Avon Park Limestone Formations that date back to the Oligocene, Late Eocene, and Late middle Eocene periods, respectively. While the Suwannee Limestone Formation occurs from 940 ft to 1,000 ft (287 m to 305 m) below land surface, the remaining layers vary from 1,000 ft (940 m) below land surface to undetermined depths.

Everglades Region: In the Everglades region, which surrounds the southern, southwestern, and southeastern perimeter of the lake, the geological formation found at the surface is a thick covering of organic soils. These organic materials started accumulating about 5,000 years ago and range in thickness from 3 ft to 10 ft (1 m to 3 m). The Fort Thompson formation occurs from 8 to 30 ft (2.4 m to 9 m) below land surface, and is composed of marine and fresh-water sands, marls, limestone, and shell beds of the Pleistocene. The organic layer and the Fort Thompson Formation of the Everglades region are found in place of the Pamlico Sand and Anastasia Formations of the flatlands. Below these strata, the series of occurrence, composition, and permeability corresponds between the two regions, differing only in relative depths (Schroeder *et al.*, 1954). Reaches 2 and 3 lie entirely within the Everglades region.

3.4.2 Geology of HHD, Reaches 2 and 3

USACE subsurface borings show that the geology under Reaches 2 and 3 includes a combination of peat, silt, clay, limestone/sandstone, sand, and shell at varying depths. Elevations of the geological layers are referenced to above and below sea level (asl and bsl, respectively).

Reach 2, West: Between the Moorehaven Lock (S-77) and Culvert 1A, subsurface borings taken below the dike show that sand, shell, and clay are most prevalent. Mainly peat, sand and silt occur between 10 and 15 feet (asl). Layers of sand and limestone/sandstone occur between 12 feet (asl) and -28 feet (bsl). According to the borings, large sections of sand, shell and clay occur at varying depths between 10 feet and -25 feet under this section of the dike.

Reach 2, Central: Sand dominates the subsurface geology under the dike between culverts 1A and Clewiston S-310. However, a thin layer of peat and silt dominates the area between 5 and 10 feet (asl). Pockets of limestone/sandstone are prevalent between 12 feet (asl) and -8 feet (bsl). Borings reveal small pockets of shell, clay, and silt at various depths among the sand between 10 feet (asl) and -40 feet (bsl).

Reach 2, East: This section under the dike between Clewiston structure 310 and Lake Harbor Structure 3 is also dominated by sand. However, peat is common between elevations 5 and 15 feet (asl). Layers of limestone/sandstone and silt occur intermittently between elevations 5 and 20 feet (asl) and between -15 and -40 feet (bsl).

Reach 3: Borings show that interspersed layers of sand, limestone/sandstone, and clay are most prevalent between 15 feet (asl) and -40 feet (bsl) under Reach 3. Peat is prevalent between 5 and 15 feet (asl). Small pockets of clay are seen throughout but are not prevalent.

3.5 SOILS

For general descriptive purposes, the soils found in the Lake Okeechobee region are grouped based on distinctive patterns of soils, relief, drainage, and natural landscape. There are three predominant soil groups in areas nearest to the HHD, each representing a distinct group of soil classes. These groups are referred to as (1) Soils of the Flatwoods, (2) Soils of Sloughs and Freshwater Marshes, and (3) Soils of the Everglades.

Soils of the Flatwoods are found at various points around Lake Okeechobee, and are especially predominant in the north. This group is made up of nearly level, poorly drained soils that are sandy throughout, and have organic staining in the subsoil. The Soils of Sloughs and Freshwater Marshes are common throughout the Lake Okeechobee region. These soils are nearly level and very poorly drained. Most are organic with a sandy substratum, and some have a thin organic surface layer and a loamy subsoil underlain by limestone. Soils of the Everglades are nearly level and very poorly drained, and are primarily found along the south, southeastern, and southwestern portions of the lake. This group of soils has a surface layer of muck underlain by limestone.

3.5.1 Soils Adjacent to Reaches 2 and 3

Reaches 2 and 3 occur mainly within the Soils of the Everglades group. According to county soil surveys data from the U.S. Department of Agriculture, Natural Resources Conservation Service, the most common detailed soil units in northern Glades County adjacent to the dike include: Immokalee sand, Lauderhill muck, Plantation muck, and Sanibel muck. Detailed soil units that occur in northern Hendry County adjacent to the dike include: Pahokee muck, Hallandale sand, Margate sand, and Adamsville variant sand. Finally, the detailed soil units adjacent to the dike in Palm Beach County include: Pahokee muck, Terra Ceia muck, and Torry muck. The muck soil units in the project area are poorly to very poorly drained and are in swamps, marshes, and depressions—drained or undrained. The sand soil units are poorly drained soils in broad areas of flatwoods. Slopes are generally less than two percent.

3.5.2 Prime and Unique Farmlands

The Federal Farmland Protection Policy Act was enacted to minimize irreversible conversion of farmland to nonagricultural uses. Under this act, Federal and state agencies develop criteria for classifying soils as "prime" or "unique" for mitigation purposes. No prime or unique farmland soil classes are located in the three counties (Glades, Hendry, and Palm Beach) that span Reaches 2 and 3. "Additional farmlands of statewide and local importance" is the remaining classification of potentially protected farmland. However, the state of Florida has not established criteria for defining and delineating this classification.

3.6 HYDROLOGY

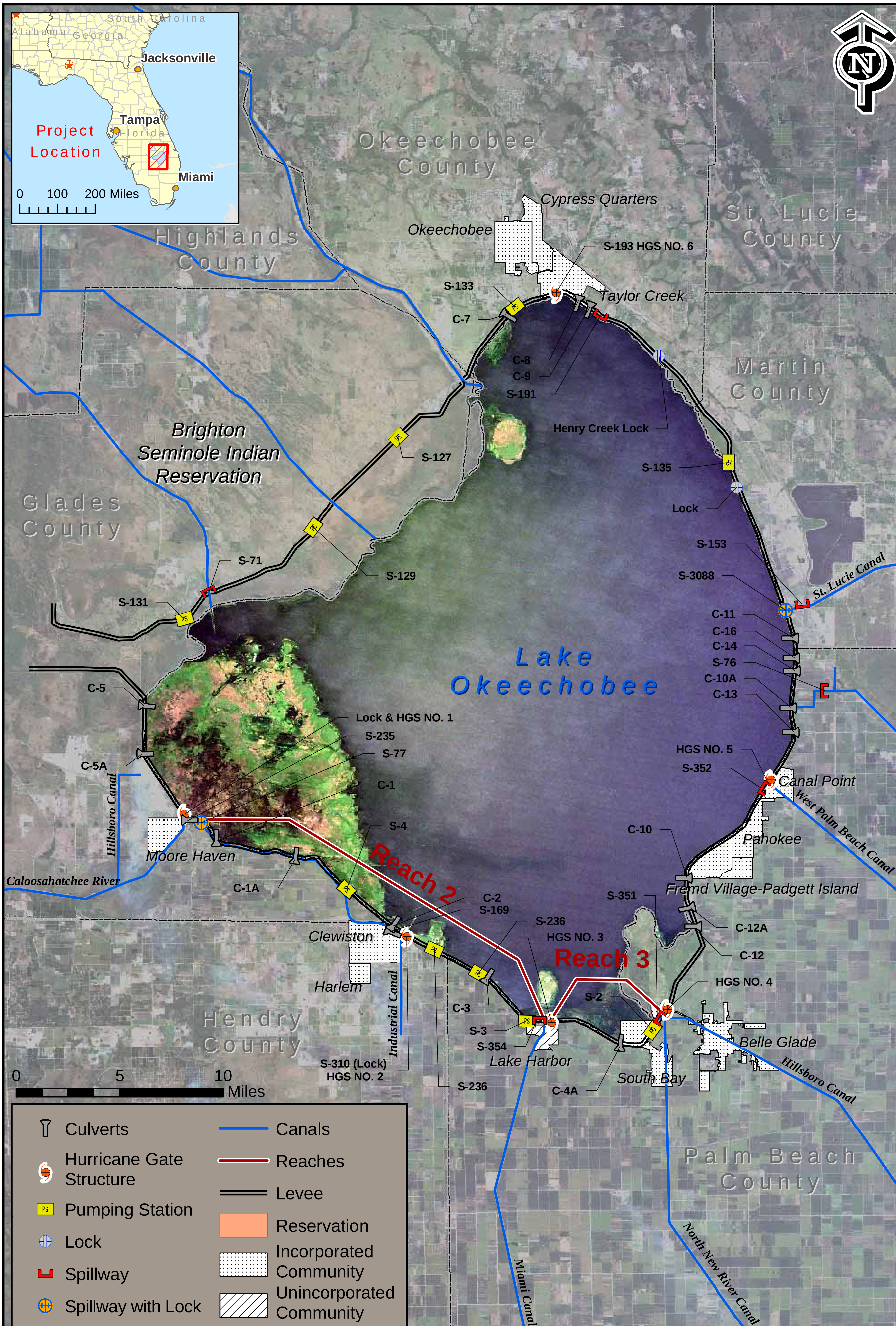
Lake Okeechobee is a major hydrologic feature of south Florida and the Everglades ecosystem. It is also the primary reservoir of the Central and Southern Florida Flood Control Project. Lake Okeechobee receives water principally from rainfall and from the Kissimmee River, which enters the lake from Okeechobee County to the north. Smaller tributaries, including Fisheating Creek, Harney Pond Canal, Indian Prairie Canal, Taylor Creek, and lesser streams from small drainage basins adjacent to the lake contribute as well.

Because of Lake Okeechobee's large surface area, much of the surface water is lost to evaporation each year. Water is also released from the lake through the principal outfall canals including the West Palm Beach, Hillsboro, North New River, Miami, St. Lucie, and Caloosahatchee River canals (Figure 7). The Caloosahatchee River and St. Lucie canals are the primary outlets for release of floodwaters when the lake is above regulation stages (USACE, 1999).

Flow in the major drainage canals is generally from Lake Okeechobee toward the coasts. However, at times the flow in the canals is toward the lake owing to various combinations of concentrated rainfall and drainage pumping from farmlands into the canals. The groundwater throughout the Lake Okeechobee area is usually within 3.28 ft (1 m) of the land surface and extends to about 330 ft (100 m) below land surface. This water table generally parallels the land-surface features. Differences in ground elevations are so slight that the water table is a relatively uniform surface with few undulations.

The principal source of recharge to the groundwater in this area is derived from local rainfall and from subsurface percolation from the canals into the permeable materials. Discharge from this shallow groundwater reservoir is by evaporation from the land or water surfaces, transpiration by plants, seepage into canals, and pumping from shallow wells. The groundwater flow typically follows a north to south gradient.

The major artesian aquifer underlying this region is the Floridan Aquifer, which occurs from about 1,000 ft (300 m) below land surface to bedrock (Schroeder *et al.*, 1954).



CULVERT SYSTEM

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT SATEMENT
REACHES 2 AND 3
HERBERT HOOVER DIKE
MAJOR REHABILITATION EVALUATION REPORT

GEC

Figure: 7
Date: November 2006
Scale:1:275,000
Source: USACE, SFWMD
Map Author: D. Shearer

The major outfall canals along Reaches 2 and 3 include the Caloosahatchee Canal, the Industrial Canal, the Miami Canal, the North New River Canal, and the Hillsboro Canal.

3.7 WATER SUPPLY

The surface and groundwater in the Lake Okeechobee area provide a valuable source of water for public, domestic, industrial, and agricultural use for much of Southeast Florida. Additionally, significant natural areas located in the region receive water from this source as well.

Lake Okeechobee serves as a source of public water supply for Canal Point, Clewiston, Belle Glade, Okeechobee, Pahokee, and South Bay. Local industries such as sugarcane refineries and produce packaging/distribution centers also employ the available groundwater and surface water for their plant operations.

The City of Fort Myers depends upon Lake Okeechobee to ensure the quantity and quality of the supply of drinking water it withdraws from the Caloosahatchee River. Maintenance of minimum flows and levels within the downstream natural system places additional demands on the lake. Urban demands are also expected to steadily increase.

Although the current regulation schedule of Lake Okeechobee was designed primarily to provide drainage, flood control and water supply benefits, the single largest demand on the lake is to provide water for agricultural irrigation. Agricultural activities use the canals and culverts associated with Lake Okeechobee as a source of irrigation water for the many sugarcane and truck crops produced in the region. To the south and east of Lake Okeechobee, the Everglades Agricultural Area (EAA) is one of the most productive farming regions in the country. The EAA relies heavily on water obtained from this resource.

Lake Okeechobee provides water to several natural areas in the region. The Everglades, located south of the lake, receives an essential share of its annual water requirements directly from Lake Okeechobee and canals along its southern portion. To the south and southeast, there are three Water Conservation Areas (WCAs) that receive water from Lake Okeechobee and serve as functional wetlands and municipal water supply. Located in southeast Palm Beach County, WCA-1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge) receives water from the West Palm Beach and Hillsboro Canals that originate from Reach 1 of the HHD. Located in southeast Palm Beach County and northern Broward County, WCA-2 (part of the Everglades Wildlife Management Area), receives water from the Hillsboro and North New River Canals also originating from Reach 1 of the HHD. Located in Broward County, WCA-3 receives water from the Miami Canal, originating from Reach 3 of the HHD west of South Bay (Figure 7).

The WCAs are viable wetland environments that also provide water supply storage for the southeast coast. Additionally, water from WCA-3 is discharged to the sloughs and wetlands of Everglades National Park (Fernald and Patton, 1984).

Water released from two of the major outfall canals provides inflow to coastal estuarine ecosystems. The Caloosahatchee (C-43) Canal feeds the Caloosahatchee River Estuary on Florida’s west coast, providing an important source of potable water for Lee County and the City of Fort Meyers. The St. Lucie Canal feeds the estuaries associated with the St. Lucie Inlet on the east coast.

3.8 WATER QUALITY

The Clean Water Act requires that surface waters of each state be classified according to designated uses. Florida has five classes with associated designated uses, which are arranged by the degree of protection required. Lake Okeechobee has been designated by the Florida Department of Environmental Protection (FDEP) to have the designated uses of Class I – Potable Water Supplies and Class III – Recreation, Propagation and Maintenance of a Healthy, Well-balanced Population of Fish and Wildlife.

Lake Okeechobee is considered a naturally eutrophic water body that is tending to become hypereutrophic, due primarily to nutrient inputs from the Kissimmee River and the Taylor Creek basins. Water quality conditions in the upper Kissimmee River appear to be improving, primarily due to re-routing of wastewater flows from the river to reuse and groundwater discharge sites. However, large quantities of nutrients are still discharged from Lake Toho to Lake Kissimmee and other downstream areas. Water quality improves from Lake Kissimmee near Lake Okeechobee, where the channel flows mostly through unimproved rangeland. Unfortunately, pollutant loadings increase as cattle and dairies grow more numerous near the lake. The lake's phosphorus is internally recycled, and a vast reservoir of the nutrient is stored in the lake sediments as well as in wetland and canal sediments. Because of this, phosphorus within the lake may not reach acceptable levels for many decades or even a century.

Widespread algal blooms and resulting fish kills have launched the environmental community and governmental agencies to investigate and analyze the lake's problems. The Lake Okeechobee Technical Advisory Committee, formed to assess the situation and recommend solutions, determined that phosphorus from dairies and agriculture was a major cause of the noxious algal blooms and that levels should be reduced by 40 percent. A few others contended that the secondary cause of increased phosphorus is the flooding of hundreds of acres of perimeter wetlands after the SFWMD decided in the late 1970s to raise the lake's water level. The higher level also reduced valuable fish-spawning grounds and waterfowl feeding and nesting habitat (USACE, 2006).

In general, the water quality trends for the lake are stable at six sites, improved at two sites, and degraded at two sites. The best water quality observations were noted for the flow entering Fisheating Creek and along the west near wetlands, while the worst water quality conditions occurred in the south near agricultural areas, and to the northeast by Taylor Creek, Nubbin Slough and the St. Lucie Canal. The reported major pollution sources in this basin were dairies and agriculture. A generalized assessment of the lake shows it as having fair water quality conditions, except for Myrtle Slough, which was shown to have poor water quality, and the extreme south-southwest section of the lake where good water quality conditions are described by the 305(b) report (FDEP, 1996).

3.9 WATER MANAGEMENT

3.9.1 Operations

As explained above, Lake Okeechobee benefits south Florida by storing large volumes of water during wet periods for subsequent environmental, urban and agricultural needs during dry periods. However, extended periods of high water levels in the lake have been identified as causing stress to the lake’s littoral zone. In addition, south Florida’s potential for heavy rains and hurricanes requires that water levels in the lake be carefully monitored to ensure that they do not rise to levels that would threaten the structural integrity of the HHD. For these reasons, when water levels in the lake reach certain elevations designated by the regulation schedule, discharges are made through the major outlets to control excessive buildup of water in the lake. The timing and magnitude of these releases is not only important for preserving the flood protection of the region, but also for protecting natural habitats of downstream estuaries and the Everglades.

The Corps is ultimately responsible for prescribing regulations and key operating criteria for the lake. The current regulation is called the Water Supply and Environment (WSE) schedule. It was adopted as the official regulation schedule in July 2000 after an extensive multi-agency and multi-objective evaluation process led to a Record of Decision (ROD) signed in July 2000. The first releases made under WSE occurred in July 2002. In the relatively short four-year period since releases began under WSE, the schedule demonstrated improved performance although weaknesses became evident. Specifically, water releases under the WSE regulation schedule were too limited for the lake's littoral zone and estuaries (USACE, 2006).

In answer to this, the Corps initiated a multi-phase effort to improve the Lake Okeechobee regulation schedule (LORS). The first phase of testing and implementation began in 2004. Phase two of the multi-phase effort to improve the regulation schedule is currently underway.

3.9.2 Structures

The Caloosahatchee River (C-43) and the St. Lucie Canal (C-44) are the primary outlets for release of floodwater when the lake is above regulation stages. Additionally, a series of structures situated around Lake Okeechobee provides flood protection, controls drainage, and facilitates navigation (Figure 7). The Corps operates the primary structures and navigation locks around the lake and is responsible for maintenance of the schedule. The SFWMD operates and maintains the secondary water control structures and pump stations.

Along Reaches 2 and 3, there are five gated culverts, four hurricane gate structures at the Caloosahatchee, Industrial, Miami, and the Hillsboro canals, and a lock at both the Caloosahatchee and Miami canals (Figure 7). Along Reach 3, there is one gated culvert and one hurricane gate structure. Control of waters from these structures is primarily the responsibility of the Corps and SFWMD.

Because the area surrounding Reaches 2 and 3 has little natural drainage, it depends on large pump stations to prevent flooding during periods of heavy rain. Excess water is pumped from the EAA into Lake Okeechobee during wet months, and water is released from the lake for irrigation during the dry growing season (Fernald and Patton, 1984).

3.10 VEGETATION AND COVER TYPES

The vegetation and cover types within the Lake Okeechobee region have been greatly altered during the last century. Historically, the natural vegetation was a mix of freshwater marshes, hardwood swamps, cypress swamps, and pine flatwoods. The freshwater marshes were the predominant cover type throughout, but especially along the southern portion of the lake where it flowed into the Everglades. These marshes were vegetated primarily with sawgrass *(Cladium jamaicense)* and scattered clumps of Carolina willow *(Salix caroliniana)*, sweetbay *(Magnolia virginiana),* and cypress *(Taxodium* spp.*)*. Hardwood swamps dominated by red maple *(Acer rubrum)*, sweetbay, and sweet gum *(Liquidambar styraciflua)* occurred in riverine areas feeding the lake, while cypress swamps composed mostly of cypress were found in depressional areas throughout the region. Pine flatwoods composed of slash pine *(Pinus elliottii)*, cabbage palm

(Sabal palmetto), and saw palmetto *(Serenoa repens)* were prevalent in upland areas especially to the north. Although some of these natural areas still exist, the introduction of controlled drainage for agriculture and land development has resulted in a significantly different set of cover types.

There is an abundance of exotic and nuisance vegetation along Reaches 2 and 3. The exotic invasive plants, melaleuca **(***Melaleuca quinquenervia***)**, Australian pine (*Casuarina* sp.)**,** and Brazilian pepper (*Schinus terebinthifolius)* are found throughout the area. In the toe ditch and the network of canals, nuisance vegetation exists, including species such as water hyacinth *(Eichhornia crassipes)* water lettuce *(Pistia stratiotes)*, hydrilla *(Hydrilla verticillata)*, cattails *(Typha sp.)*, and bamboo *(Arundinaria sp.)*.

3.10.1 Landward of HHD

Landward of the entire HHD, sugarcane plantations, improved pasture, row crops, and urban lands now prevail. The HHD itself is covered with mixed grasses that are mowed on a regular basis.

3.10.2 Waterward of HHD

The major cover types on the waterward side of Reaches 2 and 3 include open water and freshwater marshes. A 98,000-acre (154-square-mile) littoral zone is found along the Lake's western edge and on the islands in its southern shore (Kraemer Island, Torry Island and Ritta Island, which together encompass 4,000 acres). The littoral zone supports more than 50 species of emergent, submerged, and floating-leaf plants. Some of the better-known species from this region include: spikerush (*Eleocharis cellulosa*), panic grass (*Panicum* spp.), cattail (*Typha* spp.), willow (*Salix* spp.), torpedograss (*Panicum repens*), water lily (*Nelumbo* spp.), and sand cordgrass (*Spartina bakeri*) (Lake Okeechobee.org, 2006).

Anecdotal information suggests that prior to settlement, Torry and Kreamer Islands were covered by dense stands of pond apple (*Anona glabra)* and the endangered Okeechobee gourd (*Cucurbita okeechobeensis*). All three islands were settled in the early 1900s and were cleared, ditched and bermed to produce cropland. By the mid-1970s, all farming operations had been abandoned (O'Dell and Sharfstein, 2005). The Florida Fish and Wildlife Conservation Commission (FFWCC) and the South Florida Water Management District (SFWMD) recently completed a habitat enhancement project on Ritta Island through the removal of perimeter levees, ditches and abandoned concrete water control structures that impeded the natural hydrology of the islands. Since completion of the restoration project, a variety of wading birds have been sighted on the northern portion of the island and the removal of arrowroot (*Maranta arundinacea*) is expected to allow for colonization by eelgrass *(Vallisneria americana)* and native pondweed *(Potamogeton illinoensis* (O'Dell *et al.*, 2005).

3.11 WETLANDS

Wetlands in the Lake Okeechobee area, though greatly reduced in quality through human impact, still exist as valuable ecosystems both landward and waterward of the HHD. Lake Okeechobee hydraulically feeds wetlands beyond the dike, providing freshwater for the Florida Everglades to the south and for Water Conservation Areas in Palm Beach and Broward Counties.

3.11.1 Landward of Reaches 2 and 3

On November 7 and 8, 2006, an interagency team of biologists from U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), and U.S. Environmental Protection Agency (USEPA) used the Uniform Mitigation Assessment Method (UMAM) to evaluate the quality of wetlands potentially affected by the Recommended Plan. The UMAM is a standardized procedure for assessing the functions provided by wetlands and other surface waters, the amount that those functions are reduced by a proposed impact, and the amount of mitigation necessary to offset that loss. A full explanation of the UMAM procedure as provided by the Florida Administrative Code, Chapter 62-345 is in Appendix F.

The first step in the UMAM process is to determine the assessment area(s). As defined in F.A.C. 62-345.200, an assessment area is all or part of a wetland or surface water impact site, or a mitigation site that is sufficiently homogeneous in character, impact, or mitigation benefits to be assessed as a single unit. The overall area of potential impact was defined as land within 150 feet landward of the toe of the dike in Reach 3 and eastern Reach 2. A total of 229.5 acres were assessed. Western Reach 2 between S77 and S4 was not assessed because the toe of the dike borders a borrow ditch that will not be affected during project construction. Additionally, John Stretch Park was not assessed because no wetlands are present. The remaining portions of Reaches 2 and 3 were divided into assessment areas of similar conditions. Reach 2 was separated into five areas:

1. Reach 2 - West;
2. Reach 2 - East 1;
3. Reach 2 - East 2;
4. Reach 2 - East 3; and
5. Reach 2 - East 4.

Reach 3 was divided into four areas:

1. Reach 3 - John Stretch Park, East 1;
2. Reach 3 - John Stretch Park, East 2;
3. Reach 3 - Southbay West; and
4. Reach 3 - Southbay.

No jurisdictional determination was performed prior to the UMAM assessment. Therefore, the assessment acreage potentially includes non-wet areas. Where US 27 is located within the 150-foot assessment area, the roadway was deleted from the assessment acreage by calculating the area as that between the toe of dike and the edge of pavement.

The UMAM scores three wetland parameters: (1) location and landscape support; (2) water environment; and (3) community structure for vegetation and/or benthic communities. The parameters are scored on a scale of one to 10, with one being “not present” and 10 being “optimal.” For the current condition, scores ranged from one to six for all three parameters. Therefore, the wetlands are of low to moderate quality.

According to the UMAM, the dominant plant species for the entire assessment area include melaleuca (*Melaleuca quinquenervia*), Brazilian pepper (*Schinus terebinthifolius)*, Australian pine (*Casuarina equisetifolia*), leather fern (*Acrostichum danaeifolium*), cattails (*Typha* sp.), duck potato (*Sagittaria* sp.), primrose willow (*Ludwigia peruviana)*, common reed (*Phragmites australis)*, giant foxtail (*Setaria magna*), sawgrass (*Cladium jamaicense*), water-lettuce (*Pistia* *stratiotes*), and royal palm (*Roystonea elata*). For a thorough explanation of the UMAM procedure and a complete list of species, refer to Appendix F.

3.11.2 Waterward of Reaches 2 and 3

Waterward of Reaches 2 and 3 are large freshwater marshes in the shallow littoral zones of the lake. See Section 3.10.2 for an explanation of the dominant plant types in these areas.

3.12 FISH AND WILDLIFE

The Corps conducted a two-year study within the littoral zone of the lake to collect baseline wildlife data from May 1997 to November 1998 (USACE, 1999b). Much of the data for this section is based on the findings of that study combined with previous wildlife findings integrated in the 1999 report.

The area around Lake Okeechobee includes a wide variety of habitats for wildlife, including wading and migratory birds, many mammals, amphibians, and reptiles, as well as prey species such as crayfish, prawns, apple snails, and aquatic insects. The U.S. Fish and Wildlife Service (USFWS) has designated two species of mammals, 11 species of birds, and seven species of reptiles in Glades, Hendry, and Palm Beach counties as threatened or endangered. There are also two state-listed mammal species present in the counties, including the mangrove red fox and the Florida black bear, which are not on the federal list (Section 3.10). Table 2 lists fish and wildlife species typical of Lake Okeechobee.

3.13 THREATENED AND ENDANGERED SPECIES

Table 3 lists species with threatened or endangered legal status for Glades, Hendry, and Palm Beach counties. The state lists two mammals that are not listed federally—the Florida black bear and the mangrove fox squirrel. The state also lists a variety of plants and lichens not given endangered or threatened status on a federal level.

3.13.1 American Alligator

The American alligator's range extends across the southeastern states of Alabama, Arkansas, North and South Carolina, Florida, Georgia, Louisiana, Mississippi, Oklahoma, and Texas (University of Florida, 1998). This reptile's primary habitat includes freshwater swamps and marshes, but it is also seen in rivers, lakes and smaller bodies of water. Alligators have been shown to be an important part of their ecosystem, and are thus regarded by many as a "keystone" species. This encompasses many areas from control of prey species to the creation of peat through their nesting activities (University of Florida, 1998). Populations of the American alligator were severely affected in the early parts of this century, due to hunting of the animal for its skin. In 1967, this species was listed as an endangered species that prohibited alligator hunting. As a result, the alligator has undergone a successful recovery. Alligator hunting is allowed again; however, permits are issued by lottery only during alligator hunting season. The alligator is classified by USFWS as "Similarity of Appearance to a Threatened Taxon." The species to which it is similar is the American crocodile (*Crocodylus acutus)*, an endangered species.

Table 2. Fish and Wildlife Species of the Lake Okeechobee Littoral Zone

Amphibians and Reptiles
American alligator (*Alligator mississippiensis*)
Florida green water snake (*Nerodia floridana*)
Greater Siren (*Siren lacertina*)
Pig frog (*Rana grylio*)
Soft-shelled turtle (*Apalone ferox*)
Southern leopard frog (*Rana utricularia*)
Two-toed amphiuma (*Amphiuma means*)
Birds
Common gallinule (*Gallinula chloropus*)
Great blue heron (*Ardea herodias*)
Great egret (*Casmerodius albus*)
Little blue heron *(Egretta caerulea)*
Pied-billed grebe (*Podilymbus podiceps*)
Snail kite (*Rostrhamus sociabilis*)
Snowy egret (*Egretta thula*)
Tricolor heron (*E. tricolor*)
White ibis (*Eudocimus albus*
Wood stork (*Mycteria americana*)
Mammals
Bobcats (*Felis reufus*)
Florida water rat (*Neofiber alleni*)
River otters (*Lutra canadensis*)
West Indian manatee (*Trichechus manatus latirostris*)
Fish
Bluegill (*Lepomis macrochirus*)
Florida flagfish (*Jordanella floridae*)
Golden topminnow (*Fundulus chrysotus*)
Largemouth bass (*Micropterus salmoides*)
Least killifish (*Heterandria formosa*)
Redear sunfish (*L. microlophus*)
Macroinvertebrates
Apple snail (*Pomacea paludosa*)
Crayfish (*Procambarus* spp.)
Dystiscid beetles (*Dytiscidae*)
Grass shrimp (*Palaemonetes paludosus*)

Table 3. Listed Plant and Animal Species Occurring in Glades, Hendry and Palm Beach Counties, Florida

Common Name	Scientific Name	Federal Status	State Status
Reptiles			
American alligator	*Alligator mississippiensis*	SAT*	Not Listed
American crocodile	*Crocodylus acutus*	Endangered	Endangered
Eastern indigo snake	*Drymarchon couperi*	Threatened	Threatened
Green turtle	*Chelonia mydas*	Endangered	Endangered
Hawksbill	*Eretmochelys imbricate*	Endangered	Endangered
Kemp's ridley	*Lepidochelys kempii*	Endangered	Endangered
Leatherback	*Dermochelys coriacea*	Endangered	Endangered
Loggerhead	*Caretta caretta*	Threatened	Threatened
Birds			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
Crested caracara	*Caracara cheriway*	Threatened	Threatened
Florida grasshopper sparrow	*Ammodramus savannarum floridanus*	Endangered	Endangered
Florida sandhill crane	*Grus Canadensis pratensis*	Threatened	Threatened
Florida scrub jay	*Aphelocoma coerulescens*	Threatened	Threatened
Least tern	*Sterna antillarum*	Threatened	Threatened
Peregrine falcon	*Falco peregrinus*	Endangered	Endangered
Piping plover	*Charadrius melodus*	Threatened	Threatened
Snail kite	*Rostrhamus sociabilis plumbeus*	Endangered	Endangered
Southeastern American kestrel	*Falco sparverius paulus*	Threatened	Threatened
Wood stork	*Mycteria americana*	Threatened	Threatened
Mammals			
Florida black bear	*Ursus americanus floridanus*	Not Listed	Threatened
Florida panther	*Puma concolor coryi*	Endangered	Endangered
Manatee	*Trichechus manatus*	Endangered	Endangered
Mangrove fox squirrel	*Sciurus niger avicennia*	Not Listed	Threatened
Plants and Lichens			
Atlantic Coast Florida lantana	*Lantana depressa var. floridana*	Not Listed	Endangered
Bahama brake	*Pteris bahamensis*	Not Listed	Threatened
Banded wild-pine	*Tillandsia flexuosa*	Not Listed	Threatened
Beach jacquemontia	*Jacquemontia reclinata*	Endangered	Endangered
Burrowing four-o'clock	*Okenia hypogaea*	Not Listed	Endangered
Carter's large-flowered flax	*Linum carteri var. smallii*	Not Listed	Endangered
Celestial lily	*Nemastylis floridana*	Not Listed	Endangered
Coastal hoary-pea	*Tephrosia angustissima* var. *cutissii*	Not Listed	Endangered
Coastal vervain	*Glandularia maritima*	Not Listed	Endangered
Cutthroat grass	*Panicum abscissum*	Not Listed	Endangered
Dancing-lady orchid	*Tolumnia bahamensis*	Not Listed	Endangered
Edison's ascyrum	*Hypericum edisonianum*	Not Listed	Endangered
Fahkahatchee ladies' tresses	*Sacoila lanceolata* var. *paludicola*	Not Listed	Threatened
Four-petal pawpaw	*Asimina tetramera*	Endangered	Endangered
Giant orchid	*Pteroglassaspis ecristata*	Not Listed	Threatened
Golden leather fern	*Acrostichum aureum*	Not Listed	Threatened
Gulf Coast Florida lantana	*Lantana depressa* var.*sanibelensis*	Not Listed	Endangered

Common Name	Scientific Name	Federal Status	State Status
Hand fern	*Ophioglossum palmatum*	Not Listed	Endangered
Johnson's seagrass	*Halophila johnsonii*	Endangered	Not Listed
Large-flowered rosemary	*Conradina grandiflora*	Not Listed	Threatened
Many-flowered grasspink	*Calopogon multiflorus*	Not Listed	Endangered
Nodding pinweed	*Lechea cernua*	Not Listed	Threatened
Okeechobee gourd	*Cucurbita okeechobeensis*	Endangered	Endangered
Perforate reindeer lichen	*Cladonia perforata*	Endangered	Endangered
Pine pinweed	*Lechea divaricata*	Not Listed	Endangered
Ray fern	*Schizaea pennula*	Not Listed	Endangered
Sand-dune spurge	*Chamaesyce cumulicola*	Not Listed	Endangered
Sea lavender	*Argusia gnaphalodes*	Not Listed	Threatened
Silver palm	*Coccothrinax argentata*	Not Listed	Threatened
Tiny polygala	*Polygala smallii*	Endangered	Endangered
Toothed maiden fern	*Thelypteris serrata*	Not Listed	Endangered

* The American Alligator is currently designated as *Similarity of Appearance to a Threatened Taxon.*

Source: USFWS; Florida Natural Area Inventory, 2006.

3.13.2 Eastern Indigo Snake

The Eastern indigo snake has been classified as a threatened species by the USFWS since 1978 and by the FFWCC since 1971. It is the largest nonvenomous snake in North America. It is an isolated subspecies occurring in southeastern Georgia and throughout peninsular Florida. The eastern indigo prefers drier habitats, but it may be found in a variety of habitats from xeric sand hills, to cabbage palm hammocks, to hydric hardwood hammocks (Schaefer and Junkin, 1990). Indigos need relatively large areas of undeveloped land to maintain population. The main reason for its decline is habitat loss to development. Further, as habitats become fragmented by roads, indigos become increasingly vulnerable to highway mortality as they travel through their large territories (Schaefer and Junkin, 1990).

The range of the eastern indigo snake historically extended from South Carolina through Georgia and Florida to the Keys, and west to southern Alabama and Mississippi. The snake is now known to occur only in Florida and the Coastal Plain of southern Georgia. Overall, indigo snake populations are declining in abundance and distribution primarily because of habitat loss, conversion, and degradation. In southern Florida, the snake can be found in a variety of habitats, including wet prairies and mangrove swamps. In the more northern latitudes in winter it is found almost exclusively in sandy habitats typical of the Florida scrub communities, typically in association with gopher tortoises. From spring to fall, they can also be found in pine-hardwood forest, mixed hardwood forest, creek bottoms, and agricultural fields (USFWS, 1999; Hallam *et al*., 1998).

3.13.3 Bald Eagle

The bald eagle is the only eagle unique to North America. It ranges over most of the continent, from the northern reaches of Alaska and Canada down to northern Mexico. The bald eagle occurs in various habitats near lakes, large rivers and coastlines. In general, they need an environment of quiet isolation; tall, mature trees; clean waters; and prefer nesting within one-half mile (0.8 km) of water (USFWS, July 1995). The bald eagle population was decimated in the 19th and early

20th centuries by habitat destruction, hunting, pesticide use and lead poisoning. In 1967, bald eagles were officially declared an endangered species. Due to this and other protective measures, the population has made a comeback, its populations greatly improving in numbers, productivity, and security in recent years. Its strongest populations are currently found in Alaska and Florida (USFWS, July 1995). The bald eagle is currently listed as a threatened species by both the USFWS and FFWCC.

3.13.4 Wood Stork

Wood storks are listed as an endangered species by both the USFWS and FFWCC. It is the only stork occurring in the United States. In the U.S., the wood stork's range includes Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina, and Texas. The only states in which this bird is known to nest, however, are Florida, Georgia and South Carolina (Mazzotti, 1990). Wood storks are wetland dwellers and use fresh, brackish and saltwater habitats for feeding and nesting. Feeding takes place in shallow ponds, tidal pools, swamps and marshes. Nesting occurs in cypress, hardwood and mangrove swamps. The extreme dependence of the wood stork on naturally functioning wetlands makes it an excellent indicator of the health of wetland ecosystems (Mazzotti, 1990).

Until the last few decades, the wood stork was a common sight in Florida wetlands. However, between the 1930s and 1960s, there was a serious decline in this species. One reason for the decline in population has been the changes in the hydrologic regime of the Everglades, which affected its foraging habitat and food production (Mazzotti, 1990).

3.13.5 Everglade Snail Kite

The Everglade snail kite is currently listed as an endangered species by both the USFWS and FFWCC. Although previously located in freshwater marshes over a considerable area of peninsular Florida, the range of the snail kite is now limited to several impoundments on the headwaters of the St. John’s River; the southwest side of Lake Okeechobee; the eastern and southern portions of WCAs 1, 2A and 3; the southern portion of WCA 2B; the western edge of WCA 3B; and the northern portion of Everglades National Park (USFWS, May 1996).

The kite inhabits relatively open freshwater marshes that support adequate populations of apple snail, upon which this bird feeds almost exclusively. Favorable areas consist of extensive shallow, open water such as sloughs and flats, vegetated by sawgrass and spikerush (*Eleocharis* spp). The areas are often interspersed with tree islands or small groups of scattered shrubs and trees, which serve as perching and nesting sites. The water level must be sufficiently stable to prevent loss of the food supply through drying out of the surface. The southwest shore of Lake Okeechobee from the Hurricane Gate at Clewiston to the Kissimmee River (excluding deep open water) is considered critical habitat for the snail kite (USFWS, May 1996). Critical habitat is not present within the footprint of the proposed project.

The snail kite is threatened primarily by habitat loss and destruction. Widespread drainage has permanently lowered the water table in some areas. This drainage permitted development in areas that were once kite habitat. In addition to loss of habitat through drainage, large areas of marsh are heavily infested with water hyacinth, which inhibits the kite’s ability to see its prey (USFWS, May 1996). The primary area of concern in Lake Okeechobee is the large marsh in the southwestern portion of the lake and the area southwest of the inflow of the Kissimmee River.

3.13.6 Crested Caracara

The crested caracara is a unique raptor/scavenger from the family Falconidae that reaches the northern limit of its geographic range in the southern U.S. In Florida, this raptor occurs as an isolated population in the south-central region of the state. Notable changes in land use patterns have occurred throughout central Florida in recent years. As a result, the status of this population has become a subject of concern. This raptor apparently now occurs almost exclusively on privately owned cattle ranches in the south-central part of the state.

Available evidence suggests that the most serious threat to Florida's carcara population is loss or degradation of nesting and feeding habitat. Such loss is most commonly due to conversion of pasture and other grassland habitats and wetlands to citrus, sugar cane, other agriculture, and urban development. Adult caracaras exhibit high site- and mate-fidelity; therefore, extensive loss of habitat within the home range, particularly of the nesting site itself, may cause the pair to abandon that home range, or at least the nesting site. It is currently not known what degree of nesting or foraging habitat loss within a home range will cause permanent movement of a pair out of their home range (Morrison, 2001).

3.13.7 West Indian Manatee

The West Indian manatee is currently listed as an endangered species by both the USFWS and FFWCC. It is a large, plant-eating aquatic mammal that can be found in the shallow coastal water, rivers, and springs of Florida. Florida is essentially the northern extent of the West Indian manatee's range, though some manatees occasionally are reported from as far north as Virginia and the Carolinas (FP&L, 1989). The West Indian manatee lives in freshwater, brackish, and marine habitats, and can move freely between salinity extremes. It can be found in both clear and muddy water. Water depths of at least 3 to 7 ft (1 to 2 m) are preferred and flats and shallows are avoided unless adjacent to deeper water. During the summer months, manatees range throughout the coastal waters, estuaries, bays, and rivers of both coasts of Florida and are usually found in small groups. During the winter, manatees tend to congregate in warm springs and outfall canals associated with electric generation facilities (FP&L, 1989).

Over the past centuries, the principal sources of manatee mortality have been opportunistic hunting by man and deaths associated with unusually cold winters. Today, poaching is rare, but high mortality rates from human-related sources threaten the future of the species. The largest single mortality factor is collision with boats and barges. Manatees also are killed in flood gates and canal locks, by entanglement or ingestion of fishing gear, and through loss of habitat and pollution (FP&L, 1989).

3.13.8 Okeechobee Gourd

The Okeechobee gourd is currently listed as an endangered species by the USFWS and the FFWCC. It is a fibrous-rooted, high-climbing vine with tendrils. Its leaf blades are heart to kidney-shaped with five to seven shallow, angular lobes, and irregularly serrated margins. This plant occurs only along the shores of Lake Okeechobee and the St. John's River (USFWS, February, 1997). The Okeechobee gourd is usually found in pond apple (*Annona glabra*) hammocks, heavily tangled woods, and willow (*Salix* spp.) and elderberry (*Sambucus canadensis*) thickets. The seeds of this gourd germinate on bare, exposed muck and especially on alligator nests where the soil has been disturbed (USFWS, February 1997).

By 1930 at Lake Okeechobee, about 95 percent of the pond apple forests that had probably been occupied by this gourd were destroyed for agricultural purposes. At that time, the gourd was still locally abundant, but since then, it has become rare and difficult to find around the lake (USFWS, February 1997). An Okeechobee gourd survey conducted in 1990-1991 found a total of 11 sites along the southeastern shore of Lake Okeechobee. The specific location of known plant locations is sensitive information, so discussion within this text is restricted (FNAI, 1998).

3.13.9 Johnson's Seagrass

Johnson's seagrass has a limited distribution, reported as occurring only in the coastal lagoons of east Florida from Sebatian Inlet to Biscayne Bay (Eiseman, 1980). It often grows in patches between intertidal zones to three meters water depth. Although it is found in both firm sediments and sandy mud substratum, it favors firm substrate (Eiseman, 1980). Reproduction is different from most seagrasses in that it is believed to uniquely have asexual reproduction characteristics. This assumption is supported by no known identification of male flowers. The decline of this species could partially be attributed to this. Johnson's seagrass is ecologically significant. It provides habitat, nursery, and foraging areas for various plants and animals including the West Indian Manatee. It plays a major role in the viability of benthic resources (NOAA, 2006).

Johnson's seagrass has limited distributional characteristics, restricted reproductive capacity (being asexual), and is dependent on substrate stability (NOAA, 2006). Additional threats to recovery include human and natural events that alter the substrate or water quality on which the seagrass depends. For instance, boat traffic, dredging and maintenance of waterways, and storm activities, including hurricanes, can result in substrate disturbance or removal, turbid waters, siltation, salinity fluctuations, sediment resuspension, and water quality contamination. Critical habitat for Johnson's seagrass is designated in a portion of the Indian River Lagoon, north of the Sebastian Inlet Channel; a portion of the Indian River Lagoon, south of the Sebastian Inlet Channel; a portion of the Indian River Lagoon near the Fort Pierce Inlet; a portion of the Indian River Lagoon, north of the St. Lucie Inlet; a portion of Hobe Sound; a site on the south side of Jupiter Inlet; a site in central Lake Worth Lagoon; a site in Lake Worth Lagoon, Boynton Beach; a site in Lake Wyman, Boca Raton; and a portion of Biscayne Bay.

3.14 NOISE

Noise is defined as "unwanted sound" and, in the context of protecting public health and welfare, implies potential effects on the human and natural environment. Noise is a significant concern associated with construction, dredging, and transportation activities and projects. Ambient nose levels within a given region may fluctuate over time because of variations in intensity and abundance of noise sources.

Noise is regulated under the Noise Control Act of 1972, as amended. The EPA has also established noise guidelines recommending noise limits for indoor and outdoor noise activities. Under these guidelines, an average noise level over a 24-hour period of 70 A-weighted decibels (dBA) is listed as the threshold for hearing loss. An outdoor 24-hour average sound level of 55 dBA is recommended for residential areas. Additionally, the U.S. Department of Housing and Urban Development (HUD) has also developed a noise abatement and control policy. According to HUD policy, noise at or below 65 dBA is acceptable in all situations, noise between 65 and 75 dBA is generally acceptable, and noise exceeding 75 dBA is unacceptable in all situations. Noise monitoring and impacts are typically evaluated by the local government.

Along Reaches 2 and 3 there are a number of existing sources currently contributing to the overall ambient noise level. The more predominant of these sources include:

- vehicular traffic traveling along nearby highways;
- boat traffic along the rim canal;
- small industry (i.e., produce processing and distribution);
- urban activities in Moore Haven, Clewiston, and Belle Glade;
- agricultural equipment (tractors, trucks, etc.); and
- pumping stations.

Rural areas typically have noise levels of 35-55 db. Sound levels along transportation arteries are typically in the range of 70 dB. According to the Florida Department of Transportation's State Environmental Management's Office, no known ambient noise monitoring has been conducted in the project area; consequently, no quantitative data on noise levels within the project area are available for analysis.

3.15 AIR QUALITY

The Clean Air Act Amendment of 1990 directed the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for all regulated air pollutants. Federal air quality standards have been established for six criteria air pollutants:

- Carbon monoxide (CO);
- Nitrogen dioxide (NO_2);
- Ozone (O_3);
- Sulfur oxides (commonly measured as sulfur dioxide [SO_2]);
- Lead (Pb);
- Particulate matter no greater than 2.5 micrometers (μm) in diameter ($PM_{2.5}$); and
- Particulate matter no greater than 10 μm in diameter (PM_{10}).

The EPA classifies air quality by Air Quality Control Region (AQCR). The Clean Air Act defines an AQCR as a contiguous area where air quality, and thus air pollution, is relatively uniform. AQCRs often correspond with airsheds and may cross county and state lines. Each AQCR is treated as a unit for developing pollution control strategies to achieve National Ambient Air Quality Standards.

An AQCR or portion of an AQCR may be classified as attainment, nonattainment, or unclassified. A classification of attainment indicates that criteria air pollutants within the region are within NAAQS values. A nonattainment classification indicates that air pollution levels persistently exceed the NAAQS Values. A classification of unclassified indicates that air quality within the region cannot be classified (generally because of lack of data). A region designated as unclassified is treated as an attainment region.

The EPA's *Green Book Nonattainment Areas for Criteria Pollutants* (Green Book) maintains a list of all areas within the United States that are currently designated nonattainment areas with respect to one or more criteria air pollutants. Counties in the project area are not listed as attainment areas in the Green Book, indicating they are in attainment.

The EPA's AirData database contains measurements of air pollutant concentrations for the entire United States. The measurements include both criteria air pollutants and hazardous air pollutants and are compared against the NAAQS specified by the EPA. The AirData database was queried for air quality data within the project area for the interval 2002-2006. Table 4 presents air quality values provided by the AirData database for Palm Beach County. (Data are not available for Glades or Hendry counties.) Each row of the table lists standards-related air pollution values for all six criteria pollutants for one year. The values shown are the highest reported during the year by all monitoring sites in the county. As Table 4 illustrates, Palm Beach County is currently in attainment for all six criteria air pollutants.

Table 4. Air Quality Values for Palm Beach County, Florida

Year	CO (ppm)		NO_2 (ppm)	O_3 (ppm)		SO_2 (ppm)		$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)		PB (µg/m^3)
	2nd Max 1-hr	2nd Max 8-hr	Annual Mean	2nd Max 1-hr	4th Max 8-hr	2nd Max 24-hr	Annual Mean	98th Percentile	Annual Mean	2nd Max 24-hr	Annual Mean	Quarterly Mean
2002	3.8	2.3	0.017	0.084	0.062	0.002	0.001	16	8.3	46	22	*
2003	4.2	1.8	0.014	0.081	0.069	0.002	0.001	16	8.1	53	30	*
2004	3.7	2.1	0.01	0.077	0.067	0.001	0.001	21	8.1	62	30	*
2005	3.4	2.2	0.009	0.079	0.062	0.003	0.001	19	8.1	60	24	*
2006	2.9	1.7	0.01	0.093	0.071	0.002	0.001	21	9.5	49	30	*
NAAQS**	35	9	0.053	0.12	0.08	0.14	0.03	65	15	150	50	1.5

Notes: *Some values are absent due to incomplete reporting. **National Ambient Air Quality Standards

CO - Carbon Monoxide Air Quality Standards

2nd Max 1-hr- Second-highest 1-hour average concentration (in ppm) for the year. This value, rounded to the nearest 1 ppm, should not exceed the level of the 1-hour standard (35 ppm).
2nd Max 8-hr- Second-highest non-overlapping 8-hour concentration (in ppm) for the year. This value, rounded to the nearest 1 ppm, should not exceed the level of the 8-hour standard (9 ppm). AQS software computes an 8-hour average concentration for each hour of the day as a moving average of eight 1-hour values. *Non-overlapping* means that the highest and second-highest 8-hour values do not have any hours in common - they are separated in time by at least eight hours.

NO_2 - Nitrogen Dioxide Air Quality Standard
Annual Mean- Arithmetic average of all 1-hour values for the year. This value should not exceed the level of the annual standard (0.053 ppm).

O_3 - Ozone Air Quality Standards

2nd Max 1-hr- The second-highest "daily max value" -- take the highest 1-hour value of each day, pick the second-highest of those values. This value, rounded to the nearest 0.01 ppm, should not exceed the level of the 1-hour standard (0.12 ppm).

4th Max 8-hr- The fourth-highest "daily max value" -- take the highest 8-hour value of each day, pick the fourth-highest of those values. This value, rounded to the nearest 0.01 ppm, should not exceed the level of the 8-hour standard (0.08 ppm). AQS software computes an 8-hour value for each hour of the day as a moving average of eight 1-hour values.

SO_2 – Sulfur Dioxide Air Quality Standards

2nd Max 24-hr- Second-highest 24-hour average concentration (in ppm) for the year. This value, rounded to the nearest 0.01 ppm, should not exceed the level of the 24-hour standard (0.14 ppm). AQS software computes a midnight-to-midnight 24-hour average value for each day from 1-hour values.

Annual Mean- Arithmetic average of all 1-hour values for the year. This value should not exceed the level of the annual standard (0.030 ppm).

$PM_{2.5}$ – Particulate Matter smaller than 2.5 micrometers

98th Percentile- The 98th percentile 24-hour value (in µg/m^3). This value should not exceed the level of the 24-hour standard (65 µg/m^3). The 98th percentile value is higher than 98 percent of 24-hour values for the year,

Annual Mean- Arithmetic mean of 24-hour values for the year. This value should not exceed the level of the annual standard (15.0 µg/m^3).

PM_{10} – Particulate Matter smaller than 10 micrometers

2nd Max 24-hr- Second-highest 24-hour value (in µg/m^3) for the year. This value, rounded to the nearest 10 µg/m^3, should not exceed the level of the 24-hour standard (150 µg/m^3).

Annual Mean- Weighted arithmetic mean of 24-hour values for the year. The method of calculation compensates for scheduled sampling that did not occur. This value should not exceed the level of the annual standard (50 µg/m^3).

Pb – Lead Air Quality Standards

Quarterly Mean- Highest of the quarterly mean values. This value, rounded to the nearest 0.1 µg/m^3, should not exceed the level of the quarterly standard (1.5 µg/m^3). Each quarterly mean is the arithmetic average of 24-hour values for a calendar quarter: January-March (1), April-June (2), July-September (3), and October-December (4).

Source: EPA AirData Database, 2006.

The AirData database also provides annual summaries of Air Quality Index (AQI) values for counties or MSAs. The AQI is an approximate indicator of overall air quality, because it takes into account all of the criteria air pollutants measured within a geographic area. The AQI summary values include both qualitative measures (i.e., days of the year having "good" air quality) and descriptive statistics (i.e., median AQI value). Table 5 presents an AQI summary for Palm Beach County for the interval 2002-2006. Data are not available for Glades and Hendry counties.

As Table 5 indicates, air quality in the project area is generally good, with no periods in which air quality is classified as unhealthy for sensitive groups. Of the six criteria air pollutants, ozone and particulate matter of 2.5 µm or less are most likely to occur within the project area. However, as Table 5 indicates, the air quality is within NAAQS limits for these parameters.

3.16 HAZARDOUS, TOXIC AND RADIOACTIVE WASTES

Several site visits were conducted with the most recent Hazardous, Toxic and Radioactive Waste (HTRW) survey having been performed on 12 August 1998. The HTRW database, aerial photography review and site assessment of the existing conditions found the potential of HTRW contamination. The immediate property surrounding Lake Okeechobee consists of the Herbert Hoover Dike, which was free of discolored soil or stressed vegetation, or any other indicator that may indicate contamination levels requiring clean up on the dike. However, close to the dike, several locations have the potential of being a source of contamination. In the municipality of Pahokee, on the east end of the lake, businesses and private residences approach very close to the back toe of the HHD. It appears that the dike has been used as the "backyard fence." In some instances, private residences have installed a property fence creating a secure backyard boundary, the dike. This may have caused residents in the neighborhood to store materials close to the dike. Although no obvious contamination was observed, the potential of having past spills in these areas does exist. The physical inspection was performed by random spot check and driving along the road near the dike. It should be noted that rainfall and the high seepage rates in the area would have flushed-out most hydrocarbon, or smaller molecule chemical spills. Large molecule spills (such as PCBs) and metals may be less mobile, and these may still measure residual levels. During real estate procurement and project construction, further evaluations would be required. The perimeter road has several leaking underground storage tanks and there have been several reported spills around Lake Okeechobee. All of these potential contamination problems are located within towns or along the highways that run very close to the dike.

Table 5. Air Quality Index Summary for Palm Beach County, Florida

Year	# Days with AQI	Number of Days when Air Quality was				AQI Statistics			Number of Days Main AQI Pollutant was					
		Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy	Max	90th percentile	Median	CO	NO2	O3	SO2	PM2.5	PM10
Palm Beach County														
2002	365	344	21	0	0	72	45	31	0	0	171	0	190	4
2003	365	340	25	0	0	83	48	33	0	0	188	0	161	16
2004	350	313	37	0	0	85	51	34	0	0	200	0	137	13
2005	353	328	25	0	0	85	48	32	1	0	205	3	138	6
2006	182	150	32	0	0	100	56	38	1	0	122	0	53	6

Notes:

 # Days with AQI

Number of days in the year having an Air Quality Index value. This is the number of days on which measurements from any monitoring site in the county or MSA were reported to the AQS database.

Number of Days when Air Quality was…

These columns indicate how the daily AQI values for a county or MSA were distributed among four broad categories of air quality:

Good

Number of days in the year having an AQI value 0 through 50.

Moderate

Number of days in the year having and AQI value 51 through 100.

Unhealthy for Sensitive Groups

Number of days in the year having an AQI value 101 through 150.

Unhealthy

Number of days in the year having an AQI value 151 or higher. This includes the AQI categories *unhealthy*, *very unhealthy*, and *hazardous*. Very few locations (about 0.3% of counties) have any days in the very unhealthy or hazardous categories.

AQI Statistics

These columns provide simple statistical measures of the AQI values for a county or MSA:

Max

The highest daily AQI value in the year.

The highest possible AQI value is 500. Rarely, a pollutant concentration exceeds the level equivalent to AQI 500. In these instances, AQI value is given as 501 to indicate "greater than 500."

90th percentile

90 percent of daily AQI values during the year were less than or equal to the 90th percentile value.

Median

Half of daily AQI values during the year were less than or equal to the median value, and half equaled or exceeded it.

Number of Days when AQI pollutant was...

A daily index value is calculated for each air pollutant measured. The highest of those index values is the AQI value, and the pollutant responsible for the highest index value is the "Main Pollutant." The criteria pollutants used to calculate AQI are:

CO - Carbon monoxide

NO2 - Nitrogen dioxide

O3 - Ozone

SO2 - Sulfur dioxide

PM2.5 - Particulate matter smaller than 2.5 micrometers

PM10 - Particulate matter smaller than 10 micrometers

Source: EPA AirData Database, 2006.

3.17 LAND USE

3.17.1 Agriculture

The primary land use in the Lake Okeechobee region is agriculture. Major agricultural activities in the area include sugarcane plantations, cattle ranching, dairy farming, ornamental nurseries, vegetable production, and citrus groves. Farmland within the counties that surround Lake Okeechobee (Glades, Hendry, Martin, Okeechobee, and Palm Beach) occupies from 50 to 76 percent of the total land area (Purdum, 1994).

Throughout the Lake Okeechobee area, agricultural activities frequently occur very near the landward toe of the HHD. Agricultural use of the land immediately adjacent to the HHD is especially predominant in the south and southeast where the soil is higher in organics and therefore more valuable for crop production. Cattle ranching, common to the north of the lake, is present in near proximity to the HHD as well. Sugarcane fields are common along Reaches 2 and 3.

Other common land use types in the Lake Okeechobee region are frequently associated with agriculture. Sugarcane refineries produce packaging and shipping plants, and other support activities constitute a significant land use along with direct agriculture.

3.17.2 Urban Land

Another significant use of the lands in this region is urban development. Four communities are situated adjacent to Reaches 2 and 3 of the HHD (Table 6). Within these communities, there are places where residences, businesses, and municipalities occur within 100 ft of the HHD. The largest of the communities is Belle Glade, located near the Hillsboro canal with a population of more than 15,000. In addition to the four communities adjacent to the dike, South Bay, located about two miles south of Reach 3, has a population of 4,059 people (U.S. Census Bureau, 2005).

Table 6. 2005 Population Estimates for Communities Adjacent to Reaches 2 and 3

Community	Population	County
Belle Glade	15,423	Palm Beach County
Clewiston	7,173	Hendry County
Moore Haven	1,751	Glades County
Lake Harbor*	195	Palm Beach County

*Unincorporated town. Population estimate available for year 2000 only.

Source: U.S. Census Bureau, 2000 and 2005 Population Estimates.

3.17.3 Tribal Indian Reservation

The Brighton Seminole Indian Reservation occupies a large area of land west of Lake Okeechobee in Glades County. The southern end of this reservation is near the HHD just north of Lakeport and structures 131 and 71 (Figure 7). The southeastern point of the reservation is about one-half mile from the HHD. The reservation's northeastern point is approximately three miles from the HHD. According to the Census Bureau, the population of the reservation was 566 people in 2000.

3.18 TRANSPORTATION AND INFRASTRUCTURE

3.18.1 Transportation

Major transportation corridors around the perimeter of Lake Okeechobee include railroads and state and county highways. County Road (CR) 78 parallels Lake Okeechobee along its western and northern shores from Moore Haven to Okeechobee. From Okeechobee, U.S. Highway (US) 98/441 follows the northern and eastern portion of the lake to Pahokee. CR 715 then follows the HHD from Pahokee to Belle Glade.

Near Reaches 2 and 3, the major highway is US 27, which follows the southern lake area from west of Moore Haven to Belle Glade. US 27 is located within one mile of Reaches 2 and 3 between Clewiston and South Bay R.V. Park. The highway is within 50 feet of the dike just east of Lake Harbor and near South Bay Park in Reach 3. CR 720 is located within one mile south of the dike between Moore Haven and Liberty Point in Reach 2.

Railroad corridors in the Lake Okeechobee area include the Florida East Coast Railway and the South Central Florida Railroad. The East Coast Railway is located along the eastern part of the lake where it comes very near to the HHD in places along Reach 1. The South Central travels along the southern end of the lake, where it comes within one mile of the HHD in Reach 2.

3.18.2 Infrastructure

Reach 2: An electric power line extends from the boat ramp at the Moore Haven lock and dam to C-20 and into the town of Moore Haven. Sportsman's Village, located near the lock and dam, includes a wastewater treatment plant. A water pipe is located in western Reach 2 as well.

The small community of Benbow is located within a mile south of Reach 2 and about three miles east of Moore Haven on CR 720. A transmission line and water tower are located within close proximity of this community.

There are a transformer station and two cell phone towers on CR 720 just north of US 27. A KOA campground and trailer park exist here as well. These are approximately two miles southwest of S-4.

Uncle Joe's Fish Camp (located adjacent to the dike approximately four miles west of Clewiston) includes an aboveground fuel tank and an electric power line within 40-100 feet of the levee crest.

Approximately two miles southwest of S-4 are two communication towers. An electric power line runs from S-4 near the crown of the dike and along the toe ditch for about 100 feet. Two above-ground fuel tanks and a telephone cable are located here as well.

The city of Clewiston (population 7,173 in 2005) includes transmission lines, radio towers, water tanks and other infrastructure characteristic of urban centers.

Power lines run adjacent to the south side of US 27 between Clewiston and South Bay.

An aboveground fuel storage tank is located near S-236 on the dike.

At John Stretch Park (located adjacent to the dike where the Miami Canal meets S-3), an aboveground fuel storage tank and power lines with transformers are located within fifty feet of the dike crest.

From here, the power lines continue south adjacent to US 27. Other infrastructure at John Stretch Park includes a public restroom and a pedestrian bridge that crosses the Miami Canal.

The small, unincorporated community of Lake Harbor (population 195 in 2000) lies within one mile south of the dike, across US 27 from John Stretch Park. This community includes a communication tower and a water tower.

Reach 3: A 1500-gallon aboveground fuel tank is located at the toe of the dike at Culvert 4A.

The community of South Bay (population 4,059 in 2005) is located about two miles south of S-2, adjacent to the North New River Canal. This community includes transmission lines, fuel tanks, and other infrastructure normally found in incorporated communities.

The South Bay R.V. Park is located at the toe of the dike near S-2. South Bay's water filtration and treatment plant is also located here, as well at a power line between the crest and toe of the dike, a maintenance shop, and an intake structure for the water treatment plant.

The Belle Glade Recreation Area is located on the lake side of the dike and borrow canal, across from the South Bay R.V. Park. This recreation area includes a power line. Belle Glade's buried water intake is located near Tori Island.

Power lines are also located adjacent to the North New River and Hillsboro canals and come within 200 feet of the dike toe. Near the hurricane gate structure at the juncture of these canals is an aboveground fuel tank and two pedestrian bridges. The bridges cross the canals.

3.19 AESTHETIC RESOURCES

There are five public access points to view Lake Okeechobee from the elevated vantage point of the levee crown in Reaches 2 and 3. The Lake Okeechobee Scenic Trail runs atop the HHD around the entire lake, totaling approximately 110 miles (FDEP, 2006).

The levee crown affords panoramic views of the flat agricultural fields and rim canal to the south, southwest, and southeast of Reaches 2 and 3. Most of the agriculture here is sugarcane. The extensive littoral zone on the west side of the lake's perimeter is apparent from the dike in Reach 2. The littoral zone plant community is composed of a mosaic of emergent, submergent and natant plant species. Emergent vegetation within the littoral zone is dominated by cattail, spike rush, and torpedo grass. Along Reach 3, submerged vegetation is abundant along the lakeshore.

The view of Rita Island dominates the landscape when looking northward from the dike in Lake Harbor. Also in this area is John Stretch Park, which is located adjacent to the south side of the dike near the Miami Canal. This park includes a man-made pond, picnic areas, restrooms, a large grassy field, an outdoor basketball court and a boat ramp.

The visual resources seen from the vantage point of the HHD at Liberty Point (located between Moore Haven and Clewiston) includes an expansive view of the emergent vegetation of the littoral zone in the lake. The landside view includes a view of Uncle Joe's Fish Camp.

3.20 RECREATIONAL RESOURCES

Each year, more than six million people visit Lake Okeechobee and the Okeechobee Waterway. Recreational resources in close proximity to Reaches 2 and 3 include the Lake Okeechobee Scenic Trail, fishing and boating opportunities, campgrounds, and park and recreation areas.

3.20.1 Scenic Trail

The Lake Okeechobee Scenic Trail (LOST) circles the entire lake on top of the dike. The LOST is located on lands held in fee simple title by the State of Florida that are administered by the FDEP. This is a mostly double-track trail that offers recreation opportunities for hiking, biking, horse-back-riding, and fishing. The section of the trail that spans Reaches 2 and 3 is paved. Hikers and mountain bikers are able to access the trail from numerous locations. In Reaches 2 and 3, there are five access points for hikers and bikers. These are located at Moore Haven, Liberty Point, Clewiston, the Miami Canal, and Belle Glade. Equestrians are able to access the trail from various locations in the project area, including Moore haven and Clewiston Park.

3.20.2 Fishing and Boating

Lake Okeechobee and the Okeechobee Waterway offer a wide-range of fishing opportunities. There are more than 60 species of fish in the lake, the most sought-after being largemouth bass, catfish, and black crappie. Many people fish in the rim canal on the lakeward side of the dike. Boats can access the lake through navigation locks and boat ramps. In the area of Reaches 2 and 3, there are public boat ramps located at Moore Haven East and West recreation sites, and at Lake Observation Point (Bare Beach), which is located between Clewiston and the Miami Canal. Located at the junction with the Caloosahatchee River, the Moore Haven Lock and Dam serves as both an access point to the lake as well as a site for sports fishing tournaments. Other fishing and boating resources in the area include Uncle Joe's Fish Camp at Liberty Point, and the Clewiston Marina, Jolly Roger Marina, and Angler's Marina in the Clewiston area.

3.20.3 Camping

Two campgrounds with restrooms, picnic areas, and potable water are located within Reaches 2 and 3. These include the Moore Haven Recreational Village and the Belle Glade Recreation Area. Additionally, two primitive campsites are located on the landward side of the dike in Reach 2. One is approximately one mile east of Liberty Point and the other is located between Clewiston and the Miami Canal.

3.20.4 Park and Recreation Areas

Park and recreation areas that include access to picnicking, boating, fishing, biking and hiking along the dike include Moore Haven Recreational Village and Alvin Ward Park in Glades County; the Clewiston Recreation Area in Hendry County; and John Stretch Park, South Bay Recreation Area, and Belle Glade Recreation Area in Palm Beach County.

3.21 CULTURAL RESOURCES

The earliest widely accepted date of occupation of Florida dates from around 12,000 years ago. This earliest cultural period, called the Paleo-Indian period, lasted until about 7500 B.C. Few Paleo-Indian archeological sites are recorded in Florida, and none are identified by the Florida Master Site Files

(FMSF) near the HHD. During the Archaic period (ca. 7500 B.C. - ca. 500 B.C.), Indians exploited a wider range of resources than Paleo-Indians, probably used a more restricted territory, and may have led a more sedentary existence. Seasonally available food resources included deer and small game, hardwood nuts, freshwater snails, and marine shellfish. The Archaic is further subdivided into the Early Archaic (7500 B.C. to 5000 B.C.), Middle Archaic (5000 B.C. to 3000 B.C.) and Late Archaic (3000 B.C. to 500 B.C). Few Early or Middle Archaic period archeological sites are recorded in south Florida. Known sites are clustered along the Atlantic and Gulf coasts and inland waterways. Foraging and hunting were the main subsistence activities throughout the archaic period, with Late Archaic people exploiting a larger territory and wider range of aquatic and terrestrial food resources. Archaic sites become more numerous during the Late Archaic period, when essentially modern climatic conditions were established. Crude fiber-tempered pottery first appears in the Late Archaic. No Archaic period sites are located near the dike, as recorded in the FMSF. Regional cultural diversity becomes apparent in the archeological record by 500 B.C. The clearest indication is that distinctive styles of pottery were made in different parts of the state (Piper Archaeology/Janus Research 1992). In the Okeechobee Basin, the Belle Glades culture sequence (ca. 500 B.C. - A.D. 1500) is subdivided into four periods. Ceramic technology progresses from fiber tempered to fiber and sand tempered to sand tempered ceramics, with St. Johns ceramic types also being used during the Belle Glades culture sequence. Black earth middens, low sand mounds and circular and linear earthworks are Belle Glade site types located near the HHD, as recorded in the FMSF.

During the early historic period, beginning with the first Spanish colonial period (1513 - 1763), the Calusa inhabited southern Florida. Their population was decimated by European-introduced diseases, warfare, enslavement, and migration out of Florida (Archaeological Consultants Inc., 1991). The Miccosukee and the Seminole migrated into Florida in the 18th and 19th centuries from Georgia and Alabama. Throughout the mid 1800s, the U.S. relentlessly pursued a policy of Indian removal in Florida, and the Seminole, resisting removal, eventually established themselves in the Everglades, Big Cypress Swamp, and the Ten Thousand Islands. Several important battles of the Seminole Wars occurred around Lake Okeechobee including the largest and bloodiest battle of the Second Seminole War, the Battle of Okeechobee on Christmas Day in 1837 (Carr *et al*., 1995). The Okeechobee Battlefield site is located at the north end of Lake Okeechobee and is a National Historic Landmark site. Other Seminole battle and habitation sites, predominantly on tree islands, are located near the HHD.

American settlement around Lake Okeechobee began in earnest in the late 19th century when efforts to drain and reclaim the Everglades began. Agriculture began in the Everglades, south of Lake Okeechobee after drainage projects of the 1906-1927 era (Milano, 1995). During this period, the first settlements, Okeelanta and Glade Crest were established just south of the lake. By 1921, there were 16 settlements on or near Lake Okeechobee, with a total estimated population of 2,000. Settlement and agricultural activities escalated during the subsequent decades.

The West Palm Beach Canal opened in 1917 and the town now known as Canal Point was established (Archaeological Consultants, Inc., 1991). In 1918, a school was built in Pahokee. By 1920, mercantile and commercial buildings were springing up along the lake. As early as 1917 sugar cane was being produced and quickly became a flourishing industry in the region. The mid 1920s saw the south Florida real estate boom, which was crippled by the great hurricane of 1926. The 1928 hurricane devastated the recovery from the earlier storm with tremendous property damage and loss of lives (Archaeological Consultants, Inc., 1991). South Florida benefited from the civic and administrative works of Franklin D. Roosevelt's New Deal programs in the 1930s, including the Canal Point School, a structure determined eligible for inclusion on the National Register of Historic Places. After the hurricanes, work was begun locally to build a series of dikes around Lake Okeechobee. In 1935, the Corps assumed responsibility for the on-going construction. The HHD was completed in 1937 and named after President Herbert Hoover. The SHPO has listed the HHD as eligible for inclusion on the National Register of Historic Places for its historical significance (Appendix B).

3.22 SOCIOECONOMICS

The major socioeconomic resources in the Lake Okeechobee region are related to agriculture, recreation and tourism, commercial navigation, and commercial fishing.

Agriculture in this region is dependent upon Lake Okeechobee as a source of irrigation water. The regulated lake depths make it possible for farmlands to receive irrigation water year round regardless of rainfall. In the Lake Okeechobee service area, there are an estimated 742,668 acres of irrigated agricultural lands. These agricultural lands and associated activities employ hundreds of people in the area and bring millions of dollars in revenue annually.

Agriculture is dependent on releases from Lake Okeechobee for crop irrigation. During prolonged droughts, significant volumes of water from the lake are required to supplement local water supplies and to prevent saltwater intrusion into coastal aquifers and wellfields. Most of the land in the vicinity of Reaches 2 and 3 is under cultivation. Agriculture is dominated by sugarcane, accounting for 90 percent of land under cultivation. The remaining 10 percent of cultivated land primarily includes rice, row crops, and sod (David Miller & Associates, 1998).

Recreation and tourism activities in the area are enhanced by the regulated water levels of Lake Okeechobee. As a result, the lake is the largest recreational resource in the region. It has been an historic tourist destination, and its associated waterways and shoreline provide a wide variety of water-based recreation activities for local residents and out-of-state visitors, including: fishing, boating, picnicking, sightseeing, camping, swimming, birding, hunting, air boating and hiking. The recent trend toward eco-tourism has been encouraged by the planned extension of the Florida National Scenic Trail and creation of the Lake Okeechobee Scenic Trail. In 1996, the annual value of the recreational resources of the lake was estimated at $78,151,409 (David Miller & Associates, 1998).

Heavy waterfowl utilization of Lake Okeechobee attracts tourists and recreational enthusiasts. Common waterfowl species include ring-necked duck, American widgeon, northern pintail, green-winged teal, Florida duck, and lesser scaup. Lake Okeechobee supports a variety and abundance of sport fish. Consequently, sport fishing is a major recreational activity on the lake.

Lake Okeechobee is currently recognized as supporting one of the best recreational fisheries in the nation. Additionally, it supports an active commercial fishing industry. This includes several different types of commercial fishing operations and landside support activities, such as marinas and wholesale and retail distribution facilities. The annual value of the wholesale commercial fishing is $2,326,932 and employs 210 people (David Miller & Associates, 1998).

There are also commercial fisheries on Lake Okeechobee that harvest the American alligator and the Florida soft shell turtle. Alligators are harvested from the lake population to supplement the stock in alligator farming operations. Commercial fishermen harvest soft shell turtles, with some individual yields in excess of 30,000 pounds annually. The majority of the harvest is prepared for shipment to Japan, or sold locally, primarily to the Miccosukee Tribe (Moler & Berish, 1995).

The increased depth of Lake Okeechobee makes commercial navigation on the lake possible. Commercial navigation of Lake Okeechobee and associated waterways was used to transport 430,000 tons of freight in 1995. Petroleum products, including distillate fuel oil, residual fuel oil, and liquid natural gas, comprise the majority of tonnage shipped. Other commercial navigation includes fleets of day/dinner cruise vessels that operate during the tourist season from Pahokee and from Fort Myers and other commercial guided tours.

3.22.1 Demographics

Reaches 2 and 3 span portions of Glades, Hendry, and Palm Beach counties (Figure 1). This area includes three incorporated communities: Clewiston, South Bay, and Belle Glade south of the Hillsboro Canal. Specifically, the area includes: Glades County, Census Tract 2, Census Blocks 3000-3050; Hendry County, Census Tract 1 plus Block Groups 1 and 2 of Census Tract 2; and Palm Beach County Census Tracts 82.01, 83.01, and 83.02.

According to data derived from the 2000 Census, the study area's total population is 22,529 residents. A majority of the residents (89 percent) is clustered in the three urban areas listed above. The remaining 11 percent of area residents live in rural areas between the three towns.

As shown in Table 7, nearly half (49.1 percent) of the population of the area is white, and more than one-third (36.2 percent) is black. The remainder of the population (14.7 percent) is American Indian, Alaskan Native, Pacific Islander, or a mix of two or more races. Because Hispanics and Latinos may be of any race, the 2000 Census allows respondents to select one or more races for self-identification. Nearly one-third (28.8 percent) of the study area's population is Hispanic or Latino.

Table 7. Project Area Population: Ethnicity

Race	Percent of Total Population
White	49.1%
Black	36.2%
Other	14.7%
Hispanic or Latino	28.8%
Not Hispanic or Latino	71.2%

Source: U.S. Census Bureau, 2000.

To capture available median income, poverty, and labor market statistics about the area's population, Census Tract data for Hendry and Palm Beach counties were used. The U.S. Census Bureau conducts these types of population surveys only at this larger scale. Although less precise than the block-group data used above, the data lend clarity regarding the socioeconomic landscape of the general area.

As Table 8 shows, the average median household income for the project area is $27,065, with central Belle Glade (Palm Beach County Census Tract 82.01) having the bottom range of only $17,004 and the areas surrounding Clewiston (Hendry County Census Tract 2) having the highest median income of $37,210. The median household income for the state of Florida is $38,985.

Approximately one-third (31 percent) of the population throughout the study area has an income below the 1999 poverty level. Half of the population residing south and west of Belle Glade (Palm Beach County Census Tract 83.01) lives in poverty. Central Belle Glade (Palm Beach County Census Tract 82.01) also experiences a high poverty rate; 48 percent of the population in this tract lived on incomes below the 1999 poverty level. As a point of comparison, the percentage of people living below poverty throughout the state of Florida is 13 percent.

Table 8. Project Area Population: Income and Poverty Statistics

Location	Population	Households: Median Household Income in 1999	Population with Income in 1999 Below Poverty Level	Percent of Population with Income in 1999 Below Poverty Level
Census Tract 1, Hendry County	6,446	$37,210	1,197	19%
Census Tract 2, Hendry County	7,523	$31,760	2,034	27%
Census Tract 82.01, Palm Beach County	4,323	$17,004	2,085	48%
Census Tract 83.01, Palm Beach County	1,759	$24,125	875	50%
Census Tract 83.02, Palm Beach County	3,340	$25,227	1,102	33%
Totals and Averages	**23,391**	**$27,065**	**7,293**	**31%**

Source: U.S. Census Bureau, 2000.

The area's labor market, which includes residents 16-years-of-age and older who work for pay or profit, is distributed among 13 industries (Table 9). Almost one-fifth (18 percent) of workers in the area are employed by the educational, health, and social services industry. Sixteen-percent of the area's population over the age of 16 is employed by the agriculture, forestry, fishing and hunting industries. An equal percentage (16 percent) is employed in manufacturing. Only four percent of the population (329 people) is employed in the professional, scientific, and technical services industries.

Table 9. Employed Civilian Population 16 Years and Over: Employment by Industry

Industry	No. of Workers	Percent of All Workers
Educational; health and social services	1,571	18%
Agriculture; forestry; fishing and hunting; and mining	1,411	16%
Manufacturing	1,358	16%
Retail trade	862	10%
Arts; entertainment; recreation; accommodation and food services	636	7%
Public administration	521	6%
Construction	499	6%
Finance; insurance; real estate and rental and leasing	383	4%
Other services (except public administration)	339	4%
Professional; scientific; management; administrative; and waste management services	329	4%
Transportation and warehousing; and utilities	322	4%
Wholesale trade	236	3%
Information	167	2%
Total	**8,634**	**100%**

Source: U.S. Census Bureau, 2000.

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4.0 ENVIRONMENTAL EFFECTS

4.1 INTRODUCTION

This section discusses effects to the existing environment that are expected from implementation of each proposed alternative. A summary of environmental consequences is displayed in Table 1.

4.2 CLIMATE

No impact to the climate is expected to occur from implementing any of the alternative actions, including the No Action alternative.

4.3 TOPOGRAPHY, GEOLOGY AND SOILS

4.3.1 Topography

No Action Alternative. Selection of the No Action Alternative would result in no changes to the topography of Reaches 2 and 3 or the Lake Okeechobee region. Although the potential for failure of the HHD system persists under this alternative, major topographic alterations would not result from a project failure.

Recommended Plan. No effects on the topography of Reaches 2 and 3 are expected to occur from implementing the Recommended Plan. Minor changes would occur in the immediate areas where excavation and fill activities take place, but these would cause only minimal changes to the overall topography of these areas.

4.3.2 Geology

No impact to the geology of Reaches 2 and 3 or the Lake Okeechobee region is expected to occur from either the Recommended Plan or the No Action alternative.

4.3.3 Soils

No Action Alternative. Although the No Action Alternative would not cause physical changes in the study area, existing instability problems would persist. In the event of dike failure, surging waters could displace soils in areas nearest the failure. Given the importance of agriculture in the Lake Okeechobee area, the displacement of soils could be a significant adverse effect on agriculture in the vicinity of a dike failure.

Recommended Plan. Minimal soil disturbance would occur from implementing the Recommended Plan. Dike construction would be confined to the footprint of the existing facility. Minor soil disturbances could occur in association with the development and operation of staging areas, movement of heavy equipment, or other similar actions. No prime or unique farmlands would be affected.

4.4 HYDROLOGY

4.4.1 Surface Hydrology

No Action Alternative. In the event of a major failure of the HHD, the resulting flood would affect the overall hydrologic regime of the Lake Okeechobee region.

Recommended Plan. Implementation of the Recommended Plan involves filling of the tow ditch along Reach 3 and the eastern portion of Reach 2. However, filling of the toe ditch is unlikely to have any significant adverse effects on the hydrology of the area.

4.4.2 Recharge

No Action Alternative. Under the No-Action Alternative, recharge would remain unchanged from existing conditions.

Recommended Plan. Implementation of the Recommended Plan is anticipated to result in moderate impacts along Reaches 2 and 3. The installation of a cutoff wall would affect the principal source of recharge in this area. Groundwater flow would be impeded, resulting in a lowering of the water table. Subsurface percolation from canals and ditches into permeable sediments would be decreased.

4.5 WATER SUPPLY

4.5.1 Public Water Supply

No Action Alternative. The No Action Alternative is unlikely to have an effect on existing public water supplies.

Recommended Plan. Implementation of the Recommended Plan is unlikely to have adverse effects on public water supplies. No water quality concerns have been identified that would affect this resource.

4.5.2 Agricultural Water Supply

No-Action Alternative. The No-Action Alternative allows current stability problems of the HHD to persist, which could lead to a major breach of the HHD during a substantial high water event. In the event of a failure of the HHD, consequential flooding would have significant adverse effects on agricultural lands in the area of the failure. In addition, the disruption of agricultural water supply at a critical time during the growing season could have detrimental effects on the local economy. A loss of crops in the vicinity of the breach could be substantial if the breach were to occur in a heavily farmed area.

Recommended Plan. The Recommended Plan is anticipated to result in moderate adverse impacts to the agricultural water supply along Reaches 2 and 3. Installation of a cutoff wall along the length of these reaches could result in reduced tail-waters and lowered water levels in ditches and canals. Altered water levels, in turn, could reduce irrigation water for farmers. The Recommended Plan is not expected to affect agricultural water supply in other reaches of the HHD.

4.6 WATER QUALITY

No-Action Alternative. The No-Action Alternative could affect existing water quality. A breach in the dike could transport the mud sediments of Lake Okeechobee to nearby waterways, resulting in localized elevated total suspended solids and phosphorus concentrations. No significant impacts outside of the immediate area of the breach would be expected.

Recommended Plan. Implementation of the Recommended Plan could have temporary minor impacts on the water quality along Reaches 2 and 3 where construction activities could increase suspended solids and turbidity in nearby surface waters. However, silt screens and other erosion and turbidity control devices would be used, as well as the implementation of Best Management Practices (BMPs) to minimize the discharge of water containing excessive turbidity. For instance, during the construction activity, sections of the toe ditch would be isolated using earthen plugs to contain and minimize the discharge of water containing high levels of turbidity. Additionally, hay bales and turbidity curtains would be deployed to minimize impacts to wetlands adjacent to the construction area.

4.7 WATER MANAGEMENT

No-Action Alternative. The No Action Alternative could affect water management in Reaches 2 and 3. In the event of dike failure, resulting water levels would require altering management strategies by those responsible for, and relying upon, the lake's water resources.

Recommended Plan. Implementation of the Recommended Plan is anticipated to have few impacts on water management along Reaches 2 and 3. The cutoff wall would reduce seepage and could affect water levels in canals and ditches near Reaches 2 and 3, thereby affecting the management of water in the canals.

4.8 VEGETATION AND COVER TYPES

No-Action Alternative. The No-Action Alternative retains an ongoing potential for dike failure. Such a failure could result in extensive impacts from surging water on vegetation landward of the HHD in the immediate area of the failure. Sugarcane plantations, ornamental orchards, field crops, and natural vegetation could be lost. In addition, a breach could interrupt the current hydrology, and result in less water available for irrigation. Additionally, destruction of vegetation could provide an area for the expansion of invasive plant species. Loss of vegetation on the lake side of the HHD would be affected minimally in the event of a dike failure; some loss of aquatic vegetation would occur in the immediate vicinity of the breach, but a reduction in the lake level would be relatively small. No impacts to vegetation would occur in areas away from the breach site.

Recommended Plan. Implementation of the Recommended Plan would have minimal effects to vegetation, as construction would occur only within the HHD footprint. Filling the toe ditch at Reach 3 and the eastern portion of Reach 2 would eliminate wetland plant communities fringing the toe ditch. Similar plant communities adjacent to the borrow canal in the western portion of Reach 2 could be affected by construction activities. However, many of the plants found within and bordering the toe ditches, and canals are exotic and invasive species, the loss of which would not be objectionable. The Recommended Plan would not contribute to conditions favoring invasive species.

4.9 WETLANDS

No Action Alternative. A failure in the dike system would affect wetlands landward of the HHD and near the breach. Surging waters would erode soils, uproot vegetation, and physically alter the physioigraphy. Wetland impacts in the area of Reach 3 and eastern Reach 2 would be minimal because relatively few quality wetlands remain in this area. Wetland systems in the western portion of Reach 2 are more extensive and of higher quality. Wetland damage away from Reaches 2 and 3 would likely be minimal, as floodwaters would spread and dissipate. Farther away from a breach, wetlands could be affected by increased prolonged higher water levels due to flooding.

Effects on wetlands on the lake side of the dike would be minimal. A breach would not lower lake levels significantly. In the event that repairs of a large breech require more than a month to repair, water levels would still not fall below the front toe of the levee.

Recommended Plan. Wetland impacts resulting from implementation of the Recommended Plan would be minimal and limited to Reaches 2 and 3. This alternative involves filling the toe ditch and its fringing wetlands in Reach 3 and eastern Reach 2, and extending the seepage berm to the dike side of the borrow canal along western Reach 2. In addition, some wetlands may be lost due to the placement of reinforcing materials on the lake side of the dike to reduce erosion. Because no construction would occur outside the footprint of the existing project, no additional wetlands would be affected.

On November 7 and 8, 2006, an interagency team of biologists from USACE, USFWS, and USEPA used the Uniform Mitigation Assessment Method (UMAM) to evaluate the quality of wetlands potentially affected by the Recommended Plan. The UMAM scores three wetland parameters: (1) location and landscape support; (2) water environment; and (3) community structure for vegetation and/or benthic communities. The parameters are scored on a scale of one to 10, with one being "not present" and 10 being "optimal," for both with-project implementation condition and current condition. The assumption was made for the with-project implementation condition that the entire 150 foot assessment area would be impacted and would no longer function as a wetland. Therefore, all three parameters were scored as zero. For the current condition, scores ranged from one to six for all three parameters, indicating that the wetlands are of low to moderate quality.

In order to determine the functional loss of wetlands in the assessment area, the change in wetland function is first calculated as the projected functional value of the wetlands after project implementation minus the current functional value of the wetlands. This delta value is then multiplied by the assessment area acreage to give a functional loss value. Table 10 illustrates the functional loss for each assessment area.

A full explanation of the UMAM method and scoring sheets for the assessment areas are in Appendix F.

4.10 FISH AND WILDLIFE

No Action Alternative. A failure in the HHD would result in only a minor reduction in the lake level and a minimal loss of fish and wildlife habitat. Modeling results have demonstrated that in the event of a breach, the lake level would drop from an existing level of 18 ft NGVD down to 17.25 ft within 45 days of the breach (USACE, 1998). This would be a drop of 0.75 ft (0.23 m) under these conditions. The implications to fish and wildlife landward of the HHD that may result from dike failure would be limited to the areas of the breach and surrounding habitats. Wildlife habitat in the area of Reach 3 and the eastern portion of Reach 2 is of marginal quality; habitat quality appears somewhat better in western Reach 2. Those animals most likely to be affected by extensive flooding include those with limited mobility. Others, such as amphibians, reptiles, and small mammals would be impacted to a moderate degree.

Table 10. UMAM Scores for Wetlands Landward of HHD

Assessment Area	Delta	Acres	Functional Loss (Delta X # acres)
Reach 2			
West	-0.43	61.38	-26.39
East 1	-0.43	17.69	-7.61
East 2	-0.37	39.29	-14.54
East 3	-0.23	22.72	-5.22
East 4	-0.47	9.26	-4.35
Total Reach 2		150.34	-58.11
Reach 3			
John Stretch Park East 1	-0.27	10.15	-2.74
John Stretch Park East 2	-0.13	39.46	-5.13
Southbay West	-0.33	4.31	-1.42
Southbay	-0.23	25.23	-5.80
Total Reach 3		79.16	-15.10
Total Reach 2 and 3		229.50	-73.21

Recommended Plan. Fish and wildlife impacts resulting from implementation of the Recommended Plan would be minimal. The toe ditch at Reach 3 and the eastern region of Reach 2 would be filled, eliminating habitats used for foraging by wading birds on invertebrates, amphibians, reptiles, and possibly some small fishes. Impacts from construction activities could temporarily displace wildlife utilizing the HHD slope and the fringe along the borrow canal at the western portion of Reach 2.

4.11 THREATENED AND ENDANGERED SPECIES

4.11.1 American Alligator - *Alligator mississippiensis*

No Action Alternative. The American alligator would incur only minimal short-term impacts in the event of a dike failure. Its flexibility in habitat use and mobility would allow its survival. If a dike failure should occur during nesting season, the impacts on nests on the lake side of the dike should be minimal since water levels are not expected to decrease significantly during such an event. However, the potential for impacting nests landward of the dike exists in the immediate vicinity of a breach.

Recommended Plan. Any impacts to the American alligator resulting from implementing the Recommended Plan would be minor and would be limited to the immediate area of construction.

4.11.2 Eastern Indigo Snake - *Drymarchon corais couperi*

No Action Alternative. Any impacts would be minor and would occur only in the immediate area of a dike failure. Low utilization of areas on the lake side of the HHD would limit potential impacts. The levee itself provides useable habitat for the indigo snake, but a dike failure would directly affect animals in the immediate vicinity. Landward, this animal is rare due to the sub-optimal habitat.

Recommended Plan. Impacts to the indigo snake resulting from implementing the Recommended Plan would be limited to the immediate area of construction. Considering the quality of existing habitat for the eastern indigo snake along the lower third of the HHD, construction impacts could occur, but impacts to snakes would be mitigated by proper implementation of an environmental protection plan. According to the USFWS (Appendix A), the project is not likely to adversely affect the eastern indigo snake.

4.11.3 Bald Eagle - *Haliaeetus leucocephalus*

No Action Alternative. The slightly lower water levels that would result from a dike failure are not anticipated to adversely affect the bald eagle. The expected decrease in water level would be too minor to alter its foraging.

Recommended Plan. Impacts to the bald eagle resulting from implementing the Recommended Plan are expected to be minimal. However, the existence of an active bald eagle nest could alter construction plans. An active nest within 1,500 ft (457 m) of the HHD would restrict construction activities during nesting season. Surveys for active bald eagle nests would be conducted prior to construction. Bald eagle nesting areas would be subject to USFWS Nesting Protection Measures. As outlined in the November 30, 2006 USFWS letter (Appendix A), efforts should be made to "avoid construction activities that may disrupt nesting. In addition, prior to project construction, the contractor will instruct all personnel associated with the project that endangered species may be present in the area, and the need to avoid harming, harassing, or killing these species and the civil and criminal consequences. Construction activities must be kept under surveillance, management, and control to minimize any interference, disturbance, or impact to these resources." According to the USFWS (Appendix A), the project is not likely to adversely affect the bald eagle.

4.11.4 Wood Stork - *Mycteria americana*

No Action Alternative. Impacts to the wood stork in the event of a dike failure would be minimal. Slightly lower lake levels could result in slightly less foraging habitat around the lake. Any nesting colonies could be abandoned if a breach occurred at a critical nesting time during the year; however, a reduction in lake level due to breaching would be minimal.

Recommended Plan. Impacts to the wood stork resulting from implementing the Recommended Plan would be minimal to moderate. Wood storks may use the toe ditch and adjacent wetlands along Reach 3 and eastern Reach 2 for foraging; filling the toe ditch would eliminate this foraging opportunity, but abundant alternative foraging habitat is available.

4.11.5 Everglade Snail Kite - *Rosthrhamus sociabilis plumbeus*

No Action Alternative. Impacts to the snail kite would be minimal if a major dike failure should occur. The water level must be sufficiently stable to prevent loss of the apple snail through drying out of the surface. Lowering of the water level in Lake Okeechobee would not be sufficient to cause a significant loss of apple snails on which the Everglade snail kite feeds.

Recommended Plan. Construction activities would be limited to the footprint of the existing Federal project. Aside from possible temporary disturbances caused by the operation of heavy equipment, no impact on the Everglade snail kite or its foraging habitat is expected.

4.11.6 Crested Caracara - *Caracara cheriway*

No-Action Alternative. Any impacts would be minor and would occur only in the immediate area of a dike failure. Nest trees in the path of a surge of water from a breach could be uprooted. Because of the wide variety of habitats used for foraging, temporary flooding associated with dike failure would likely not significantly affect the caracara.

Recommended Plan. Because caracaras exhibit a wide range of tolerance to human activities, and because construction would be confined to the footprint of the existing HHD project, construction of the project is not anticipated to adversely affect the caracara. In the event that caracara nest trees are discovered near staging areas, appropriate management practices would be followed (Morrison, 2001).

4.11.7 West Indian Manatee - *Trichechus manatus*

No Action Alternative. Few, if any, adverse impacts on the manatee are likely to occur in the event of a dike failure. Expected water level reductions would not be sufficient to affect the animal's food supplies or exposure to boat-related injury or death.

Recommended Plan. Construction activities would be limited to the footprint of the existing Federal project. Aside from possible temporary disturbances caused by the operation of heavy equipment, no impact on the manatee or its foraging habitat is expected.

4.11.8 Okeechobee Gourd - *Curbita okeechobeensis*

No Action Alternative. Okeechobee gourds are limited to the shores of Lake Okeechobee inside the HHD. Slightly lower lake levels resulting from a major dike failure may affect existing Okeechobee gourd population in this area. Given its limited range and habitat requirements, any alteration in the hydrology where this plant occurs could significantly damage the population. However, impacts to these gourds would more likely occur with sustained high water events.

Recommended Plan. Construction of the Recommended Plan will be confined to the existing footprint of the HHD system. The dikes are grassed and mowed, which creates conditions unfavorable to the Okeechobee gourd. The only site in Lake Okeechobee with apparently mature plants is Ritta Island; plants at other sites appear to be in poor health and transitory (USFSW, 1999). Implementation of the Recommended Plan is unlikely to affect the Okeechobee gourd.

4.11.9 Johnson's Seagrass - *Halophila johnsonii*

There is no Johnson's seagrass in the HHD project area. However, Johnson's seagrass and its critical habitat have been identified downstream from and within the range of influence of the HHD. The Hillsboro Canal discharges south of Boca Raton and into Lake Wyman. The Miami Canal connects to the Miami River, which discharges into Biscayne Bay.

No-Action Alternative. In the event of a failure in the HHD system in Reaches 2 or 3, efforts to reduce floodwaters as soon as practicable would likely include channeling waters through the Hillsboro Canal and the Miami Canal to areas along the coast where Johnson's seagrass occurs. Elevated turbidity and suspended solids concentrations in floodwaters, as well as nutrients associated with Lake Okeechobee sediments, would be transported by the canals to areas of Johnson's seagrass critical habitat.

Recommended Plan. Construction of the Recommended Plan would result in storm runoff with elevated turbidity and suspended solids entering into the Hillsboro Canal, the Miami Canal, and the Caloosahatchee River or their tributaries. Any alteration in water quality would be temporary and limited to the period of construction. To alleviate any downstream affects, turbidity would be controlled through strict turbidity and erosion control measures, which would be implemented throughout construction.

It has been determined that implementation of the project may effect, but is unlikely to adversely affect, Johnson's seagrass or listed critical habitat. Coordination with NMFS for effects to Johnson's seagrass is ongoing. The proposed modifications to the dike structure would not alter the management of the lake, or discharges into tributaries. All work would be completed within the footprint of the existing Federal project.

4.12 NOISE

No Action Alternative. The No Action Alternative would not increase ambient noise levels near the HHD. Therefore, no impacts are expected to result due to selection of this alternative.

Recommended Plan. Heavy machinery associated with construction of the Recommended Plan could result in nuisance noise. Although sound levels could exceed 70 dB in proximity to construction activities, attenuation with distance from the construction site would reduce the noise. Few residences are located near the project area, but noise could disturb persons engaged in outdoor activities at such locations as an RV camp in Reach 3, and John Stretch Park and Uncle Joe's Fish Camp in Reach 2. Construction staging areas away from the dike also have a potential for creating nuisance noise. Because noise would be associated with construction, its production would be temporary.

4.13 AIR QUALITY

No Action Alternative. Selection of the No-Action Alternative would not affect air quality.

Recommended Plan. Emissions associated with the Recommended Plan would be generated from heavy machinery operating for short periods in the area where construction occurs. Construction activities would cause minor short-term air quality impacts in the form of fugitive dust or airborne particulate matter from earthwork and unpaved roads accessed for the project. The area is rural, and short-term loadings of internal-combustion engine exhaust gases would be negligible.

Every Federally funded project must be consistent with state plans for implementing the provisions of the Clean Air Act Amendments (State Implementation Plans). This project is in conformance with the State Implementation Plan because it would not cause violations of the National Ambient Air Quality Standards.

4.14 HAZARDOUS, TOXIC AND RADIOACTIVE WASTES (HTRW)

No Action Alternative. The No Action Alternative is not anticipated to affect or contribute to HTRW in the region.

Recommended Plan. The project conditions assume that any HTRW found during any phase of the project would be remediated in accordance with local, state and Federal laws. Therefore, it can be assumed that conditions at future construction sites would be contamination-free or of low levels that generally do not present a material risk of harm to public health or the environment.

Within the adjacent agricultural areas there are numerous temporary pump sites and fuel storage areas. These makeshift portable tanks are not reported, and therefore are not presented in the HTRW database. In addition, pesticide/chemical-mixing areas may also exist. These agricultural fields, outbuildings, equipment fueling and agricultural processing facilities would be outside the immediate area of construction and should not pose an HTRW concern. Remediation would be required if any HTRW problems are encountered during construction.

The proposed earth-moving activities involve the temporary and permanent displacement of HHD earthen materials. These earthen materials are expected to be free of HTRW given that they were largely placed in the dike by hydraulic means over 50 years ago. It is unlikely that groundwater contamination that originates on the landward side of the HHD would migrate into the project site because groundwater in the area typically flows from the lakeside of the HHD to the landward side.

4.15 LAND USE

4.15.1 Agriculture

No Action Alternative. The No Action Alternative could significantly impact agriculture in the Lake Okeechobee area. In the event of a major structural failure of the HHD, flooding could destroy crops in the area of the failure. Floodwaters from a breach could result in immediate and long-term damage to crops in this area. The extent of agricultural damage in total acreage would be dependent upon the location of the breach in relation to agricultural activities, the lake levels at the time of the breach, and duration of flooding.

Recommended Plan. Implementation of the Recommended Plan could affect agriculture and agricultural lands. Installation of a cutoff wall could result in reduced tailwaters. The extent of this reduction, if any, is unknown, but any reduction in irrigation waters could adversely affect the availability of water in canals used to irrigate crops. Land use is not expected to change with implementation of the Recommended Plan; construction would be confined to the footprint of the existing HHD.

4.15.2 Urban Land

No Action Alternative. The No Action Alternative could result in significant consequences to urban lands around Lake Okeechobee. In the event of a major failure of the HHD, consequential flooding could have significant effects on urban lands in the area of the failure. The No Action Alternative allows current stability problems of the HHD to persist, which could lead to a major breach of the HHD during a substantial high water event. Loss of life and property in the vicinity of the breach could be substantial if the breach were to occur in a heavily populated area.

Recommended Plan. Implementation of the Recommended Plan would not result in impacts to the urban lands along Reaches 2 and 3. Construction activities would be retained to the area within the footprint of the Federal project.

4.16 TRANSPORTATION AND INFRASTRUCTURE

4.16.1 Transportation

No Action Alternative. Major transportation corridors around the perimeter of Lake Okeechobee include several highways and railroads. Impacts to existing transportation corridors resulting from a major failure of the HHD would be extensive. Structures nearest the breach could be destroyed, and travelers or freight on roads or railroads would be endangered. Even moderate flooding from a low velocity breach is likely to cause road closures and traffic delays.

Recommended Plan. Because construction of the Recommended Plan would be restricted to the footprint of the existing structure, no effects on transportation infrastructure would occur. Highway traffic can be expected to increase slightly and temporary slow-downs may result from the movement of construction equipment and personnel, but such effects are expected to be minor.

4.16.2 Infrastructure

No Action Alternative. Infrastructure within close proximity of HHD, Reaches 2 and 3 include overhead utility and transmission lines, a water treatment plant, radio towers and fuel tanks. Impacts to these structures resulting from a major failure of the HHD would be extensive. Structures nearest the breach could be destroyed, putting nearby parks and communities at risk. Damage to utility and transmission lines could cause communication and power outages.

Recommended Plan. Based on a preliminary survey, no impacts to transmission or communication structures, water and wastewater facilities, or fuel tanks is expected to result from implementation of the Recommended Plan. However, a detailed infrastructure survey will be completed prior to construction. At that time, a determination will be made regarding any necessary compensation or takings.

4.17 AESTHETIC RESOURCES

No Action Alternative. Impacts to aesthetics in the short term are anticipated, as patches and temporary emergency construction are necessary to repair ongoing piping and boils. Without major reconstruction, dust and noise from emergency construction would continue, portions of the dike would remain closed, and aesthetics and safety would be compromised.

Recommended Plan. Short-term impacts to aesthetic resources within the project area would result from construction activities and/or access of construction equipment through lands designated for staging, access and construction. Recreational areas where degraded aesthetics could affect outdoor activities include John Stretch Park and Uncle Joe's Fish Camp, both of which are adjacent to the dike. Construction activities are limited to the existing area of HHD, and the grassy side slopes of the dike are the only vegetated areas that would be affected. Aesthetics would return to existing conditions following construction when the dike is revegetated.

4.18 RECREATIONAL RESOURCES

No Action Alternative. Moderate adverse impacts to recreation resources are anticipated without major repairs to the dike. Piping and boils would continue, requiring emergency repairs for frequent breaches in the dike. Areas affected would be closed during construction for reasons of safety.

Recommended Plan. Impacts to recreation resources within the project area would result from construction activities and/or access of construction site, equipment, and staging areas. Impacts resulting from the construction of the Recommended Plan for the HHD rehabilitation would adversely affect recreation resources in the project area. Most of the construction impacts would result in a temporary disruption due to increased noise, dust and heavy equipment traffic. Other impacts may have a longer lasting affect.

Construction areas would necessitate heavy equipment traversing and working in the area of fishing, boating, sightseeing, and picnicking facilities that are located in the area. Construction near culverts and other structures could result in temporary restriction of bank fishing in the area. Preconstruction conditions would return upon completion of the project construction. No permanent adverse impacts to these recreation resources in the project vicinity are expected to occur as a result of the Recommended Plan. Visitors to John Stretch Park would experience increased noise and dust during construction of the Recommended Plan. Accessing the dike by construction crews may result in excessive wear of the park's paved roads; park amenities may require accelerated maintenance schedules. When project construction has been completed, recreation use in the area can be expected to return to pre-construction conditions.

During construction, access to certain parts of the Lake Okeechobee Scenic Trail (LOST) would be restricted, and parts of the trail would be removed. Following construction, access to the trail by the public would be restored. However, the Corps is not authorized to restore the paved surface of the scenic trail following construction. Coordination with FDEP would be conducted prior to and during construction.

4.19 CULTURAL RESOURCES

No Action Alternative. The No Action Alternative, with its continued potential for dike failure and catastrophic flooding, could have moderate to extensive consequences on nearby historic properties.

Recommended Plan. The HHD (8PB208) is historically significant and is potentially eligible for inclusion in the National Register of Historic Places (NRHP). However, the Corps has determined in accordance with the National Historic Preservation Act of 1966 (NHPA), as amended, that the Recommended Plan would cause minimal impacts on the HHD. Because construction would be restricted to the footprint of the existing Federal project, no other cultural resources would be affected. The Corps has requested concurrence with this finding from the SHPO (Appendix B).

Of note is that in a letter dated April 7, 2005, SHPO concurred with the Corps determination that reconstruction of the HHD in Reach 1 "will have no adverse effect on the characteristics qualifying this property for listing in the *National Registry of Historic Places.*" A Copy of SHPO letter is included in Appendix B.

4.20 SOCIOECONOMICS

No Action Alternative. Significant socioeconomic implications could result from continued degradation of dike stability leading to a breach of the HHD. The potential for loss of life and property from a breach is significant. The No Action Alternative does not provide adequate protection from the seepage and stability problems that threaten populated areas of Reaches 2 and 3.

Recommended Plan. It is not anticipated that there would be any long-term adverse socioeconomic impacts from implementing the Recommended Plan. Temporary adverse impacts that might be experienced include increased traffic congestion and possibly reduced tourism.

Construction and ongoing operation/maintenance would generate beneficial economic impacts for the local region and the State of Florida. Expenditures for construction and any ongoing operation/maintenance of the project would benefit employment rates, labor income, gross domestic product, and government revenues. Benefits would be even higher when taking into account the procurement of goods and services and the spending of additional labor income (indirect and induced effects of the capital spending). Construction would require tradespersons with a variety of skills. It is anticipated that most of the construction employment would be filled by individuals residing in the local study area. The project would create significant employment opportunities in other industries, including community, business, personal services, manufacturing and retail trade. Other economic benefits include a positive impact on Florida's gross domestic product and a contribution to an increase in labor incomes.

In addition to benefits to the private sector and individual households, county, state and Federal governments would benefit from the construction and operation/maintenance. Higher revenues would result from personal income taxes, employee and employer contributions to unemployment insurance plans, and other indirect taxes on goods and services.

Because construction of the Recommended Plan, as well as continued operation/maintenance, is retained in the footprint of the existing Federal project, no property transfers or relocations of individuals is required.

4.21 CUMULATIVE EFFECTS

Cumulative impacts are defined in 40 CFR 1508.7 as those impacts that result from:

> *...the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

4.21.1 Past Actions

Prior to development of the area south of Lake Okeechobee in the 19th century, a pond apple swamp-forest transitioned into pond apple hammocks and then into the sawgrass communities of the Everglades. Since that time, changes in South Florida have had marked impacts on Lake Okeechobee.

In the mid to late 1800s, modifying the hydrology of Lake Okeechobee and the Everglades was considered to be economically important. Canals would provide a navigation route between the Atlantic Ocean and the Gulf of Mexico. Clearing the land for agriculture would reduce the U.S. reliance on the West Indies by growing comparable crops in Florida. In the 1890s, a canal connecting Lake Okeechobee with Caloosahatchee River was constructed, providing the lake an outlet to the Gulf of Mexico. In the early 1900s, the Everglades Drainage District constructed several other canals that provided a slow, continuous drainage from Lake Okeechobee and the Everglades. The goal was to drain the northern Everglades for agriculture to prevent the crops from flooding. At the turn of the 20th century, sugar cane was first planted on exposed lands. Construction of the St Lucie, Hillsboro, North New River, West Palm Beach, and Miami canals, and the construction of a 47-mile-long muck levee around the southern rim of the lake altered water levels. During the 1920s, land was cleared, the town of Clewiston grew, and sugar cane and citrus became important local industries. From 1931 to 1941, sugar cane production expanded from 410,000 tons 873,000 tons.

In the 1920s, two major hurricanes struck south Florida. One generated a storm surge in the lake that flooded coastal areas and hundreds of acres to the south and killed more than two thousand people. Congress directed the USACE to prevent a recurrence, and the HHD was one of the first features of the solution. Because of the system of canals and levees built by the Corps, all discharges into and out of the lake are currently artificially controlled except Fisheating Creek.

More recently, the Central and South Florida study and the Comprehensive Everglades Restoration Program have been instituted to attempt to restore some of the natural flows from Lake Okeechobee to the Everglades.

4.21.2 Reasonable Foreseeable Future Actions

Two high-profile projects are anticipated in the general study area. The USACE anticipates completing reconstruction of HHD in the remaining reaches around Lake Okeechobee. It is likely that reconstructing the HHD would likely also produce only negligible effects on the natural environment.

In addition, the Lake Okeechobee Regulation Schedule Study (LORSS) was initiated to address continued high lake levels, estuary ecosystem conditions, and lake ecology conditions that occurred since 2003. The need for a new regulation schedule has been established by the continued deterioration of the Lake Okeechobee littoral zone and both the Caloosahatchee and St. Lucie estuaries. The recommended regulation schedule represents the best operational compromise to improve the environmental health of certain major Central and Southern Florida (C&SF) ecosystems, while providing for public health and safety and the safe operation of the HHD.

4.21.3 Natural Environment

Cumulative impacts associated with past actions have produced a natural environment that is markedly different from that of 150 years ago. The environment has been so altered that the contribution of the incremental effects of the Recommended Plan to cumulative impacts on the natural environment is negligible.

4.21.4 Human Environment

Past actions have resulted in a dike system that, although state-of-the-art when it was completed, is now recognized as substandard. The incremental effect of the Recommended Plan is a major beneficial contribution to cumulative effects of past, present, and reasonable foreseeable projects to protect public health and safety.

4.22 UNAVOIDABLE ADVERSE EFFECTS

As discussed under each resource element in Section 4.0, adverse effects associated with implementing the Recommended Plan would not be significant. Unavoidable adverse effects that would result from implementation of this alternative are expected to be minimal to moderate in severity. A summary of unavoidable negative impacts follows.

4.22.1 Topography, Geology and Soils

No significant adverse impacts to the topography, geology, and soils are likely to occur due to implementation of the Recommended Plan. Construction of the Recommended Plan would be restricted to the footprint of the existing Federal project. However, some soil disturbance could occur at staging areas. No effects on prime or unique farmlands would occur.

4.22.2 Water Resources

Minimal adverse impacts to the hydrology, water supply, water quality, and water management are expected to result from implementing the Recommended Plan.

4.22.3 Vegetation and Cover Types

No significant adverse impacts to the vegetation and cover types are likely to occur from implementing the Recommended Plan. Minimal effects would occur only within the existing HHD footprint.

4.22.4 Wetland Resources

The Recommended Plan would result in the filling of wetlands fringing the toe ditch along Reach 3 and eastern Reach 2, as well as wetlands along the dike side of the borrow canal in western Reach 2. Compensation for the loss of wetlands would be provided.

4.22.5 Fish and Wildlife Resources

Minimal adverse effects to fish and wildlife are likely to occur due to implementation of the preferred alternative. The foraging habitat for wading birds in the landward toe ditch at Reach 3 and eastern Reach 2 would be filled, necessitating their foraging at abundant alternative locations. Additionally, habitat for reptiles, amphibians, fishes, and invertebrates utilizing the toe ditch would be lost.

4.22.6 Threatened and Endangered Species

Impacts to threatened and endangered species are expected to be minimal. The foraging habitat for listed wading birds (e.g., wood storks, tri-colored heron, little blue heron) in the toe ditch at Reach 3 and eastern Reach 2 would be filled, necessitating their foraging at abundant alternative locations. Surveys and management measures for certain species would be conducted or followed prior to construction to minimize impacts. See Section 5.0 for details.

4.22.7 Noise

Minor localized noise related impacts during construction operations are expected to occur.

4.22.8 Air Quality

Minor localized air quality impacts during construction operations are expected to occur.

4.22.9 Land Use

Because construction would be limited to the footprint of the existing Federal project, no alteration of land use would result from the project.

4.22.10 Aesthetic Resources

Limited, short-term adverse impacts associated with construction activities would affect the quality of aesthetic resources within the project area.

4.22.11 Recreation Resources

Limited but significant, short-term and long-term adverse impacts associated with construction activities would be imposed on recreation resources within the project area. These impacts may be mitigated by implementation of a well planned recreation measures plan which would account for the cost of pavement resurfacing at parks and other areas used for staging and equipment access, tree replacement, and park amenity replacement, rehabilitation, or repair. An inventory of park amenities and utilities prior to construction would facilitate a rapid return to pre-construction state for those areas so impacted. However, the Corps does not have authority for this project to make repairs to such areas as LOST that would be removed or impacted with construction. These areas could be impacted long term.

4.23 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Long-term benefits and short-term adverse environmental impacts represent tradeoffs between the local short-term use and the long-term benefits of a project. Long-term productivity would result from an improved HHD offering greater protection from catastrophic dike failure and flooding to the human and natural environments in the Lake Okeechobee area.

Short-term uses associated with the Recommended Plan include construction resources, dollars, and labor expended during road construction. They also include short-term construction-related inconveniencies related to traffic flow, noise, businesses, and other environmental effects, as discussed in Section 4.0 of this document.

The long-term beneficial effects of enhanced flood protection resulting from the implementation of this project greatly outweigh any unavoidable adverse impacts.

4.24 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

The Recommended Plan would require irreversible and irretrievable commitments, which would include the expenditure of funding, energy, labor, and materials. The project would not cause the permanent removal or consumption of any renewable resources. However, implementation would commit lands and resources for reconstruction of the HHD, fill material, and other project features.

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5.0 MITIGATION

As part of their concurrence with the 1999 DEIS, the USFWS recommended in the Coordination Act Report (CAR) that the Corps provide mitigation for the backfilling of Reach 1 wetlands by restoration of degraded wetlands. The Corps concurred with the mitigation recommendations and created mitigation between 2000 and 2004 through wetlands grading, tree planting and melaleuca (*Melaleuca quinquenervia*) removal. Melaleuca, Brazilian pepper (*Schinus terebinthifolius)*, and Australian pine (*Casuarina equisetifolia*) were all treated and removed in Reach 4 from Old Sportsman's Village to just north of the Marina. Additionally, native wetland trees including cypress, red maple, and pond apple were planted along the toe of HHD in the mitigation area in June of 2004. The UMAM was used to assess the value of habitat created. The tree planting resulted in 1 credit of mitigation. Other mitigation was created through the removal of 57 acres of melaleuca adjacent to Reach 2 (near the Alvin Ward Boat Ramp) and maintenance of this area. The UMAM scored the habitat value as equivalent to 26.32 credits. Photographs, worksheets and determination formulas for the UMAM and mitigation assessment are included in Appendix F.

The total mitigation created in the two areas is 27.32 (Table 11). A portion of this mitigation (3.8 acres) was used for Reach 1 improvements, leaving a total of 23.52 mitigation credits available for Reach 2 and 3 assessment areas. The UMAM for Reach 2 and 3 impact assessment areas showed that the total number of credits needed is 73.21. Therefore, an additional 49.69 mitigation credits are required to offset the proposed 229.50 acres of impacts in Reaches 2 and 3.

Table 11. Mitigation Credits

Mitigation Credits Needed for Reaches 2 and 3	Total Mitigation Credits Created	Mitigation Required for Reach 1	Mitigation Credits Available	Additional Mitigation Credits Needed for Reaches 2 and 3
73.21	27.32	3.8	23.52	49.69

The Corps recommends and will request authorization to provide off-site compensatory mitigation for wetland losses resulting from the reconstruction of HHD at Reaches 2 and 3.

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6.0 ENVIRONMENTAL COMMITMENTS

The U.S. Army Corps of Engineers and contractors commit to avoiding, minimizing or mitigating for adverse effects during construction activities by including the following commitments in the contract specifications:

1. The Corps shall conduct a pre-construction survey to determine actual locations of bald eagle nests within the immediate vicinity of Reaches 2 and 3 prior to issuance of any construction contracts. Results shall be coordinated with the USFWS, Vero Beach office.

2. Standard protection measures regarding the Eastern indigo snake shall be included in the environmental protection plan when the Corps proceeds to the plans and specifications phase for this project.

3. The Corps shall conduct a survey for burrowing owls commensurate with that for bald eagle nests prior to issuance of any construction permits. The Corps shall consult with the FFWCC regarding adopting standardized protection measures should any owls be identified within Reaches 2 and 3. Results shall be coordinated with the USFWS and FFWCC. If burrowing owls are found to be present in the project area, impacts shall be minimized by altering construction schedules to avoid the nesting season and/or burrows shall be cordoned off to avoid their direct destruction.

4. Continued recreation planning shall be performed during detailed project engineering and design. In addition, the appropriate FDEP representative shall be contacted to insure collaboration on design features with the Scenic Trail Master Plan Coordination and the Lake Okeechobee Scenic Trail. An inventory of park amenities and utilities prior to construction would facilitate a rapid return to preconstruction state for those areas so impacted.

   At this time, it is anticipated that a portion of the Lake Okeechobee Scenic Trail may be removed during construction. The construction contractors will be required to limit all impacts away from the trail and other park amenities to the extent practical. However, parts of the trail may be removed during construction. The Corps will continue to coordinate with FDOT and FDEP on the impacts to the trail.

5. Construction crews shall be made aware of the potential for the presence of the Okeechobee gourd. If the gourd is found, the Service shall be notified.

6. The project will require a water quality certification under Chapter 373, F.S. and Section 402 of the Clean Water Act**.**

7. Turbidity screening and diversion will be used to control impacts to the drainage ditches and connected canals. Runoff from the construction site or from storms shall be controlled, retarded, and diverted to protected drainage courses by means of diversion ditches, benches, and by any measures required by area wide plans approved under paragraph 208 of the Clean Water Act. Temporary and permanent erosion and sedimentation control features or screening will be installed. Temporary velocity dissipation devices shall be placed along drainage courses to provide for non-erosive flows. Temporary erosion and sediment control measures such as berms, dikes, drains, sediment traps, sedimentation basins, grassing, mulching, baled hay or straw, and silt fences shall be maintained until permanent drainage and erosion control facilities are completed and operative. For silt fences, the filter fabric is to be of nylon,

polyester, propylene, or ethylene yarn of at least 50 lb/in strength and able to withstand a flow rate of at least 0.3 gal/ft sq/minute. It also would contain ultraviolet ray inhibitors and stabilizers and be a minimum of 36 inches in width.

In addition, during construction, the Contractor will be responsible to keep construction activities, including refueling and maintenance sites, under surveillance, management, and control to avoid pollution of surface, ground waters, and wetlands. The Contractor is responsible to conduct all operations in a manner to minimize turbidity and shall conform to all water quality standards as prescribed by Chapter 62-302, State of Florida, Department of Environmental Protection.

8. Project construction shall not destroy migratory birds, their active nests, their eggs, or their hatchlings. Monitoring for such would be required of the construction contractor. A buffer zone around active nests or nestling activity would be required during the nesting season.

7.0 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

The alternative plans were considered in relation to compliance with Federal environmental review and consultation requirements.

7.1 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, as amended

A Notice of Intent to prepare a *Second Supplemental Environmental Impact Statement to the Final EIS on Herbert Hoover Dike Major Rehabilitation and Evaluation Report, Reaches 2 and 3* was published in the Federal Register Volume 71, Number 153 on August 9, 2006. A Scoping Letter describing the proposed project and soliciting comments was sent to government agencies, non-governmental agencies, Indian Tribes and the interested public on August 10, 2006. Written responses to the Scoping Letter were submitted to the Corps and served to assist in identifying potential environmental and planning issues throughout the study. A copy of the Scoping Letter and written responses are on file at the U.S. Army Corps of Engineers, Jacksonville District.

In general, the comments reflect a willingness of local, regional, state, and Federal agencies to participate in the project. Comments and responses to those comments have been incorporated into the Supplemental Draft EIS in Appendix E.

7.2 FISH AND WILDLIFE COORDINATION ACT OF 1958, as amended

In response to the requirements of this Act, the Corps has and will continue to maintain continuous coordination with the U.S. Fish and Wildlife Service and the Florida Fish and Wildlife Conservation Commission during all stages of the planning and implementation of this project. The November 30, 2006 USFWS letter and the 1999 USFWS Coordination Act Report in Appendix A addresses the Fish and Wildlife Coordination Act of 1958.

7.3 ENDANGERED SPECIES ACT OF 1973, as amended

Through its November 30, 2006 letter (Appendix A), USFWS has concurred that the Recommended Plan is “not likely to adversely affect” listed species. Any changes or additional designs of the project would be coordinated to ensure that those recommendations mutually agreed upon between the Corps and either USFWS or NMFS, as appropriate, are carried out. This project is in full compliance with the Act.

7.4 NATIONAL HISTORIC PRESERVATION ACT OF 1966, as amended

The Florida SHPO has stated the Herbert Hoover Dike is historically significant for its engineering design and is potentially eligible for listing in the National Register. The Corps will continue to consult with SHPO regarding the rehabilitation of the dike. The study is in full compliance with this Act.

7.5 CLEAN WATER ACT of 1972, as amended

Full compliance will be achieved with issuance of Water Quality Certification under Section 401 from the State of Florida. A Section 404(b)(1) Evaluation is included in this report as Appendix C. The study is in compliance at this stage. Section 402(b)(2) requires that a NPDES construction activities permit be acquired. The FDEP issues these permits within 48 hours of application. This permit will be acquired prior to initiation of construction.

7.6 CLEAN AIR ACT OF 1972, as amended

This project has been coordinated with the Florida Department of Environmental Protection, Air Quality Division, and the U.S. Environmental Protection Agency. No air quality permits are required, and no permanent sources of air emissions are part of the Recommended Plan. This project is in full compliance with Sections 176 and 309 of the Clean Air Act.

7.7 COASTAL ZONE MANAGEMENT ACT OF 1972, as amended

A Federal consistency determination has been prepared in accordance with the provisions of 15 CFR 930 and is located in Appendix D.

7.8 FARMLAND PROTECTION POLICY ACT OF 1981

No farmland would be affected in the project footprint. The project is in full compliance.

7.9 WILD AND SCENIC RIVER ACT OF 1968, as amended

No rivers designated under the Act are in the project area. The project is in full compliance.

7.10 ESTUARY PROTECTION ACT OF 1968

No estuaries under the Act are in the project area. However, failure of the dike, a possibility under the no action alternative, could severely negatively impact estuaries downstream of Lake Okeechobee as large deliveries of fresh water dramatic change the estuarine water chemistry. The project is in full compliance.

7.11 FEDERAL WATER PROJECT RECREATION ACT OF 1965, as amended

The effects of the proposed action on outdoor recreation have been considered and are presented in the Supplemental and Final EIS. Short-term impacts to the Lake Okeechobee Scenic Trail located on top of the dike will require close coordination with FDOT and FDEP in order to return the trail to as-built conditions and limit trail closure time. Continued recreation planning will be performed during detailed project engineering and design. The project is in full compliance at this stage.

7.12 RESOURCE CONSERVATION AND RECOVERY ACT OF 1976

This law has been determined to be not applicable, as there are no items regulated under this act either being disposed of or affected by this project.

7.13 TOXIC SUBSTANCES CONTROL ACT OF 1976

This law has been determined to be not applicable, as there are no items regulated under this act either being disposed of or affected by this project.

7.14 MARINE PROTECTION, RESEARCH, AND SANCTUARIES ACT OF 1972, as amended

This Act is not applicable. Ocean disposal of dredged material is not proposed as a part of the HHD Major Rehabilitation Evaluation Feasibility Report.

7.15 RIVERS AND HARBORS APPROPRIATION ACT OF 1899

The study is in full compliance. The proposed work would not obstruct navigable waters of the United States.

7.16 COASTAL BARRIER RESOURCES ACT

This Act is not applicable. The study area is not in a designated Coastal Barrier Resources Act unit.

7.17 SECTION 904 OF THE 1986 WATER RESOURCES DEVELOPMENT ACT

Section 904 of the 1986 Water Resources Development Act requires that the plan formulation and evaluation process considered both quantifiable and unquantifiable benefits and costs of the quality of the total environment, and preservation of cultural and historical values. The study and report are in full compliance.

7.18 SECTION 307 OF THE 1990 WATER RESOURCES DEVELOPMENT ACT

Section 307 of the 1990 Water Resources Development Act establishes, as part of the water resources development program, an interim goal of no overall net loss of the Nation's remaining wetlands, and a long-term goal of increasing the quality and quantity of the Nation's wetlands. The Recommended Plan is in compliance. Several acres of remnant, poor quality wetlands are likely to be effected. Avoidance of higher quality wetlands and mitigation for effected wetland acreage will ensure there is no net loss of wetland function.

7.19 E.O. 11988, FLOODPLAIN MANAGEMENT

The study is in compliance. While the considered alternatives have no impact on avoidance of development in the flood plain, the Recommended Plan would directly support a reduction in hazards and risks associated with floods and would minimize the impact of floods on human safety, health and welfare. The Recommended Plan would have no impact on the restoration and preservation of the natural and beneficial values of the base flood plain.

7.20 E.O. 11990, PROTECTION OF WETLANDS

The study is in compliance. The Recommended Plan would result in filling the landward toe ditch, a man-made, yet functional wetland of moderate to poor functional value. However, appropriate measures to provide compensatory mitigation would be taken.

7.21 E.O. 12114, ENVIRONMENTAL EFFECTS ABROAD OF MAJOR FEDERAL ACTIONS

This executive order is not applicable to this study. The study area does not include lands outside the United States.

7.22 E.O. 12898, ENVIRONMENTAL JUSTICE

Executive Order 12898 requires the Federal government to review the effects of their programs and actions on minorities and low-income communities. The Recommended Plan that was formulated for the Herbert Hoover Dike would help to ensure the safety of those communities within the study area as well as residents living within the area anticipated to be impacted in the event of a project failure. In addition to ensuring the safety and well being of residents and their property, implementation of the Recommended Plan may have a significant beneficial effect on local communities through job creation, increased sale of construction material and other goods necessary to sustain a large construction force for the duration of the project. The study area is known to contain an important percentage of low income and minority individuals. This project is not expected to have disproportionately high and adverse human health or environmental impacts on minority or low-income populations.

7.23 SAFE DRINKING WATER ACT (SDWA) of 1974, as amended

Lake Okeechobee, as well as ground and surface waters, supply drinking water for several communities around the lake. Implementation of the project would not impact water quality of Lake Okeechobee, ground waters, or surface water used to supply drinking water. This project complies with the Act.

7.24 E.O. 13112, INVASIVE SPECIES

Exotic and invasive plant species are within drainage swales, connecting canals, wetlands, and some uplands within the project area. However, the project will not contribute to nutrient loading that could favor invasive species. In addition, some removal of invasives will be necessary, and maintained, within the toe dike swales for purposes of constructing and maintaining the proposed inverted drain system. Ballast water organisms or terrestrial exotic wildlife species are not anticipated to be affected. This project is in full compliance with the Act.

7.25 MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

The project is in compliance with these acts. Under the Migratory Bird Treaty Act, project construction shall not destroy migratory birds, their active nests, their eggs, or their hatchlings. Monitoring for such would be required of the construction contractor. A buffer zone around active nests or nestling activity would be required during the nesting season.

7.26 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Coordination has been completed with the NMFS under provisions of this Act. In a letter dated April 18, 2005, NMFS concurred with the Corps' determination that the EFH and other marine resources would not be affected and the goals and requirements of the Acts have been met. This project is in full compliance with the Act.

8.0 PUBLIC COORDINATION

8.1 SCOPING

A Notice of Intent (NOI) to prepare a *Second Supplemental Environmental Impact Statement to the Final EIS on Herbert Hoover Dike Major Rehabilitation and Evaluation Report, Reaches 2 and 3* was published in the Federal Register Volume 71, Number 153 on August 9, 2006. A Scoping Letter describing the proposed project and soliciting comments was sent to government agencies, non-governmental agencies, Indian Tribes and the interested public on August 10, 2006. Written responses to the Scoping Letter were submitted to the Corps and served to assist in identifying potential environmental and planning issues throughout the study. Copies of the NOI, the Scoping Letter, and written responses are included in Appendix E.

8.2 CIRCULATION OF DRAFT SUPPLEMENTAL EIS

Copies of the Draft Supplemental EIS have been mailed to appropriate Federal, State, and local agencies, as well as to persons known to have an interest in the project. Public libraries in the project area have also been provided copies to maintain in their reference sections. A list of recipients is provided in Section 9.0. Additional copies of the Draft Supplemental EIS have been made available to any requesting parties. The Draft Supplemental EIS was also posted electronically for web viewing.

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9.0 LIST OF PREPARERS

The people who were responsible for contributing to this Draft Supplemental EIS are listed in Table 12.

Table 12. List of Preparers

Name	Discipline/ Expertise	Organization	Role in Document Preparation
Pauline Smith	Engineer	USACE	Project Management
Barbara Cintron	Ecologist	USACE	Project Management; Supervision; Review
Nancy Allen	Biologist	USACE	NEPA and Environmental Technical Lead
Carrie Bond	Biologist	USACE	NEPA and Environmental Technical Assistant
David Pugh	Archeologist	USACE	Cultural Resources
Hansler Bealyer	Real Estate	USACE	Real Estate
Jay Davis	Civil Engineer	USACE	Engineering Technical Lead
Sam Honeycutt	Geotechnical Engineer	USACE	Geotechnical Lead
John Pax	Attorney	USACE	Reviewer
Kenneth Duggar	Biologist	USACE	Reviewer
Michael Loden	Environmental Scientist	G.E.C., Inc	EIS/Report Preparation; Supervision; Review
Laura Carnes	Environmental Planner	G.E.C., Inc	EIS/Report Preparation; General
Cade E. Carter	Civil Engineer	G.E.C., Inc	EIS/Report Preparation; Engineering
Stephanie Murray	Biologist	G.E.C., Inc	EIS/Report Preparation; Biology
Joseph Wyble	Geologist	G.E.C., Inc	EIS/Report Preparation and Review

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10.0 LIST OF RECIPIENTS

FEDERAL AGENCIES

Bureau of Indian Affairs
Everglades National Park
Federal Emergency Management Administration
Federal Highway Administration
National Marine Fisheries Service
U.S. Environmental Protection Agency, Region 4
U.S. Army Corps of Engineers
U.S. Department of Agriculture
U.S. Department of Energy
U.S. Department of Housing and Urban Development
U.S. Department of the Interior
U.S. Department of Justice
U.S. Fish and Wildlife Service

STATE AGENCIES

Department of Agriculture and Consumer Services
Florida Department of Agriculture
Florida Department of Environmental Protection
Florida Department of Transportation
Florida Fish and Wildlife Conservation Commission
Florida Power and Light
South Florida Water Management District

ASSOCIATIONS

1000 Friends of Florida
Audubon Society of the Everglades
Caloosahatchee River Citizens Association
Defenders of Wildlife
FADE
Florida Audubon Society
Florida Sportsmen Conservation Association
Florida Wildlife Federation
Friends of Lake Okeechobee
Friends of the Everglades
Izaak Walton League
Lake Region Audubon Society
League of Women Voters, Broward
National Audubon Society
National Parks and Conservation Association
National Resources Defense Council
National Wildlife Federation
Ridge Audubon Society
Save the Manatee
Sierra Club, Loxahatchee
St. Lucie River Initiative
The Arthur R. Marshall Foundation and Florida Environmental Institute, Inc.
The Florida Biodiversity Project
The Nature Conservancy
The Wilderness Society
Tropical Audubon Society
Trust for Public Lands
World Wildlife Fund

NATIVE AMERICAN TRIBES

Miccosukee Tribe of Indians
Seminole Tribe of Florida

FLORIDA LIGISLATIVE OFFICES

Government Responsibility Council
House Environmental Protection Committee
Legislative Library

AGRICULTURE INTERESTS

Dairy Farmers Inc.
Drake Ranch
Florida Cattleman's Association
Florida Citrus Mutual
Florida Sugar Cane League, Inc.
Flo-Sun, Inc.
Frierson Farm
Gulf Citrus Growers
Indian River Citrus league
Landers & Parsons
Lewis Friend Farms, Inc.
MacVicar, Frederico & Lamb, Inc.
McArthur Farm
South Florida Agricultural Council
Stitt Ranch Inc.
Sugar Cane Growers Cooperative
United States Sugar Corp.

COUNTIES

Glades County Administration
Hendry County Administration
Martin County Administration
Metro-Dade Center, Office of the City Manager
Miami Date County
Okeechobee County Administration
Osceola County Administration
Palm Beach County Administration
Polk County Administration
St. Lucie County Administration

COUNTY LIBRARIES

Barron Library
Belle Glade Branch Public Library
Clewiston Public Library
Glades County Public Library
Hendry County Public Library
Highlands County Library System
Luola V. York Library
Martin County Library System
Okeechobee County Library
Osceola County Library System
Palm Beach County Library System
South Bay Public Library
St. Lucie County Library System

OTHER PUBLIC

Belle Glade Chamber of Commerce
Bill Mathis
City of Pahokee
LBFH Inc.
Marine Industries Association of Florida
Mr. and Mrs. Clayton Diebel
Mr. Jack Moler
Mr. John Geddie
Okeechobee Waterways Association
Pahokee Chamber of Commerce
Pahokee Marina

11.0 ACRONYMS AND ABBREVIATIONS

asl	Above Sea Level
BMPs	Best Management Practices
bsl	Below Sea Level
CFR	Code of Federal Regulations
CAR	Coordination Act Report
C&SF	Central and Southern Florida Project
Corps	US Army Corps of Engineers
dB	decibels
DEIS	Draft Environmental Impact Statement
EAA	Everglades Agricultural Area
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FFWCC	Florida Fish and Wildlife Conservation Commission
FGFWFC	Florida Game and Fresh Water Fish Commission
FMSF	Florida Master Site File
FNAI	Florida Natural Areas Inventory
FNST	Florida National Scenic Trail
GLOTA	Greater Lake Okeechobee Tourist Alliance
HHD	Herbert Hoover Dike
HGS	Hurricane Gate Structure
LOST	Lake Okeechobee Scenic Trail
MRR	Major Rehabilitation Report
MWL	Minimum Water Level
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act of 1966, as amended
NRHP	National Register of Historic Places
PSD	Prevention of Significant Deterioration
SDEIS	Supplemental Draft Environmental Impact Statement
SFWMD	South Florida Water Management District
SHPO	State Historic Preservation Officer
UMAM	Uniform Mitigation Assessment Method
USFWS	United States Fish and Wildlife Service
VE	Value Engineering
WCA	Water Conservation Area

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12.0 REFERENCES CITED

Archaeological Consultants, Inc. 1991. A Cultural Resources Survey of a Segment of State Road 15 from State Road 729 to State Road 700 at Canal Point in Palm Beach County, Florida. Ms on file, FMSF, Tallahassee, Florida.

Carr, Robert S., W.S. Steele, and Joe Davis. 1995. Archaeological Assessment and Survey of the Rowland Tract, Okeechobee County, Florida. AHC Technical Report #114. Ms on file, U.S. Army Corps of Engineers, Jacksonville, Florida.

David Miller & Associates. March 1998. Final Report; Economic Impact Evaluation, Lake Okeechobee Regulation Schedule Study.

Eiseman, N.J. and C. McMillan. 1980. A new species of seagrass, *Halophila johnsonii,* from the Atlantic coast of Florida. Aquat. Bot. 9:15-19.

FNAI. March, 1998. Florida Natural Areas Inventory: Element Occurrence Records. Tallahassee, Florida.

FP&L. 1989. The West Indian Manatee In Florida. Written by Victoria Brook Van Meter for Florida Power & Light Company. Miami, Florida.

Fernald, Edward A., and Donald J. Patton. 1984. Water Resources Atlas of Florida. Florida State University.

Florida Department of Environmental Protection (FDEP), Office of Greenways and Trails. (2006). Lake Okeechobee Scenic Trail. Internet resource: http://www.dep.state.fl.us/gwt/.

Florida Department of Environmental Protection. (1996). 1996 Water Quality Assessment for the State of Florida. Technical Appendix: South and Southeast Florida. Tallahassee, FL.

Florida Department of Environmental Protection. March 1998. Air Resources Management System, Air Index Reports for Martin and Palm Beach Counties, Florida.

Hallam, Charlotte O., Kimberly Wheaton, and Richard Fischer. 1998. Eastern Indigo Snake (*Drymarchon corais couperi*) on Military Reservations in the Southeastern United States. Technical Report SERDP-98-2. U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS.

Henry, James A., Kenneth M. Portier, and Jan Coyne. 1994. The Climate and Weather of Florida. Pineapple Press, Inc. Sarasota, Florida. 279 pp.

Klein, Howard, M. C. Schroeder, and W. F. Lichtler. 1964. Report of Investigations No. 37, Geology and Ground-Water Resources of Glade and Hendry Counties, Florida. U.S. Geological Survey. Tallahassee, Florida.

Lake Okeechobee.org. 2006. Geology and Hydrology of Lake Okeechobee. Internet Resource: http://www.lakeokeechobee.org/.

Lichtler, William F. 1960. Report of Investigations No. 23, Geology and Ground-Water Resources of Martin County, Florida. Water Resources Division, U.S. Geological Survey. Tallahassee, Florida.

Mazzotti, Frank J. December, 1990. University of Florida, Florida Cooperative Extension Service. Publication SS-WIS-12: Wood Storks (Mycteria americana). Gainesville, Florida.

Milano, Karen Webster. 1995. City of Belle Glade Historic Site Survey. Prepared for the City of Belle Glade. Ms on file, FMSF, Tallahassee, Florida.

Moler, Paul E., and Joan E. Berish. 1995. Impact of Commercial Exploitation on Softshell Turtle Populations. Florida Game and Fresh Water Fish Commission. Tallahassee, FL

Morrison, J.L. 2001. Recommended management practices and survey protocols for Audubon's crested caracara (*Caracara cheriway audubonii*) in Florida. Technical Report No. 18. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

National Oceanic and Atmospheric Administration (NOAA), Office of Marine Fisheries. 2006. Internet resource: www.nmfs.noaa.gov/pr/species/plants/johnsons.htm

O'Dell, Kim, Bruce Sharfstein and Steve Gornak. 2005. Restoration of Former Agricultural Land to Wetlands on Lake Okeechobee's Ritta Island. Proceedings of the 16th Annual Conference of the Florida Lake Management Society, pp. 4.9-4.10.

Piper Archaeology/Janus Research. 1992. Cultural Resource Assessment Survey of the Proposed Levee-Midway Transmission Line, St. Lucie, Martin, Palm Beach, Broward, and Dade Counties, Florida. Ms on file, FMSF, Tallahassee Florida.

Purdum, Elizabeth, *et al*. 1994. Florida County Atlas and Municipal Fact Book. Florida State University.

Schaefer, Joe, and Janet Junkin. December, 1990. University of Florida, Florida Cooperative Extension Service. Publication SS-WIS-24: The Eastern Indigo Snake: A Threatened Species. Gainesville, Florida.

Schroeder, M. C., D. L. Milliken and S. K. Love. 1954. Report of Investigations No. 13, Water Resources of Palm Beach County, Florida. Water Resources Division, U.S. Geological Survey. Tallahassee, Florida.

University of Florida. 1998. Florida Museum of Natural History, Species Account. Internet Resource: <http//www.flmnh.ufl.edu/natsci/herpetology/brittonerocs/csp_amis.htm>.

U.S. Army Corps of Engineers (USACE). 2006. Lake Okeechobee Regulation Schedule Study. Draft Supplemental Environmental Impact Statement. Jacksonville, Florida.

U.S. Army Corps of Engineers (USACE). 1999a. Lake Okeechobee Regulation Schedule Study. Final Environmental Impact Statement. Jacksonville, Florida.

U.S. Army Corps of Engineers (USACE). 1999b. Wildlife Survey and Habitat Utilization Study of Western Littoral Zone, Lake Okeechobee, Florida.

U. S. Department of Agriculture (USDA), Soil Conservation Service. December 1978. Soil Survey of Palm Beach County Area, Florida.

U.S. Department of the Interior. July 1997. Land Acquisition Programmatic Environmental Assessment, Everglades Agricultural Area. Internet Resource: http://www.nps.gov/planning/ever/eaa/wildlife.htm

U.S. Fish and Wildlife Service (USFWS). 1999. South Florida Multi-species Recovery Plan. 2172 pages.

U.S. Fish and Wildlife Service (USFWS). February, 1997. U.S. Fish and Wildlife Service Division of Endangered Species. Okeechobee Gourd, Species Account. Internet Resource: http://www.fws.gov/r9endspp/i/qad.html

U.S. Fish and Wildlife Service (USFWS). May, 1996. U.S. Fish and Wildlife Service Division of Endangered Species. Everglade Snail Kite, Species Account. Internet Resource: http://www.fws.gov/r9endspp/i/b/sab0v.html

U.S. Fish and Wildlife Service (USFWS). February, 1996. U.S. Fish and Wildlife Service, Official Correspondence.

U.S. Fish and Wildlife Service (USFWS). July, 1995. Bald Eagle, Wildlife Species Biologue. Internet Resource: <http:/www.fws.gov/r9extaff/biologues/bio_eagl.html>

U.S. Fish and Wildlife Service (USFWS). March, 1998. Multi Species Recovery Plan for the Threatened and Endangered Species of South Florida, Volume I of II, Okeechobee Gourd. U.S. Fish and Wildlife Service, Atlanta, Georgia.

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13.0 INDEX

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Appendix A

FISH AND WILDLIFE COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

November 24, 2006

RECEIVED
30 NOV 2006

Stuart J. Appelbaum
Chief, Planning Division
U.S. Army Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Appelbaum:

The Fish and Wildlife Service (Service) has reviewed the additional information submitted by the U.S. Army Corps of Engineers (Corps), dated October 4, 2006, regarding a technical review report on Herbert Hoover Dike (HHD) Major Rehabilitation Project that included recommendations for urgent repairs to Reach 1A. The Corps has suspended construction of the previously selected plan (bench and cutoff wall) and wants to begin the toe ditch repairs quickly, in anticipation of the 2007 rainy season. A review group of Corps' engineers recommended depositing and compacting sand and gravel in the levee toe ditch and building up a berm over the ditch. The purpose of the work is to stabilize the outer toe of HHD and prevent further deterioration. This letter represents the Service's view of the effects of the proposed action in accordance with section 7 of the Endangered Species Act of 1973, as amended (87 Stat. 884; 16 U.S.C. 1531 *et seq.*) and the provisions of the Fish and Wildlife Coordination Act of 1958, as amended (FWCA) (48 Stat. 401; 16 U.S.C. 661 *et. seq.)*.

FISH AND WILDLIFE COORDINATION ACT

The proposed modifications are very similar to a component of the alternatives originally considered for HHD repair in the 1999 Draft EIS, and previously addressed in our Final FWCA report dated December 20, 2001, and in our previous supplemental FWCA reports, dated March 4, 2003, and March 8, 2004. Since the Corps had documented the proposed fill in the 1999 draft EIS, and subsequently carried out the mitigation actions for wetlands losses, and the revised design appears to avoid further impacts to wetlands, no additional mitigation will be required. However, if modifications are made to the project design that potentially impact wetland habitat, further evaluation may be required under the FWCA.

THREATENED AND ENDANGERED SPECIES

The Service concurred on June 9, 1999, with the Corps' determination that the project was "not likely to adversely affect" the threatened bald eagle (*Haliaeetus leucocephalus*) or the threatened eastern indigo snake (*Drymarchon corais couperi*). We must remind you the Corps' proposed measures to avoid adverse effects to the bald eagle and the eastern indigo snake remain in effect.

Our field inspections indicated the consistent presence of a bald eagle along the HHD between Canal Point and Pahokee at about Mile 10, measuring south from Port Mayaca. This was noted in our draft FWCA reports, dated February 11, 2000, and March 8, 2004. The Corps must search the area for bald eagle nests prior to construction to avoid construction activities that may disrupt nesting. In addition, prior to project construction, the contractor will instruct all personnel associated with the project that endangered species may be present in the area, and the need to avoid harming, harassing, or killing these species and the civil and criminal consequences. Construction activities must be kept under surveillance, management, and control to minimize any interference, disturbance, or impact to these resources.

On October 5, 2006 an interagency team composed of Corps staff, an Engineer from the Florida Department of Environmental Protection, Corps contract staff, and a Service biologist conducted an inspection of Reaches 1, 3, and 2 with project engineer Jacob R. Davis. We discussed the subject modifications to the plan now included for urgent repairs to Reach A.

It appears the subject repairs will not further impact wildlife with the exception of temporary impacts associated with construction. We are delighted to see the effort the Corps' project engineer has made to minimize potential impacts on wildlife resources. In addition, we have noticed sensitivity analysis has been performed for Reach A to determine the nature and amount of backfill materials used in these repairs. We continue to encourage Corps' engineering staff to perform this analysis for each identified section to determine the total length of the portion of the toe ditch that needs to be backfilled. The Corps can further limit project cost and also environmental impacts as the project proceeds to detailed design.

Based on our review of the information provided regarding the recommendations for urgent repairs to Reach A and the Corps' continued acceptance of measures to avoid adverse effects to the bald eagle and the eastern indigo snake, we find there is no need to reinitiate consultation at this time. If modifications are made to the project, if additional information involving potential effects to listed species becomes available, if a new species is listed, or if designated critical habitat may be adversely affected by the project, reinitiation of consultation may be necessary.

We greatly appreciate your cooperation in this planning effort and thank you for your support in protecting significant fish and wildlife resources. If you have any questions regarding this project, please contact Agustin P. Valido at 772-562-3909, extension 298.

Sincerely yours,

Paul Souza
Field Supervisor
South Florida Ecological Services Office

cc:
Corps, Jacksonville, Florida (Nancy Allen)
Corps, Jacksonville, Florida (Jacob R. Davis)
FWC, West Palm Beach, Florida (Chuck Collins)
FDEP, West Palm Beach, Florida (Stan Ganthier)
Service, Jacksonville, Florida (Miles Meyer)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

December 20, 2001

Colonel James G. May
District Engineer
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Attention: Planning Division

Re: Herbert Hoover Dike
Major Rehabilitation Report
(Reach One)

Dear Colonel May:

We are pleased to provide the enclosed final Fish and Wildlife Coordination Act (FWCA) report for the Herbert Hoover Dike Major Rehabilitation report. This report is provided in accordance with the Fish and Wildlife Coordination Act of 1958 (48 Stat. 401, as amended: 16 U.S.C. 661 et seq.) and section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). In a letter dated November 12, 1998, the Florida Fish and Wildlife Conservation Commission provided concurrence with the findings and recommendations in our draft FWCA report. This report constitutes the recommendations of the Secretary of the Interior in accordance with section 2(b) of the FWCA.

We greatly appreciate your cooperation in this planning effort. If you have any additional questions, please contact David Hallac at 561-562-3909, extension 279, or Robert Pace at extension 239.

Sincerely yours,

For James J. Slack
Field Supervisor
South Florida Ecological Services Office

Enclosure

cc:
FWS, ARD-ES Atlanta, GA (Cynthia Dohner)
Corps, Jacksonville, FL (Olice Carter)
Corps, Jacksonville, FL (Carl Dunn)
Corps, Clewiston, FL (Angie Charles)
FWC, Vero Beach, FL (Joe Walsh)

FINAL FISH AND WILDLIFE COORDINATION ACT REPORT

ON THE

HERBERT HOOVER DIKE
MAJOR REHABILITATION REPORT
(REACH ONE)

Prepared by:

Robert T. Pace and David E. Hallac
U.S. Fish and Wildlife Service
South Florida Restoration Office
Vero Beach, Florida

December 11, 2001

I. IDENTIFICATION OF PURPOSE, SCOPE, AND AUTHORITY

The levee system around Lake Okeechobee began as a project of the State of Florida with the construction of 47 miles of low levees in 1927. The River and Harbor Act of July 3, 1930, approved reconstruction and improvement of the levee after the original low levee failed during the 1928 hurricane. Reconstruction of the levees started in 1931 along the south shore of the lake. By 1937, 69.2 miles of continuous levee had been completed around the west, south, and east shores of the lake.

The Flood Control Act of 1948 (P.L. 858, 80th Congress, 2d Session) authorized the first phases of the comprehensive plan to provide flood protection and other water control benefits in central and south Florida. In 1961, the levee system was dedicated and renamed the Herbert Hoover Dike (HHD). The elevation of the HHD was raised and structural improvements were made between 1962 and 1967.

In 1993, the U.S. Army Corps of Engineers (Corps) prepared a special report entitled, "Herbert Hoover Dike, Seepage and Stability Analysis." The present feasibility study, which will result in a Major Rehabilitation Report (MRER), stems from concerns about the stability of the HHD. The emphasis of the current phase of study is Reach One of the HHD (see *Location of the Study Area*, below). The major objectives of the MRER are to: 1) determine the overall engineering condition of the HHD at Reach One; 2) determine the current reliability of all major project features; 3) identify project features which are not reliable; 4) develop methods to remedy or manage the problems; 5) identify environmental concerns; and 6) identify a recommended plan and cost estimate for the plan.

II. DESCRIPTION OF STUDY AREA

A. Location of the Study Area

The HHD system is approximately 143 miles (230 km) long, and is divided into eight segments or "Reaches" for planning purposes. The southeastern segment, Reach One, is the focus of the present study. Reach One is an approximately 22.4 mile (36 km) long segment of the HHD located along the southeast portion of the Lake. This segment extends from the St. Lucie Canal at Port Mayaca, south to the Hillsboro Canal at Belle Glade (Figure 1).

B. Description of the Study Area

The habitat types landward of Reach One have been greatly altered during the last century. Historically, the natural vegetation was a mix of freshwater marshes, hardwood swamps, cypress swamps, and pine flatwoods. Although some of these natural areas still exist, the introduction of controlled drainage for agriculture and land development has resulted in a significantly different set of cover types. Land uses along the landward edge of the levee are largely residential, commercial, or agricultural. Sugarcane fields are located in many cases directly along the landward toe of the HHD or are located a short distance away. Other agricultural uses along the HHD include tree nurseries, small banana plantations, and other fruit groves, especially mangoes.

Residential lots are present along portions of the toe of the HHD, particularly in the cities of Canal Point and Pahokee. The Florida East Coast Railway borders a portion of the HHD, as does the Palm Beach County Glades Airport.

The remaining wildlife habitats consist primarily of wetlands found along the toe ditch and adjacent low-lying areas and are usually a result of impoundment rather than natural hydrology. The majority of these are small, isolated freshwater wetlands which are located in the northern portion of Reach One within the strip of land between the HHD and the transportation corridor (Highway 98/441 and the Florida East Coast Railroad). The toe ditch itself provides some usable wetland habitat along the entire length of Reach One. Typical vegetation in these wetlands includes Carolina willow (*Salix caroliniana*), melaleuca (*Melaleuca quinquenervia*), Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casuarina* sp.), water hyacinth (*Eichhornia crassipes*), cattail (*Typha domingensis*), water lettuce (*Pistia stratiotes*), and duckweed (*Lemna* sp.). Although wetlands present on the landward side of Reach One may not be considered high quality ecosystems, they do host a variety of small fishes and invertebrates and provide usable foraging habitat for wading birds.

Waterward of Reach One, there are few wetland areas immediately adjacent to the HHD. Due to dredging activities for the rim canal which parallels the dike, the littoral zone is narrower than would occur naturally. The water depth increases rapidly here, providing less than optimal habitat. Beyond the rim canal, however, large freshwater marshes are still found waterward of Reach One. These are primarily around Kreamer and Torry Islands which are located near the southern extent of Reach One, and provide several thousand acres of valuable habitat.

III. FISH AND WILDLIFE RESOURCES OF CONCERN IN PLANNING

A. Introduction

The fish and wildlife resources of Lake Okeechobee are of remarkable value, including threatened and endangered species, abundant waterfowl, an exceptionally productive recreational fishery, and commercial fisheries. The commercial fisheries generate $6.3 million annually, and consist of a trotline fishery for catfish (*Ameriurus* spp. and *Ictalurus* spp.), and a haul seine fishery for catfish and bream (*Lepomis* spp.) (Bell 1987). The recreational fishery generates $22.1 million annually and has an estimated asset value of $100 million (Bell 1987). Waterfowl and alligator hunting are also important recreational and commercial activities in the lake.

The Fish and Wildlife Service (Service) has great interest in the protection and enhancement of fish and wildlife resources within Lake Okeechobee. However, the preferred design of this project should have negligible effect on habitat conditions on the lakeshore side of the HHD. Our description of affected resources and fish and wildlife concerns in this FWCA report concentrates on those resources found on either the HHD itself or the areas to be affected by construction of the preferred alternative immediately to the landward side of the HHD.

B. Fish and Wildlife Resources

Wading birds are commonly observed on both the landward and waterward sides of the HHD, indicating a viable population of small fishes and invertebrates along either toe of the dike. Wading birds observed include great blue heron (*Ardea herodias*), great egret (*Casmerodius albus*), little blue heron (*Egretta caerulea*), tricolored heron (*E. tricolor*), snowy egret (*E. thula*), cattle egret (*Bubulcus ibis*), white ibis (*Eudocimus albus*), and wood stork (*Mycteria americana*). Other birds observed along the waterward side of the HHD included the snail kite (*Rostrhamus sociabilis plumbeus*), black skimmer (*Rynchops niger*), brown pelican (*Pelecanus occidentalis*), double-crested cormorant (*Phalacrocorax auritus*), and anhinga (*Anhinga anhinga*).

Within the waters of the lake, important species contributing to the sport and commercial fisheries include largemouth bass (*Micropterus salmoides*), catfish (Ictaluridae) black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), redeared sunfish (*Lepomis microlophus*), and Florida gar (*Lepisosteus platyrhincus*). Although some of these larger species may be present in the borrow pit on the landward side of the HHD (Figures 3 and 4), the shallow wetlands along most of the length of the landward side of the levee are most likely inhabited by smaller marsh inhabiting fishes, such as the ubiquitous mosquitofish (*Gambusia holbrooki*), least killifish (*Heterandria formosa*), and sailfin mollie (*Poecilia latipinna*).

Several species of reptiles and amphibians are likely to inhabit the shallow wetlands and the deeper borrow pit along the landward side of the HHD, where project impact will occur. The Service has not surveyed these areas for reptiles and amphibians, but we anticipate the presence of several species of turtles and frogs, and the American alligator (*Alligator mississippiensis*).

C. Threatened and Endangered Species

Based on the Corps' agreement (letter dated November 30, 1998) to implement the protective measures for the Eastern indigo snake and bald eagle, the Service concurred (Service 1999) with the Corps' determination of not likely to adversely affect threatened and endangered species or designated critical habitat.

1. Federally Listed Species

The following federally listed threatened and endangered species were considered in this informal consultation:

Trichechus manatus	West Indian manatee	Endangered
Haliaeetus leucocephalus	Bald eagle	Threatened
Rostrhamus sociabilis plumbeus	Snail kite	Endangered
Mycteria americana	Wood stork	Endangered
Drymarchon corais couperi	Eastern indigo snake	Threatened
Cucurbita okeechobeensis	Okeechobee gourd	Endangered

As noted above, the endangered wood stork and the endangered snail kite are known to occasionally feed in the wetlands to be affected along the landward side of the HHD. However, the principal habitats in the area for both of these species are located within the littoral zone of Lake Okeechobee, and the project is not expected to affect these habitats. Neither species is known to nest close to Reach One.

The West Indian manatee is known to inhabit Lake Okeechobee. Since the manatee only inhabits the lake itself, and because construction associated with the planned alternatives will occur along the landward base and crown area of the HHD, no protective measures are required.

The bald eagle may be of greatest concern with regard to the proposed alternatives. Two nests have been reported and entered into the Florida Natural Areas Inventory (FNAI) database. One of the nests is near Belle Glade and is approximately 5 miles from the southern-most edge of Reach One. The other nest is near the City of Pahokee, in proximity to Reach One of the HHD. This nest has been classified as active from 1990 through 1995, although no chicks have been produced from it for the same time period. A bald eagle nest must be inactive for five years to be considered abandoned (Service 1987).

Prior to detailed design of the proposed project, and again before issuance of any contracts for construction, the Corps should have a qualified biologist survey up to 1 km from the construction site to determine the exact location of any bald eagle nests and research their history of activity within the preceding five years (Service 1987). The previously reported locations for the two nests mentioned above would be the starting point for these surveys, but it is important to recognize that an established nesting territory for a pair of bald eagles may contain several alternate nest sites. It is also possible that in the years before completion of detailed design and initiation of construction, an entirely new breeding pair of eagles may establish a nest site within the zone of disturbance of the proposed project. Therefore, the surveys should not be limited to the previously known nest sites. Specific recommendations to protect any bald eagle nests should be determined on a case-by-case basis. A 750-foot primary zone and, as a minimum, a 750-foot secondary zone should be established around any active nests. Construction should not occur within 1,500 feet of an active nest during the nesting season, which normally lasts from October 1 to May 15. A specific bald eagle management plan should be prepared and reviewed by the Service 6 months to one year prior to mobilization of construction.

The threatened Eastern indigo snake is known to occur in the vicinity of the HHD, as evidenced by FNAI records. Standard protective measures for the Eastern indigo snake include display of educational posters at construction staging areas and instruction of crew members in protection measures. Construction crews should be informed of the protected status of the species and should be instructed to allow any Eastern indigo snakes to escape unharmed if they are flushed by construction activity.

Although the endangered Okeechobee gourd is known to occur on Torry Island, we do not anticipate any effect on the species if the selected alternative restricts construction to the crown and landward side of the HHD.

2. State Listed Species

In addition to the species mentioned above, a number of other species listed by the State of Florida as threatened, endangered, or of special concern are likely to be present in the project area. These include the following:

Ajaia ajaja	Roseate spoonbill	SSC
Aramus guarauna	Limpkin	SSC
Egretta caerulea	Little blue heron	SSC
Egretta rufescens	Reddish egret	SSC
Egretta thula	Snowy egret	SSC
Egretta tricolor	Tricolored (=Louisiana) heron	SSC
Eudocimus albus	White ibis	SSC
Grus canadensis pratensis	Florida sandhill crane	T
Pelecanus occidentalis	Brown pelican	SSC
Speotyto cunicularia	Burrowing owl	SSC
Alligator mississippiensis	American alligator	SSC

Although the Corps should consult with the Florida Fish and Wildlife Conservation Commission (FWC) about any specific recommendations with regard to these species, the Service is aware of the FWC's particular concern about protecting burrowing owls, which may be present along Reach One of the HHD. Burrowing owl nests were documented as occurring along other portions of the HHD in the late 1980s (M. Poole, FWC, personal communication 1998), and we recommend that surveys be conducted to determine if burrowing owl nests are found in Reach One. If nests are found along Reach One, modifications of timing or location of activity may be needed to avoid taking of nests. Burrowing owl nests are generally inactive between July 10 and February 15. Flagging placed at least 10 feet around burrows, combined with education of construction workers to avoid those areas, might avoid direct destruction of burrows, although disturbance around the burrows may be unavoidable. Please contact the Nongame Wildlife Section Supervisor of the FWC in Tallahassee for specific protection measures to protect the burrowing owl.

IV. SUMMARY OF PLAN SELECTION PROCESS, AND IDENTIFICATION OF EVALUATED ALTERNATIVES

The Corps has become increasingly concerned about the seepage and stability of the HHD since the 1994-1995 high water event. Boils and pipings were observed in 1995 at several sites along Reach One. The 1997-1998 El Niño also raised water stages in Lake Okeechobee. The Corps has described several alternatives to address this problem:

No Action Alternative This would allow the continued potential for unsatisfactory performance of the HHD along Reach One.

Alternative 1 This alternative involves construction of a stability berm at the landside toe of the levee and installing culverts with automatic/manual gates and pumps to control the water level in the ditches. During high lake stage events, water levels landward of the dike would be raised in order to reduce differential head, and increase dike stability.

Alternative 2 This alternative involves construction of an upstream impervious cutoff wall and a landside stability berm at the toe of the levee which would impede groundwater flow and control under-seepage.

Alternative 3 (The Corps's Preferred Alternative) This alternative entails installation of a seepage berm with relief trench along the lower portion of the landward toe of the embankment.

V. FISH AND WILDLIFE RESOURCE CONCERNS AND PLANNING OBJECTIVES

The Service's principal concern has been to avoid any disposal of fill material or armoring of shoreline along the littoral zone of Lake Okeechobee, which would have significant adverse impact on fish and wildlife resources. Filling or excavation of wetlands along the landward side of the HHD is of lesser concern, but is a significant enough loss of habitat to require compensatory mitigation. A secondary concern would be the impact of excavation or earth movement along the waterward slope of the HHD; although this would not directly eliminate littoral zone habitat, the Service would be concerned about potential erosion of soil into the lake and/or increased input of dissolved nutrients. A third level of concern involves the indirect impact of disturbance on fish and wildlife in the project area; these concerns are discussed above, particularly with respect to the bald eagle, the Eastern indigo snake, and the burrowing owl.

VI. PROJECT IMPACT EVALUATION

A. Evaluation Framework

The Service has evaluated wetland functions and values to be affected by the project in accordance with the Wetland Rapid Assessment Procedure (WRAP) (Miller and Gonsalus 1997). The linear wetlands along the toe of the HHD are not readily identifiable at the map scale used by the National Wetlands Inventory or the landuse coverages available from the South Florida Water Management District (SFWMD). The Service made a preliminary selection of potential WRAP polygons from inspection of 3-meter resolution Digital Orthophoto Quarter Quads (DOQQs) (1996 images). Based on 1998 field inspections prior to issuance of the Draft FWCA report, and based on interpretation of the DOQQ images, the wetlands at the northern end of Reach One (just south of Port Mayaca) were known to be more diverse and of higher quality than in the southern portion of the project, where wetland values were reduced and quite similar for greater distances along the HHD. On this basis, the Service decided to begin the WRAP evaluations at the northern end of the project, where evaluation points needed to be more closely spaced.

Sites for WRAP evaluations were selected from these initial locations during the field inspection on November 3, 1999. The values at these sites were extended to polygons of appropriate length along the HHD, according to places where transitions in environmental conditions occur. The WRAP team was composed of the following members: Mark Ziminske, Corps, Jacksonville; Angie Charles, Corps, Clewiston; Tim Towles, Florida Fish and Wildlife Conservation Commission, Vero Beach; David Ferrell, Service, Vero Beach; and Robert Pace, Service, Vero Beach. In addition to observation of emergent vegetation and birds, dip netting at each site assisted in estimating the value of each wetland as habitat for fish and aquatic invertebrates.

A second field inspection was conducted on January 19, 2000. Its purpose was not to further evaluate existing wetland functions, but to establish the following: 1) a more informed estimation of the location and extent of project impacts as interpreted by the Project Engineer, Pete Grace; 2) confirmation of points along the project where WRAP polygons begin and end (transition in habitat conditions); 3) greater focus on identifying potential sites for creation of compensatory wetlands; and 4) orientation of the Corps biologist, Olice Carter, to outstanding environmental issues for the project. The second field inspection included Mr. Grace, Mr. Carter, Ms. Charles, and Mr. Pace. Locations of observations were measured as miles south of the southern end of Port Mayaca.

Based on current plans (prior to detailed design), Mr. Grace advised the Service to evaluate impacts based on deposit of fill on average 30 feet beyond the current toe of the HHD. This would completely eliminate any canal or ditch present along the toe and, in some portions of the project, would also impact a narrow strip of wetlands beyond the canal or ditch.

Area measurements for WRAP polygons (both existing conditions and the proposed compensatory mitigation sites) were calculated by multiplying widths of features observed in the field by length measurements using Arcview software, based on the DOQQs and other digitized data sets, particularly landuse, and hydrography.

B. Fish and Wildlife Resources Without the Project

The Service anticipates that the proposed work in Reach One could be completed within 10 years, so we have selected the year 2009 as the planning horizon for this project. The future without project conditions are expected to be similar to the existing conditions. The Corps and the SFWMD are considering changes to the Lake Okeechobee regulation schedule. Although small changes in the regulation schedule for Lake Okeechobee can provide broad benefits to fish and wildlife on a large scale across the extent of the lake, no major habitat shifts are expected close to the Lake Okeechobee rim canal within Reach One of the HHD. Our field inspection revealed that limited control of melaleuca has occurred along the waterward side of some portions of the HHD, but extensive stands of melaleuca are still present, particularly along the Lake Okeechobee rim canal near Torry Island. Although some additional melaleuca control is likely to occur in Lake Okeechobee without the proposed project, current efforts are concentrated in the extensive interior marshes of the lake, with no immediate plans to address the densest stands along the rim canal. Except for some increase in residential and commercial development in the cities of Pahokee and Belle Glade, no major changes in land use are anticipated along the landward side (toe ditch) of the HHD. The area is likely to remain largely rural, with extensive areas of sugarcane and scattered plots of fruit trees and vegetables along major portions of Reach One of the HHD.

C. Project Impacts

Through early coordination between the Service and the Corps, initial concerns regarding the direct impact of the alternatives on the littoral zone of Lake Okeechobee have been eliminated. None of the considered alternatives would directly disturb the lakeshore toe of the HHD. The impacts of the considered alternatives are briefly summarized below.

No Action Alternative The No Action Alternative would cause no additional direct or indirect impacts to fish and wildlife in the project area, beyond the existing maintenance activities for the HHD. However, the current instability problems would most likely increase and would be unsatisfactory to the Corps. Should these problems result in partial failure of the HHD, the implications to fish and wildlife landward of the HHD would be limited to the areas of the breach and immediately adjacent habitats, and the effects would likely be of short duration. The expected drop in water levels in Lake Okeechobee due to a partial failure of the HHD would likely be gradual and not so extreme as to cause major environmental damage to the lake's littoral zone.

Alternative 1 Excavation necessary for installation of the gated culvert system and stability berm would cause a temporary loss of wetland habitat located along the landward toe of the HHD. The raised water levels during high lake water events however, may result in larger wetland areas, increasing the potential area of fish and wildlife habitat. As water levels recede in the ditch at the landward toe of the HHD, wading birds might be attracted to feed following a high stage event in the lake. The overall fish and wildlife habitat value of these ditches would depend on to what extent dense native vegetation (such as cattail) and/or exotic vegetation (such as Brazilian pepper) would be allowed to grow in the ditches. Overly dense growths of vegetation would likely reduce the diversity of wildlife finding preferred habitat in the ditch. Because the habitat value of the existing wetlands along the toe ditch of the HHD is reduced by the dense growth of exotic species, the habitat value of the replacement ditch likely would compensate for the temporary loss of the existing habitat, provide that a program to control exotic species is instituted for the replacement ditch.

Alternative 2 Excavation and filling necessary for installation of the stability berm (up to 30 feet wide) will cause some loss of wetland habitat located along the landward toe of the HHD, which would require compensatory mitigation. This alternative is not preferred by the Corps primarily due to the cost of constructing the cutoff wall. The Service does not prefer this alternative because installation of the cutoff wall would require major excavation and deposit of material along the waterward slope of the HHD, increasing the threat of erosion of material into Lake Okeechobee. Even if erosion barriers were placed along the construction site, some nutrient-laden runoff would likely reach the lake. All of the other considered alternatives would not require disturbance of the well stabilized grassy slope on the waterward slope of the HHD.

Alternative 3 (The Corps's Preferred Alternative) Converting existing toe ditches to a controlled system of covered culverts as part of a seepage berm would eliminate existing wetlands within an estimated 50-foot wide right of way of the current toe of the HHD. Compensatory mitigation is under way for this loss.

VII. EVALUATION AND COMPARISON OF THE SELECTED PLAN AND EVALUATED ALTERNATIVES

A. Factors Considered in Impact Evaluation

The following matrix provides a comparison of the environmental protection measures recommended by the Service for each of the alternatives (other than the No Action Alternative)

	Compensatory Wetland Mitigation	Exotic Vegetation Control	Erosion Control Along Lakeshore Slope	Water Quality Monitoring in Lake	Measures to Avoid Disturbance of Wildlife
Alternative 1	None	In replacement toe ditch	Yes	Yes	Yes, greater area than Alts. 2 & 3
Alternative 2	Yes	In compensatory wetlands	No	No	Yes
Alternative 3	Yes, probably greater than Alt. 2	In compensatory wetlands	No	No	Yes

The Service recommends against selection of Alternative 1 due to the greater area of potential construction disturbance for wildlife such as the burrowing owl and the Eastern indigo snake. We also recommend against Alternative 1 due to the potential for sediment erosion and dissolved nutrient impacts on Lake Okeechobee.

Due to its greater width of excavation and filling along the landward toe of the HHD, Alternative 3 would likely require a greater area of compensatory mitigation than Alternative 2, but either of these alternatives would be acceptable to the Service, provided the compensatory mitigation recommended below is carried out.

B. Wetland Functional Assessment

The WRAP scores support the observation that wetland function generally declines from north to south along Reach One (Table 1). In the north, a wide and deep canal runs along the toe of the HHD. This provides nearly permanent aquatic habitat for organisms, supporting not only small forge fishes but large predatory fishes, alligators, and turtles. The northern canal is also well buffered from disturbance, with forested wetlands to the east and no adjacent urban or agricultural lands. Water quality in the northern portions of Reach One was considered to be good. The willow-dominated (*Salix caroliniana*) community at the northern end of Reach One was evaluated as having the highest functional index (.75) in the project. Other wetlands in the northern portions were dominated by the exotic Brazilian pepper (*Schinus terebinthifolius*), and were given a lower index of .58. Proceeding south towards Pahokee, the canal adjacent to the toe of the HHD became generally narrower; its water quality was considered to be adversely affected by dense coverage of floating vegetation, particularly the exotic water hyacinth (*Eichhornia crassipes*); and the proximity of a railroad eliminated the buffer to the east. Adjacent to the urban portions of Pahokee, little or no wetlands were found adjacent to a narrower ditch at the base of the HHD, buffers were absent to the east, and water quality was reduced. The lowest functional value was assigned to a lengthy portion in the southern end of Reach One where a narrower and shallower ditch followed the base of the HHD, with adjacent sugarcane. Although this ditch supported growth of periphyton and contained small fish that could be consumed by wading birds, the diversity of aquatic animals it could support was considered to be reduced by the fact that it was likely to dry completely in times of drought. This would make it less suitable for larger predatory fishes, alligators, and some species of turtles.

C. Evaluation of Proposed Compensatory Mitigation.

In a letter, dated March 8, 2001, the Corps provided a description of the strategy to compensate for unavoidable impacts to wetlands anticipated in Reach One of the Herbert Hoover Dike Major Rehabilitation Feasibility Study. A Service biologist first visited the proposed compensation area with Corps personnel on February 15, 2001.

The Corps has initiated the removal of exotic vegetation (primarily melaleuca) in a wetland approximately 44.2 acres in size adjacent to the Lake Okeechobee Rim Canal in the vicinity of Moore Haven (Figure 2). On December 3, 2001, Service biologists visited the site and observed the progress of exotic vegetation removal; all mature melaleuca trees had been cut down and consolidated for burning and a very low density of young melaleuca saplings were apparent. Although that work is not associated with the Herbert Hoover Dike Project, the Corps proposes to supplement that project by planting native trees and shrubs in the treated area as compensation for the anticipated wetland impacts. The native trees and shrubs to be planted include bald cypress (*Taxodium distichum*), pond apple (*Annona glabra*), coastal plain willow (*Salix caroliniana*), wax myrtle (*Myrica cerifera*), salt bush (*Baccharis* spp.), and red maple (*Acer rubrum*).

Using our planting recommendations listed below (Section VIII), the Service supports this concept, which if successful, would be likely to adequately compensate for the anticipated wetland losses for Reach One of the Herbert Hoover Dike Rehabilitation project.

We were unable to assemble a WRAP team to evaluate the compensatory mitigation site before melaleuca clearing was initiated. Based upon WRAP evaluations of similar dense mature melaleuca-forested wetlands, near the Pennsuco wetlands in Miami-Dade County, we have assigned a functional index of 0.40 to the initial condition of the wetlands (Service 2001). We used ArcView Software and Digital Orthophoto Quarter Quads (DOQQs) (1996 images) to analyze the proposed compensatory mitigation site. We measured the area of the compensatory mitigation site to be 44.2 acres (Figure 2).

The compensatory mitigation site is expected to result in a native forested wetland with interspersed open water after complete exotic vegetation removal and planting of native vegetation at appropriate elevations. Thus, contingent upon the above recommendations, the Service has attempted to estimate potential credit for functional "lift". If we assume that a future functional index of 0.90 will be reached at the mitigation site, this would provide 0.50 "lift" relative to the original 0.40. The estimated lift will require documentation by a WRAP team after native re-vegetation is complete. The 0.50 credit on 44.2 acres would result in a gain of 22.1 functional units. The 22.1 functional units would compensate for the debit of 18.9 functional units and includes an additional 3.2 functional units which may provide credits to compensate for additional wetland losses in future reaches of the Herbert Hoover Dike Rehabilitation project

VIII. RECOMMENDATIONS AND SUMMARY OF POSITION

The Service finds the Corps's selected plan to be acceptable, provided that:

1) compensatory wetland mitigation will be provided for unavoidable losses of wetlands;

2) control of exotic vegetation will be carried out in perpetuity in the compensatory wetlands;

3) construction will be scheduled to avoid activity within 1500 feet of any active bald eagle nest during the nesting season;

4) standard protective measures will be carried out to avoid wounding or killing Eastern indigo snakes;

and

5) if burrowing owls are found to be present in the project area, impacts will be minimized by altering construction schedules to avoid the nesting season and/or burrows will be cordoned off to avoid their direct destruction.

We offer the following recommendations to increase the likelihood of maximizing compensatory wetland functions and values at the compensatory mitigation site:

1. The Service had initially recommended aerial spraying of herbicide over the entire area to inhibit germination of exotic plants from the seed bank. However, melaleuca saplings were not found in significant numbers during our December 3, 2001 inspection. Therefore, hand picking should be used to prevent further proliferation of melaleuca. Treatments of exotics would likely be required at least once a year for no less than five years.

2. Either remote surveys using Light Detection and Ranging (LIDAR) technology or a ground-based survey methodology will assist in creating a detailed planting plan in accordance with the micro-topography of the site. Planting the most appropriate species along landscape contours of differing hydroperiod will improve survival of the plants. More specifically, we provide the following planting recommendations:

A. Plant bald cypress on higher elevations in roughly circular stands (cypress domes) that approximate the size of the existing bald cypress stand that was not cleared within the compensatory mitigation site.

B. Plant pond apples in lower elevation areas as rings around the edges of bald cypress domes.

C. Plant red maple trees at the highest elevations and along the edges of the compensatory mitigation site.

D. Maintain small areas (clearings less than 0.5 acres in size) of open water areas at the deepest locations.

3. A Wetland Rapid Assessment Procedure (WRAP) team should visit the site once a year for five years after planting to determine the functional value of the wetland relative to anticipated impacts of the Herbert Hoover Dike project.

IX. LITERATURE CITED

Bell, F.W. 1987. The economic impact and valuation of the recreational and commercial fishing industries of Lake Okeechobee, Florida. Florida Game and Fresh Water Fish Commission; Tallahassee, Florida. 102 pp.

Poole, M. 1998. Telephone conversation, referencing 1987 field notes by a FWC biologist.

Miller, Raymond E., Jr., and B.E. Gunsalus. 1997 (Updated August 1999). Wetland Rapid Assessment Procedure (WRAP). Technical Publication REG-001. South Florida Water Management District; West Palm Beach, Florida.

U.S. Fish and Wildlife Service. 1987. Habitat management guidelines for the bald eagle in the Southeast region. U.S. Fish and Wildlife Service; Atlanta, Georgia.

_____. 1998. Multi-species recovery plan for the threatened and endangered species of south Florida. Volume I of II. The Species. Technical/Agency Draft. Atlanta, Georgia.

_____. 1999. Letter to Army Corps of Engineers. (June 9, 1999).

_____. 2001. Supplemental Planning Aid Report on the Water Preserve Areas Feasibility Study Palm Beach, Broward, and Miami-Dade counties.

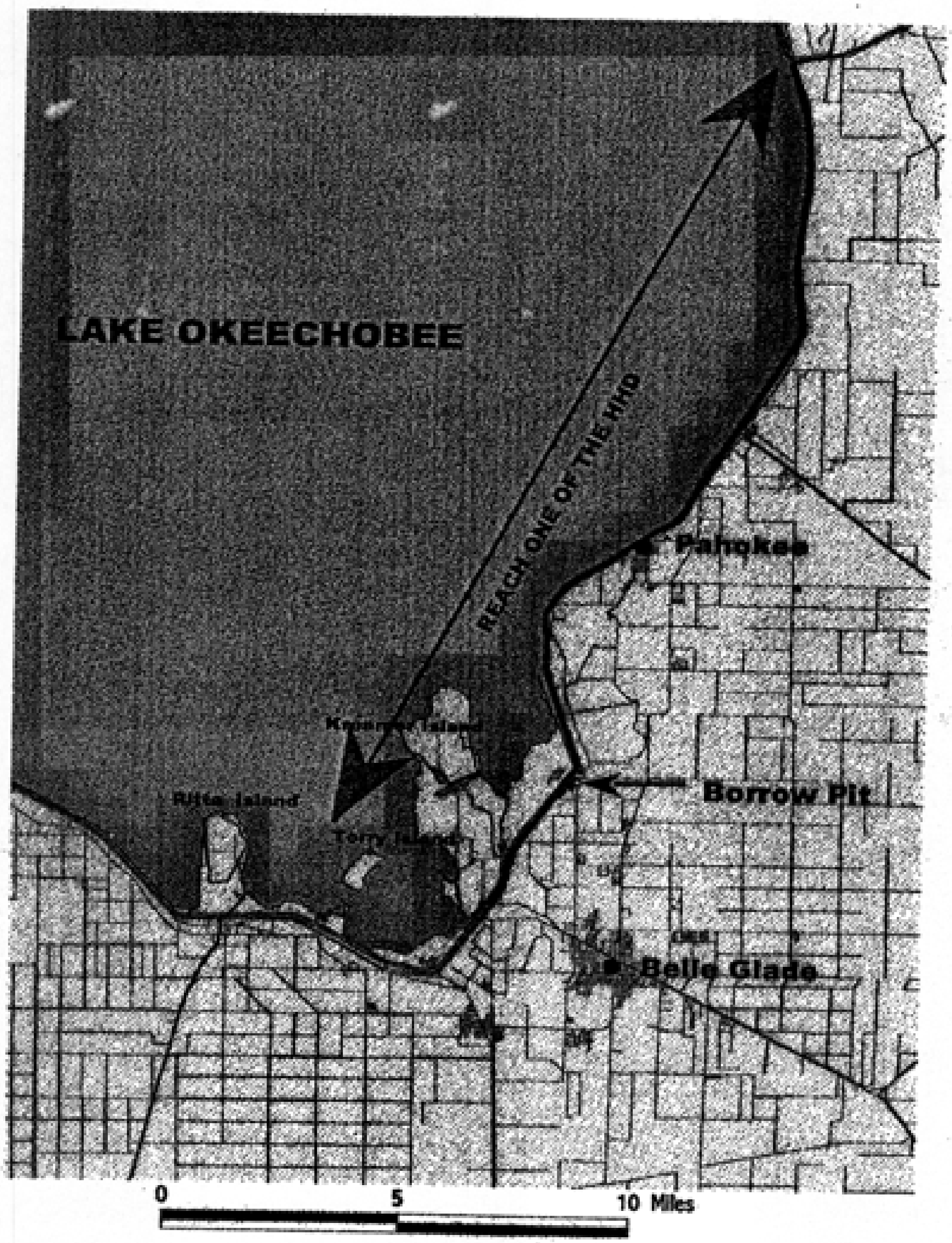

Figure 1. Reach One of the Herbert Hoover Dike Major Rehabilitation Project

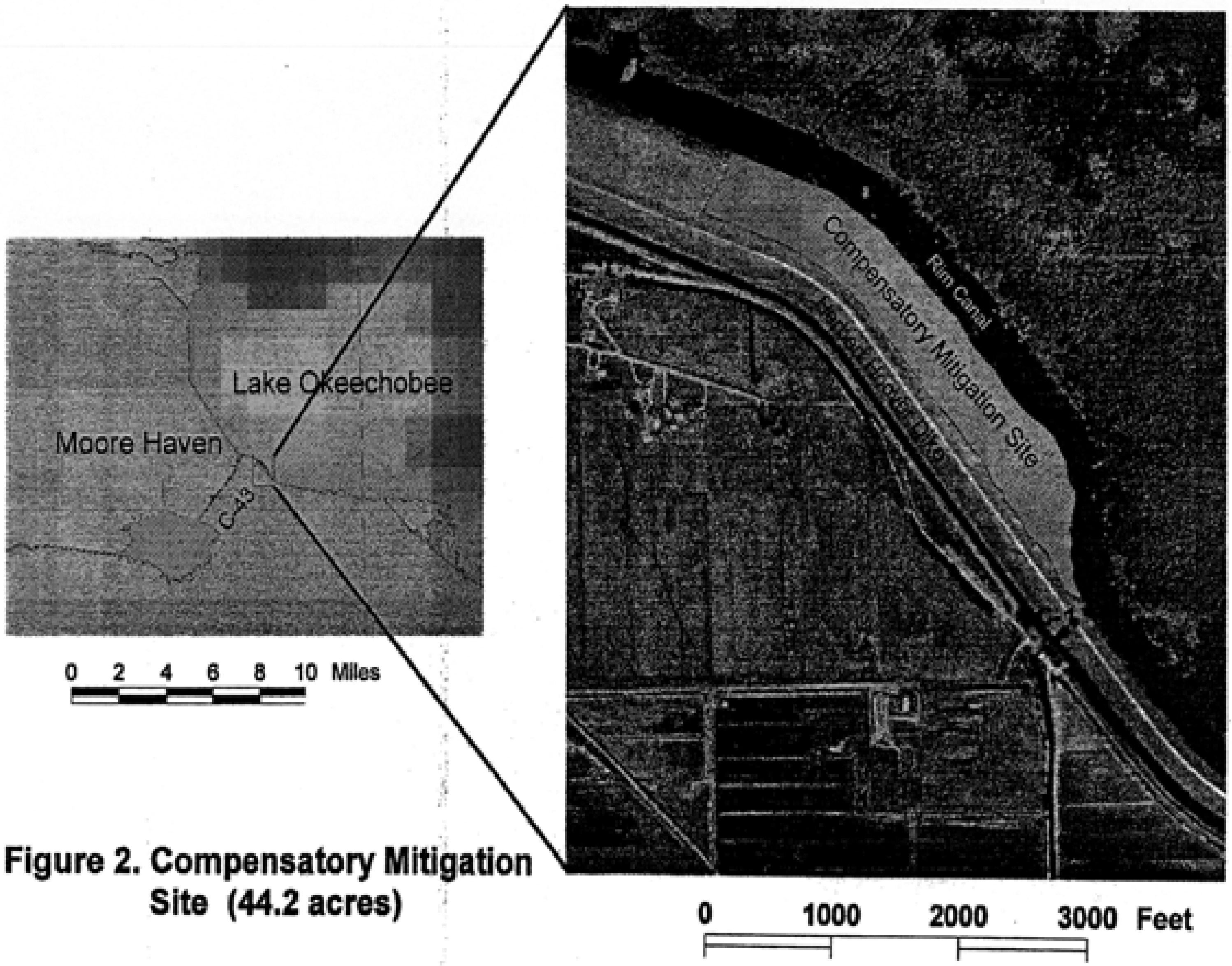

Figure 2. Compensatory Mitigation Site (44.2 acres)

Table 1. Existing wetland functions to be lost through construction of Reach One of the Herbert Hoover Dike rehabilitation project.

Polygon Number	Evaluation Location[1]	Descriptor[2]	WRAP Score	Length (Feet)	Width (Feet)	Area (Acres)	Functional Units
1	0.2	willow	0.75	1,313	10	0.30	0.23
2	0.5	canal	0.62	4,320	20	1.98	1.23
3	0.5	*Schinus*	0.58	2,992	10	0.69	0.40
4	1.2	canal	0.57	4,970	15	1.71	0.98
5	1.7	*Schinus*	0.58	970	15?	0.33	0.19
6	2.1	marsh/shrub	0.67	3,896	10	0.89	0.60
7	2.1	canal	0.55	9,358	20	4.30	2.36
8	3.5	canal	0.65	3,425	20	1.57	1.02
9	3.5	marsh	0.55	5,624	10	1.29	0.71
10	5.0	canal	0.57	6,463	15	2.23	1.27
11	6.0	ditch	0.53	14,652	10	3.36	1.78
12	8.4	canal	0.65	18,483	15	6.37	4.14
13	12.9	ditch, urban area	0.47	14,327	12	3.95	1.86
14	15.1	ditch at airport	0.57	8,022	8	1.47	0.84
15[3]	19.0	ditch, beside sugar cane	0.32	22,113	8	4.06	1.30
				Total Functional Units			18.90

[1]Expressed as miles south of Port Mayaca; see map.

[2]We have used the term "canal" for water conveyances 15 feet or greater in width, while narrower (and generally shallower) conveyances are termed "ditches."

[3]Includes roadside swale (from approx. mile 16.7 to mile 18.0), which was determined not to meet the definition of a regulatory wetlands

Appendix B

CULTURAL RESOURCES COORDINATION

FLORIDA DEPARTMENT OF STATE
Glenda E. Hood
Secretary of State
DIVISION OF HISTORICAL RESOURCES

April 7, 2005

Mr. Bradd R. Schwichtenberg, PE
Planning Division, Environmental Branch
Jacksonville District Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

Re DHR Project File Number: 2005-3027 / Received by DHR: March 29, 2005
Supplemental Draft Environmental Impact Statement
Herbert Hoover Dike Major Rehabilitation Evaluation Report for Reach 1
Martin and Palm Beach Counties

Dear Mr. Schwichtenberg:

Our office received and reviewed the above referenced project in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended in 1992; and the National Environmental Policy Act of 1969, as amended. The State Historic Preservation Officer is to advise and assist federal agencies when identifying historic properties (listed or eligible for listing, in the National Register of Historic Places), assessing effects upon them, and considering alternatives to avoid or reduce the project's effect on them.

Based on a review of the information provided, it is the opinion of this office that this project could have an effect on the original design of the Herbert Hoover Dike, 8PB2028, considered historically significant for its engineering design. However, this office concurs that the proposed necessary modifications will have no adverse effect the characteristics qualifying this property for listing in the *National Register of Historic Places*.

If there are any questions concerning our comments, please contact Laura Kammerer, Deputy Historic Preservation Officer for Review and Compliance, by telephone at 850-245-6333. Thank you for your interest in protecting Florida's historic properties.

Sincerely,

for Laura A. Kammerer, Deputy SHPO

Frederick P. Gaske, Director, and
State Historic Preservation Officer

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Planning Division
Environmental Branch

NOV 3 0 2006

Mr. Frederick Gaske, Director
State Historic Preservation Officer
Division of Historical Resources
500 South Bronough Street
Tallahassee, Florida 32399-0250

RE: DHR Project File Number: 2005-3027

Dear Mr. Gaske:

The U. S. Army Corps of Engineers (Corps), Jacksonville District, is proposing to undertake a major rehabilitation of the Herbert Hoover Dike, 8HN179/8PB2028 (HHD) around Lake Okeechobee in southern Florida. This phase of the rehabilitation will occur in Reaches Two and Three, along the southwestern and southern portions of the HHD. Reach Two is approximately 20 miles long, extending from Spillway Structure-77 (formerly Hurricane Gate Structure-1) in Moore Haven, Glades County, to S-354 (HGS-3) in Lake Harbor, Palm Beach County. Reach Three is approximately 7 miles long, extending from S-354 (HGS-3) in Lake Harbor to S-351 (HGS-4) in Belle Glade, Palm Beach County (Enclosure 1).

The proposed rehabilitation in Reaches Two and Three involves the installation of a cutoff wall with a seepage berm, relief trench and drainage swale along the landward toe of the HHD embankment. The project area will extend approximately 150 feet out from the landward toe of the HHD embankment. A typical cross-section of the proposed project area is shown in enclosure 2.

No modification or rehabilitation will be made to any of the existing locks and spillway structures within Reaches Two and Three. A review of the Florida Master Site Files in April 2002, revealed a number of historical resources near the HHD, but none are located in the project area or the Corps' rights-of-way.

Based on a review of the engineering design and in compliance with the National Historic Preservation Act of 1966, as amended and 36 CFR Part 800, we believe this project could have an effect on the original design, however there will be no adverse effect of the characteristic qualifying Herbert Hoover Dike for listing in the *National Register of Historic Places* (Refer to DHR Project File #:2005-3027).

COPY

We seek your concurrence with this determination. If you have any questions regarding this, please contact David Pugh at 904-232-1361. Please respond within 30 days after receipt of this letter.

Sincerely,

Marie G. Burns

Marie G. Burns
Chief, Environmental Branch

Enclosure

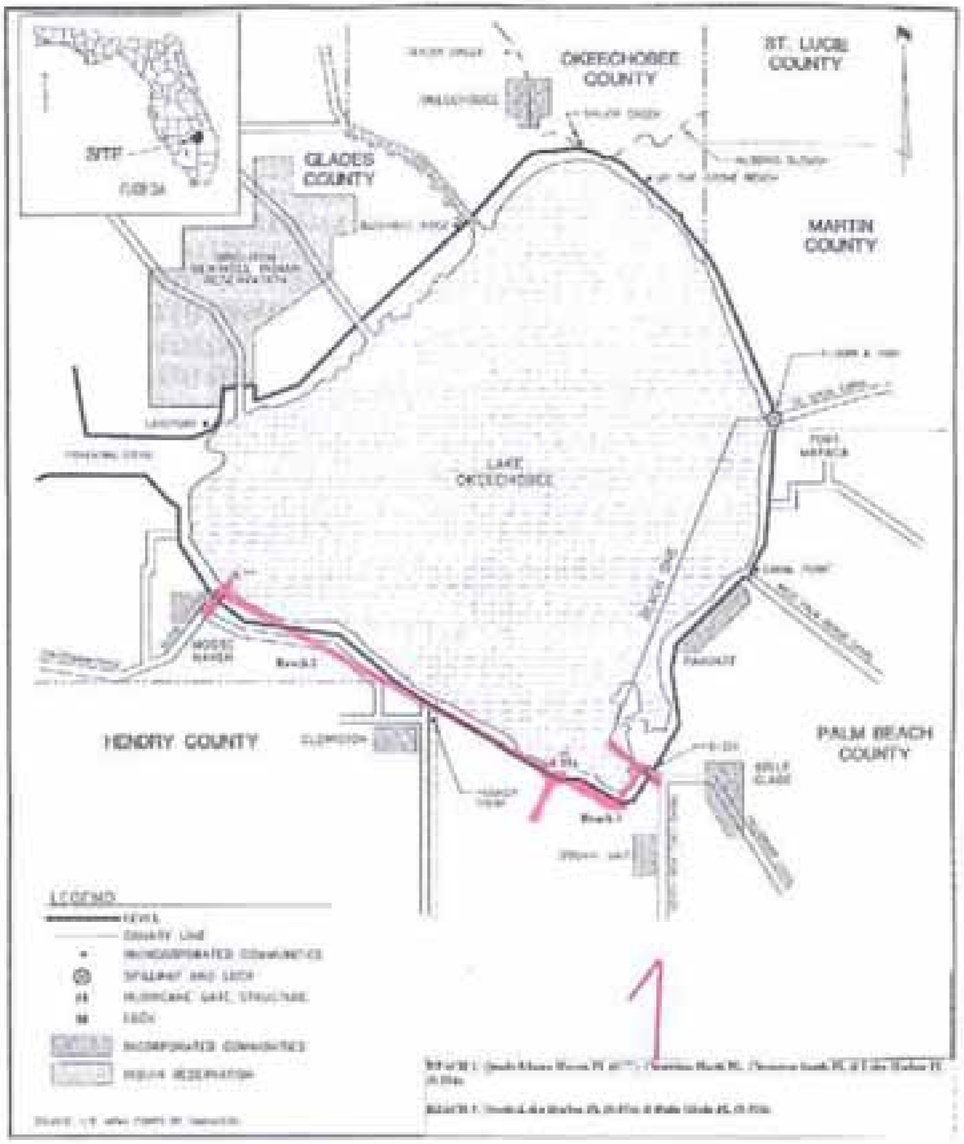

Figure 1. Project Location Map

Enclosure 1

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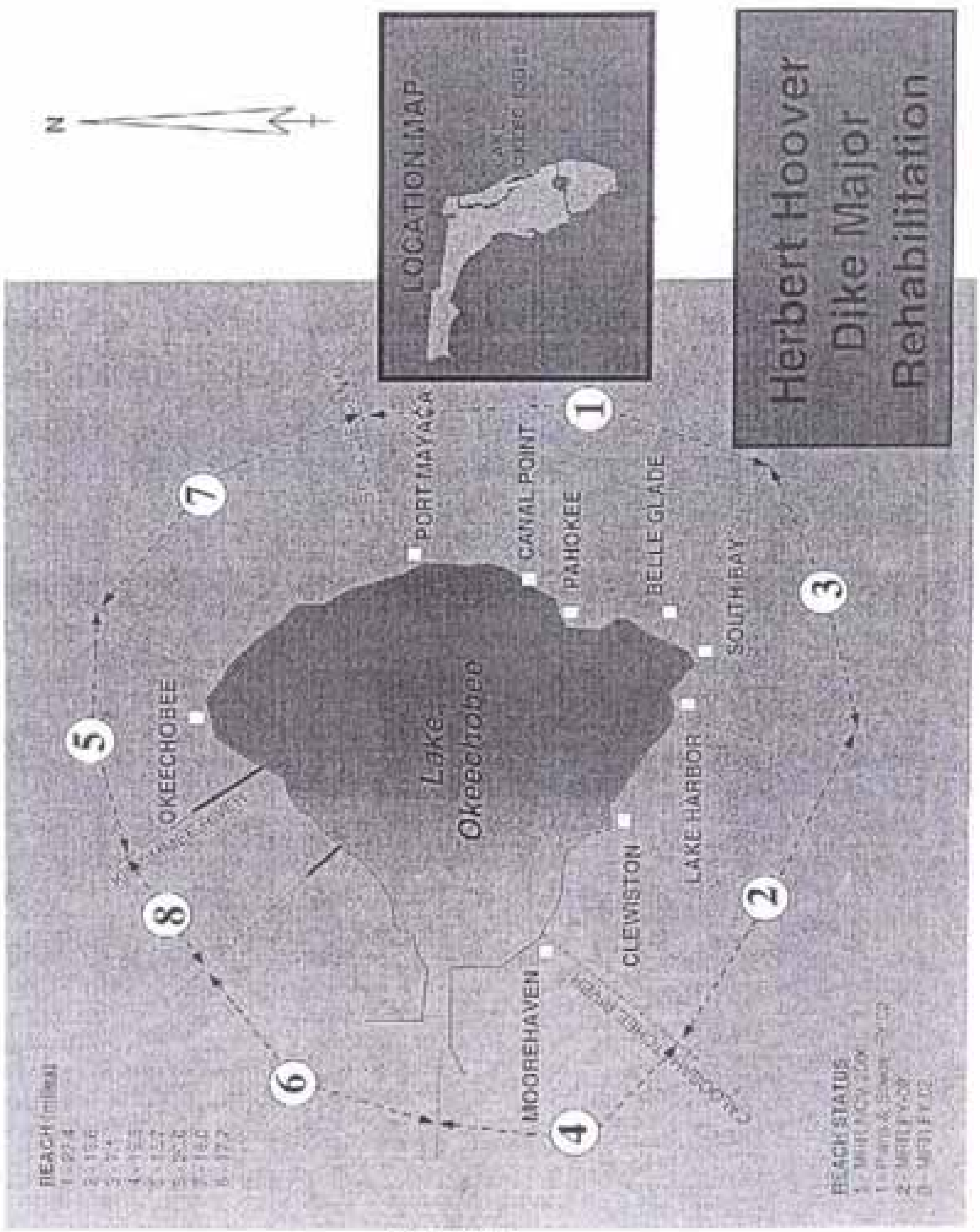

Enclosure 1a

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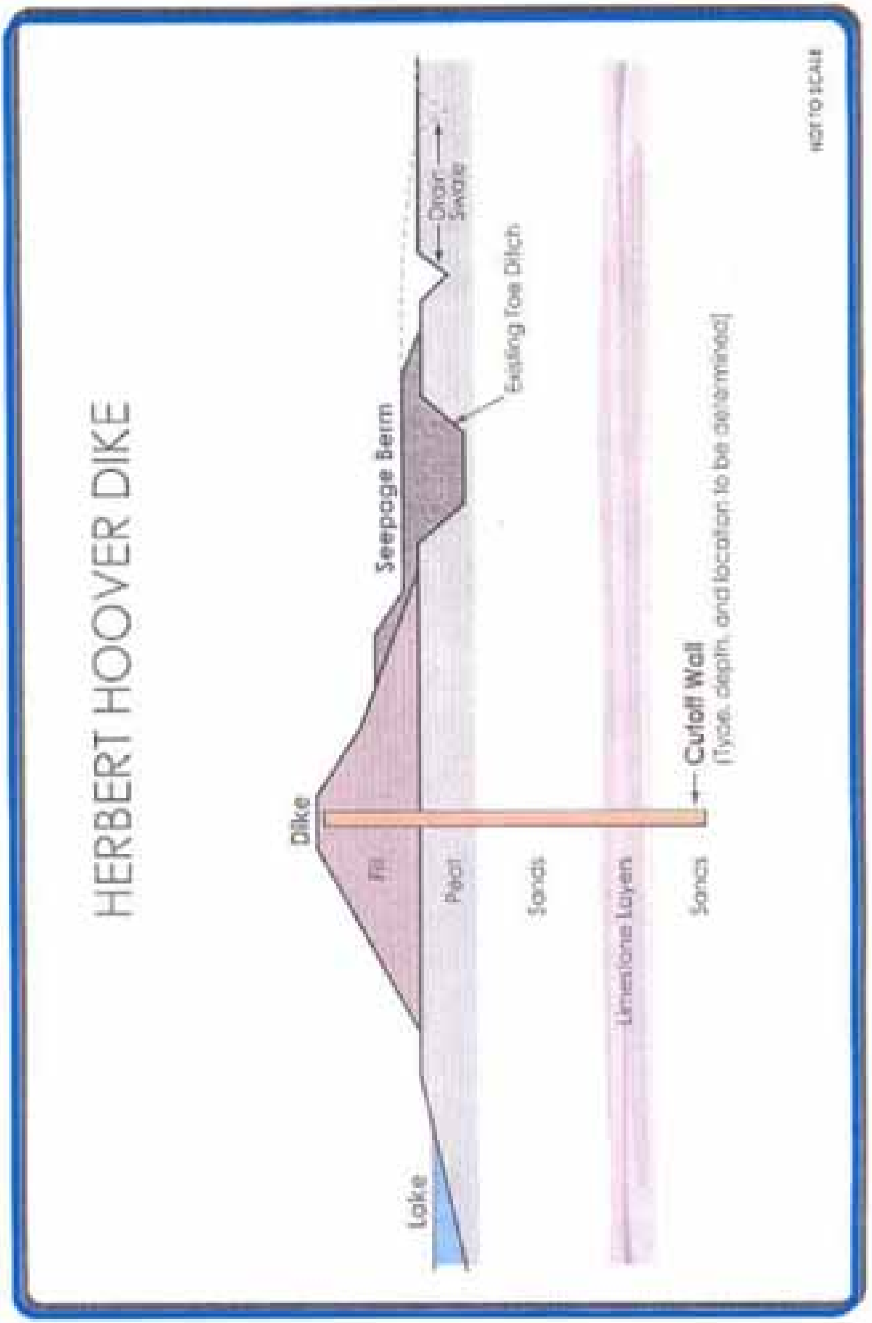

Enclosure 2

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RECEIVED
26 Sept 2006

FLORIDA DEPARTMENT OF STATE
Sue M. Cobb
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Ms. Lauren Milligan
Florida Department of Environmental Protection
3900 Commonwealth Boulevard, MS #47
Tallahassee, Florida 32399-3000

September 20, 2006

Re: DHR No.: 2006-7553 / Received by DHR: August 17, 2006
SAI #: 200202261582C
Department of the Army – Jacksonville District Corps of Engineers
Scoping Notice – 2nd Draft Supplemental Environmental Impact Statement for the Herbert Hoover Dike Major Rehabilitation Evaluation Report, Reaches 2 and 3
Palm Beach, Hendry and Glades Counties

Dear Ms. Milligan:

Our office received and reviewed the above referenced project in accordance with Section 106 of the *National Historic Preservation Act of 1966* (Public Law 89-665), as amended in 1992, and *36 C.F.R., Part 800: Protection of Historic Properties*; Chapter 267, *Florida Statutes*, and Florida's Coastal Management Program, and implementing state regulations; for possible impact to historic properties listed, or eligible for listing, in the *National Register of Historic Places*, or otherwise of historical, architectural or archaeological value. The State Historic Preservation Officer is to advise and assist state and federal agencies when identifying historic properties, assessing effects upon them, and considering alternatives to avoid or minimize adverse effects.

We reviewed the referenced Scoping Letter indicating that that the Jacksonville District, U.S. Army Corps of Engineers (Corps) is preparing supplemental National Environmental Policy Act documents pertaining to the Herbert Hoover Dike (8PB2028). A review of our records indicates that the Herbert Hoover Dike is potentially eligible for listing in the National Register, because it considered historically significant for its engineering design. Therefore, we look forward to receiving the supplemental environmental documents and rehabilitation plans; and consulting with the Corps regarding the rehabilitation of the dike in order to ensure stability.

Provided the above condition regarding continued consultation with this office, the proposed activities will be consistent with the historic preservation laws of Florida's Coastal Management Program and the National Historic Preservation Act.

RECEIVED
20 Sept 2006

FLORIDA DEPARTMENT OF STATE
Sue M. Cobb
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Mr. Stuart J. Appelbaum
Jacksonville District Corps of Engineers
Planning Division, Environmental Branch
P.O. Box 4970
Jacksonville, Florida 32232-0019

September 19, 2006

RE: DHR No.: 2006-7157/ Date Received by DHR: August 14, 2006
Scoping Letter for 2nd Draft Supplement to 1999 Draft Environmental Assessment (EIS) and 2005 Final Supplemental Environmental Impact Statement (FEIS) Herbert Hoover Dike Major Rehabilitation Evaluation Report – Reaches 2 and 3 – From West of Belle Glade, Palm Beach County to East of Moore Haven, Glades County, Florida

Dear Mr. Appelbaum:

Our office received and reviewed the above referenced project in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended and *36 CFR Part 800: Protection of Historic Properties* and the *National Environmental Policy Act of 1969, as amended* (NEPA). The State Historic Preservation Officer is to advise Federal agencies as they identify historic properties (archaeological, architectural, and historical) listed, or eligible for listing, in the *National Register of Historic Places*, assess effects upon them, and consider alternatives to avoid or minimize adverse effects.

We reviewed the referenced Scoping Letter indicating that that the Jacksonville District, U.S. Army Corps of Engineers (Corps) is preparing supplemental National Environmental Policy Act documents pertaining to the Herbert Hoover Dike (8PB2028). A review of our records indicates that the Herbert Hoover Dike is considered historically significant for its engineering design. Therefore, we look forward to receiving the documents and coordinating with the Corps regarding the structural modifications to the existing levee which are currently under development for Reaches 2 and 3.

If there are any questions concerning our comments, please contact Janice Maddox, Historic Sites Specialist, by electronic mail at jmaddox@dos.state.fl.us, or by telephone at 850/245-6333. Thank you for your interest in protecting Florida's historic properties.

Sincerely,

Frederick P. Gaske

Frederick P. Gaske, Director, and
State Historic Preservation Officer

500 S. Bronough Street • Tallahassee, FL 32399-0250 • http://www.flheritage.com

☐ Director's Office (850) 245-6300 • FAX: 245-6436
☐ Archaeological Research (850) 245-6444 • FAX: 245-6452
☒ Historic Preservation (850) 245-6333 • FAX: 245-6437
☐ Historical Museums (850) 245-6400 • FAX: 245-6433

☐ Southeast Regional Office (954) 467-4990 • FAX: 467-4991
☐ Northeast Regional Office (904) 825-5045 • FAX: 825-5044
☐ Central Florida Regional Office (813) 272-3843 • FAX: 272-2340

Appendix C

SECTION 404(b)(1) EVALUATION

SECTION 404(b)(1) EVALUATION

HERBERT HOOVER DIKE
MAJOR REHABILITATION EVALUATION REPORT

I. Project Description

A. Location.

The proposed Herbert Hoover Dike (HHD) Major Rehabilitation Evaluation study is located at the HHD, which is an earthen levee surrounding Lake Okeechobee, in Glades, Hendry, Martin, Okeechobee, and Palm Beach Counties. Reach 2 is 20.42 miles long and extends from the Caloosahatchee River at Moore Haven to the Miami Canal near Lake Harbor. Reach 3 is 6.70 miles long and extends from the Miami Canal to the Hillsboro Canal in Belle Glade.

B. General Description.

The Recommended Plan includes the construction of a seepage berm that would extend to the far side of the existing toe ditch at the edge of the existing project right-of-way; the toe ditch would be filled with an inverted filter/seepage berm. In addition, a seepage cutoff wall would be installed in the center of the dike.

This design would be modified slightly for the western portion of Reach 2, where, instead of a toe ditch outside the levee, a borrow canal is present. The seepage berm would extend to the edge of the borrow canal nearest the dike; the borrow canal would not be filled. The western portion of Reach 2 is characterized by a clay layer found approximately 25 to 40 feet below the surface; such a clay layer is not present at Reach 3 or eastern Reach 2. The cutoff wall in western Reach 2 would tie into the clay layer.

C. Authority and Purpose.

The Flood Control Act (Act), approved by Congress on 30 June 1948, authorized the first phase of a comprehensive plan to provide flood protection and other water control benefits in central and south Florida. The Act included measures for improving control of Lake Okeechobee by constructing or modifying the spillways and other structures, and enlarging the Lake Okeechobee levees to provide the intended flood protection, water storage and water supply. Levee seepage and stability have a direct effect on the capability of the levee to provide the authorized protection. The authorization for levee repairs and modifications of the Flood Control Act of 1948 justify the proposed renovation to Reach 1 of the HHD.

The general goal of the HHD MRR is to provide a reliable embankment system around Lake Okeechobee to contain the lake waters for flood protection, water supply, and navigation.
An unreliable embankment system could allow for a failure of the system to contain lake waters. Such a failure could result in loss of life, property, and habitat. A reasonable and effective rehabilitative effort is required to eliminate this possibility.

D. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. Material from the levee will need to be excavated prior to installation of the cutoff wall and seepage berm. This material is composed primarily of fill material

for the HHD from the excavation of the lake rim canal and contains a mixture of sand, silts and clays with varying content of organic materials. The proposed seepage berm and inverted filter will be composed of select granular materials, primarily limestone or quartz, gravel and sand-sized particles. The cutoff wall will be composed of cementitious slurry.

(2) Quantity of Material. Unknown. Specific information will be determined during detailed design.

(3) Source of Material. No definitive source of borrow material has been identified. A commercially licensed source of quarry material that produces ASPM standard gradations will be identified.

E. Description of the Proposed Discharge Site.

(1) Location. See Figure 1 of EIS.

(2) Size. Approximately 27 miles of landward HHD slope and HHD toe.

(3) Type of Site. The project site is an upland embankment composed primarily of fill material and vegetated by mixed grasses. The embankment toe is bordered by a toe ditch throughout most of Reaches Two and Three. The toe ditch contains mostly invasive or exotic vegetation, but provides wetland habitat. Agricultural fields and residential development are adjacent to the HHD. In the western portion of Reach 2 there is a borrow canal outside of the levee instead of a toe ditch. The seepage berm would extend to the edge of the borrow canal nearest the dike; the borrow canal would not be filled.

(4) Type of Habitat. The habitat consists of upland managed levee slopes, invasive brush, and inundated toe ditches.

(5) Timing and Duration of Dredging.

Not applicable to this project.

F. Description of Disposal Method.

As necessary for construction of each project element.

II. Factual Determinations

A. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. The cutoff wall would be excavated at an elevation to be determined by geotechnical experts. The HHD landward toe ranges in elevation from 12 to 14 feet NGVD of 1929. The fill areas are at the base of the back toe of the landward side of the dike.

(2) Type of Fill Material. The proposed fill for seepage berm will be composed of select granular materials primarily limestone or quartz, gravel and sand sized particles. The cutoff wall will be composed of cementitious slurry.

(3) Dredge/Fill Material Movement. The fill material will be stabilized and should not be subject to erosion.

(4) Physical Effects on Benthos. Benthic organisms may be temporarily displaced during construction activities.

B. Water Circulation, Fluctuation and Salinity Determination.

(1) Water Column Effects. Standing water and soils periodically inundated will be temporarily impacted during construction. Turbidity and erosion will be controlled during and after construction.

(2) Current Patterns and Circulation. Construction of the berm at the toe ditches should have minimal effect on current hydrologic circulation patterns. Construction of the cutoff wall will have an impact on hydrological patterns within the HHD footprint. The designers will re-evaluate the location and depth of the wall with regard to their impacts on groundwater.

(3) Normal Water Level Fluctuations and Salinity Gradients. Surface and ground water levels will not be effected. Salinity levels should not be affected by the proposed project.

C. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site. There may be a temporary increase in turbidity levels in the project area during discharge. Turbidity will be short-term and localized and no significant adverse impacts are expected. State standards for turbidity will not be exceeded.

(2) Effects on the Chemical and Physical Properties of the Water Column. There may be temporary impacts to the chemical and physical properties of nearby waters during construction activities. There are no acute or chronic chemical impacts anticipated as a result of construction. An environmental protection plan, prepared during detailed design, will address concerns regarding monitoring of equipment, maintenance and security of fuels, lubricants etc.

(a) Light Penetration. Some decrease in light penetration may occur in the immediate vicinity of the construction area. This effect will be temporary, limited to the immediate area of construction, and will have no adverse impact on the environment.
(b) Dissolved Oxygen. Dissolved oxygen levels will not be altered by this project.
(c) Toxic Metals, Organics, and Pathogens. No toxic metals, organics, or pathogens are expected to be released by the project.
(d) Aesthetics. The aesthetic quality of the water in the immediate area of the project may be temporarily affected by turbidity during construction. This will be a short-term and localized condition.

(3) Effects on Biota.

(a) Primary Productivity and Photosynthesis. Fill will replace the HHD toe ditch, which is vegetated by mixed wetland plants. Primary production within the lake outflows should not be affected.
(b) Suspension/Filter Feeders. An increase in turbidity adjacent waterways could adversely impact burrowing invertebrate filter feeders within and adjacent to the immediate construction area. It is not expected that a short-term, temporary increase in turbidity will have any long-term negative impact on these highly fecund organisms.
(c) Sight Feeders. No significant impacts on these organisms are expected as the majority of sight feeders are highly motile and can move outside the project area.

D. Contaminant Determinations.

Material which will be dredged from the proposed borrow site will not introduce, relocate, or increase contaminants at the fill area.

E. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. No adverse impacts on autotrophic or heterotrophic organisms are anticipated.

(2) Effects on Benthos. No adverse impacts to benthic organisms are anticipated.

(3) Effects on Nekton. Mostly small forage fish may be temporarily displaced by construction and turbid waster. However, no long-term adverse impacts on nekton are anticipated.

(4) Effects on the Aquatic Food Web. No adverse impacts on aquatic organisms are anticipated. There is expected to be a relatively minor temporary effect on the aquatic food web due to construction activities. Wetlands at toe ditch and lake should maintain their functional value.

(5) Effects on Special Aquatic Sites. (a) Hardground and Coral Reef Communities. There are no hardground or coral reef communities located within the proposed project site.

(6) Endangered and Threatened Species. There will be no significant adverse impacts on any threatened or endangered species or on critical habitat of any threatened or endangered species. Refer to Section 5.00 of the Draft EIS for measures that will be implemented to protect endangered and threatened species.

(7) Other Wildlife. No adverse impacts to small foraging mammals, reptiles, or wading birds, or wildlife in general are expected.

(8) Actions to Minimize Impacts. All practical safeguards will be taken during construction to preserve and enhance environmental, aesthetic, recreational, and economic values in the project area. Specific precautions are discussed in the Draft EIS.

F. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. The dredged material will not cause unacceptable changes in the mixing zone water quality requirements as specified by the State of Florida's Water Quality Certification permit procedures. No adverse impacts related to depth, current velocity, direction and variability, degree of turbulence, stratification, or ambient concentrations of constituents are expected from implementation of the project.

(2) Determination of Compliance with Applicable Water Quality Standards. Because of the inert nature of the material to be used as fill, Class III water quality standards will not be violated.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supplies. No municipal or private water supplies will be impacted by the implementation of the project.

(b) Recreational and Commercial Fisheries. Recreational and commercial fisheries should not be impacted by the implementation of the project.
(c) Water Related Recreation. Water related recreation in the immediate vicinity of construction will likely be impacted during construction activities. This will be a short-term impact.
(d) Aesthetics. The existing environmental setting may be adversely impacted, particularly at parks and other natural settings. Construction activities will cause a temporary increase in noise and air pollution caused by equipment as well as some temporary increase in turbidity. Some vegetation buffering natural areas or parks may be unavoidably removed during construction. These impacts are not expected to adversely affect the aesthetic resources over the long term and once construction ends, conditions will return to pre-project levels. Trees removed would be replaced.
(e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. State and local parks do exist within the proposed project area and would be temporarily impacted by construction activities as described in (d) above. In addition, certain stretches of the LOST may be damaged or removed by construction activities. These impacts would be minimized and avoided as practicable.

G. Determination of Cumulative Effects on the Aquatic Ecosystem.

There will be no cumulative impacts that result in a major impairment of water quality of the existing aquatic ecosystem as a result of the placement of fill at the project site.

H. Determination of Secondary Effects on the Aquatic Ecosystem.

There will be no secondary impacts on the aquatic ecosystem as a result of the construction.

III. Findings of Compliance or Non-compliance with the Restrictions on Discharge.

A. No significant adaptations of the guidelines were made relative to this evaluation.

B. No practicable alternative exists which meets the study objectives that does not involve discharge of fill into waters of the United States.

C. The discharge of fill materials will not cause or contribute to, violations of any applicable State water quality standards for Class III waters. The discharge operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

D. The placement of fill materials for implementation of the proposed project will not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended.

E. The placement of fill material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur.

F. Appropriate steps have been taken to minimize the adverse environmental impact of the proposed action. Turbidity will be monitored so that if levels exceed State water quality standards, the contractor will be required to cease work until conditions return to normal.

G. On the basis of the guidelines, the proposed disposal of dredged material and fill of wetlands are specified as complying with the requirements of these guidelines.

Appendix D

COASTAL ZONE MANAGEMENT ACT CONSISTENCY EVALUATION

FLORIDA COASTAL ZONE MANAGEMENT PROGRAM
FEDERAL CONSISTENCY EVALUATION PROCEDURES

HERBERT HOOVER DIKE
MAJOR REHABILITATION EVALUATION REPORT

1. Chapter 161, Beach and Shore Preservation.

The intent of the coastal construction permit program established by this chapter is to regulate construction projects located seaward of the line of mean high water and which might have an effect on natural shoreline processes.

Response: The proposed work project is not seaward of the mean high water line and would not affect shorelines or shoreline processes.

2. Chapters 186 and 187, State and Regional Planning.

These chapters establish the State Comprehensive Plan which sets goals that articulate a strategic vision of the State's future. Its purpose is to define in a broad sense goals and policies that provide decision-makers directions for the future and provide long-range guidance for orderly social, economic and physical growth.

Response: The proposed work has been coordinated with the State without objection.

3. Chapter 252, Disaster Preparation, Response and Mitigation.

This chapter creates a state emergency management agency, with the authority to provide for the common defense; to protect the public peace, health and safety; and to preserve the lives and property of the people of Florida.

Response: The proposed project purpose is to strengthen and protect the existing lake levee system, thereby ensuring adequate flood control for residents of the region. No action may result in conditions which enhance the possibility of a project failure, resulting in an emergency situation and potentially causing significant damage to persons and property. Therefore, this work would be consistent with the efforts of Division of Emergency Management.

4. Chapter 253, State Lands.

This chapter governs the management of submerged state lands and resources within state lands. This includes archeological and historical resources; water resources; fish and wildlife resources; beaches and dunes; submerged grass beds and other benthic communities; swamps, marshes and other wetlands; mineral resources; unique natural features; submerged lands; spoil islands; and artificial reefs.

Response: The proposed project is the least destructive to the aforementioned resources of all the action alternatives considered to date. The proposed project includes lands that are already within the HHD levee right of way and are therefore in Federal ownership. Impacts to wetlands inside the project area are expected to be mitigated in the area.

5. Chapters 253, 259, 260, and 375, Land Acquisition.

This chapter authorizes the state to acquire land to protect environmentally sensitive areas.

Response: The proposed project includes lands that are already within the HHD levee right of way and are therefore in Federal ownership.

6. Chapter 258, State Parks and Aquatic Preserves.

This chapter authorizes the state to manage state parks and preserves. Consistency with this statute would include consideration of projects that would directly or indirectly adversely impact park property, natural resources, park programs, management or operations.

Response: Construction areas would necessitate heavy equipment traversing and working in the area of fishing, boating, sightseeing, and picnicking facilities that are located in the area. Construction of near culverts and other structures could result in temporary restriction of bank fishing in the area. Preconstruction conditions would return upon completion of the project construction. No permanent adverse impacts to these recreation resources in the project vicinity are expected to occur as a result of the recommended plan. Visitors to John Stretch Park would experience increased noise and dust during construction of the Recommended Plan. Accessing the dike by construction crews may result in excessive wear of the park's paved roads; park amenities may require accelerated maintenance schedules. When project construction has been completed, recreation use in the area can be expected to return to pre-construction conditions.

During construction, access to certain parts of the Lake Okeechobee Scenic Trail (LOST) would be restricted, and parts of the trail would be removed. Following construction, access to the trail by the public would be restored. However, the Corps is not authorized to restore the paved surface of the scenic trail following construction. Coordination with FDEP would be conducted prior to and during construction.

Impacts will be avoided and minimized to the extent practicable throughout construction activities.

7. Chapter 267, Historic Preservation.

This chapter establishes the procedures for implementing the Florida Historic Resources Act responsibilities.

Response: This project has been coordinated with the State Historic Preservation Officer (SHPO). The SHPO, in a letter dated April 7, 2005, concluded that the HHD (8PB208) is historically significant and may be eligible for inclusion on the National Register of Historic Places (NRHP). However, the SHPO has determined that the proposed necessary modifications will not adversely affect the characteristics qualifying this property for listing in the NRHP. Because construction would be restricted to the footprint of the existing Federal project, no other cultural resources would be affected.

Historic preservation compliance will be completed to meet all responsibilities under Chapter 267.

8. Chapter 288, Economic Development and Tourism

This chapter directs the state to provide guidance and promotion of beneficial development through encouraging economic diversification and promoting tourism.

Response: Contribution from the study area to the State's tourism economy would not be compromised by project implementation. Temporary, short-term impacts may be realized during construction due to effects to municipal and county parks and bank fishing areas. These effects are not expected to be significant. During construction, access to certain parts of the Lake Okeechobee Scenic Trail (LOST) would be restricted, and parts of the trail would be removed. Following construction, access to the trail by the public would be restored. However, the Corps is not authorized to restore the paved surface of the scenic trail following construction. Coordination with FDEP would be conducted prior to and during construction.

The project would be compatible with tourism for this area and could potentially contribute to overall growth and development of the area therefore, would be consistent with the goals of this chapter.

9. Chapters 334 and 339, Public Transportation.

This chapter authorizes the planning and development of a safe balanced and efficient transportation system.

Response: The proposed project would not impact the existing public transportation system of the area and therefore would be consistent with the goals of this chapter.

10. Chapter 370, Saltwater Living Resources.

This chapter directs the state to preserve, manage and protect the marine, crustacean, shell and anadromous fishery resources in state waters; to protect and enhance the marine and estuarine environment; to regulate fishermen and vessels of the state engaged in the taking of such resources within or without state waters; to issue licenses for the taking and processing products of fisheries; to secure and maintain statistical records of the catch of each such species; and, to conduct scientific, economic, and other studies and research.

Response: The proposed HHD Major Rehabilitation project is located completely inland and would have no affect on saltwater resources either directly or indirectly through discharge downstream. The proposed project is therefore not applicable to chapter 370.

12. Chapter 372, Living Land and Freshwater Resources.

This chapter establishes the Florida Fish and Wildlife Conservation Commission and directs it to manage freshwater aquatic life and wild animal life and their habitat to perpetuate a diversity of species with densities and distributions that provide sustained ecological, recreational, scientific, educational, aesthetic, and economic benefits.

The FWS CAR is in Appendix A with FFWCC comments.

13. Chapter 373, Water Resources.

This chapter provides the authority to regulate the withdrawal, diversion, storage, and consumption of water.

Response: The proposed project does not involve the transportation or discharge of pollutants. Environmental protection measures will be enforced during construction to avoid inadvertent spills or other sources of pollution.

14. Chapter 376, Pollutant Spill Prevention and Control.

This chapter regulates the transfer, storage, and transportation of pollutants and the cleanup of pollutant discharges.

Response: This work does not involve the transportation or discharging of pollutants. Conditions will be placed in the contract to handle any inadvertent spill of pollutants. Therefore, the project would comply with this Act.

15. Chapter 377, Oil and Gas Exploration and Production.

This chapter authorizes the regulation of all phases of exploration, drilling, and production of oil, gas, and other petroleum products.

Response: This work does not involve the exploration, drilling or production of gas, oil or petroleum product and therefore does not apply.

16. Chapter 380, Environmental Land and Water Management.

This chapter establishes criteria and procedures to assure that local land development decisions include consideration of the regional impacts of proposed large-scale development.

Response: The work does not involve land development as described by this chapter; therefore, this chapter is not applicable.

17. Chapter 388, Arthropod Control.

This chapter provides for a comprehensive approach for abatement or suppression of mosquitoes and other pest arthropods within the state.

Response: The work would not further the propagation of mosquitoes or other pest arthropods.

18. Chapter 403, Environmental Control.

This chapter authorizes the regulation of pollution of the air and waters of the state by the DEP.

Response: A Draft Environmental Impact Statement has been prepared and will be reviewed by the appropriate resource agencies including the Department of Environmental Protection.

19. Chapter 582, Soil and Water Conservation.

This chapter establishes policy for the conservation of the state soil and water through the Department of Agriculture. Land use policies will be evaluated in terms of their tendency to cause or contribute to soil erosion or to conserve, develop, and utilize soil and water resources both onsite or in adjoining properties affected by the work. Particular attention will be given to work on or near agricultural lands.

Response: The proposed work is located near agricultural lands but would not be expected to adversely impact them. Project implementation would include appropriate erosion control plans and measures to ensure compliance.

Appendix E

PUBLIC COORDINATION

Notice of Intent

[Federal Register: August 9, 2006 (Volume 71, Number 153)]
[Notices]
[Page 45539]
From the Federal Register Online via GPO Access [wais.access.gpo.gov]
[DOCID:fr09au06-69]

DEPARTMENT OF DEFENSE
Department of the Army, Corps of Engineers

Intent To Prepare a Second Supplemental Environmental Impact Statement to the Final EIS on Herbert Hoover Dike Major Rehabilitation and Evaluation Report, Reaches 2 and 3, in Palm Beach and Glades Counties, FL

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.
ACTION: Notice of intent.

SUMMARY: On July 8, 2005, the Jacksonville District, U.S. Army Corps of Engineers (Corps) issued a Final Supplemental Environmental Impact Statement (FSEIS) for the Major Rehabilitation actions proposed for Herbert Hoover Dike (HHD), Reach One. Herbert Hoover Dike is the levee that completely surrounds Lake Okeechobee. On September 23, 2005, a Record of Decision was signed adopting the preferred alternative as the Selected Plan for Reach One.

At this time the Corps plans to extend rehabilitation along Reaches Two and Three of HHD. This stretch of HHD extends for approximately 27 miles between an area west of Belle Glade, Palm Beach County to east of Moore Haven, Glades County, FL.

ADDRESSES: U.S. Army Corps of Engineers, Planning Division, Environmental Branch, P.O. Box 4970, Jacksonville, FL 32232-0019.

FOR FURTHER INFORMATION CONTACT: Ms. Barbara Cintron at (904) 232-1692 or e-mail at Barbara.b.cintron@usace.army.mil.

SUPPLEMENTARY INFORMATION:

a. The proposed action will be the selected plan described in the July 2005 SEIS with the additional action of extending construction along Reaches Two and Three of the levee. The proposed action will not affect the Regulation Schedule for Lake Okeechobee. It s expected that all construction will take place within the existing real estate footprint of the HHD.

b. Alternatives to be considered separately for each reach include alternative structural modifications to the existing levee which are currently under development.

c. A scoping letter will be used to invite comments on alternatives and issues from Federal, State, and local agencies, affected Indian tribes, and other interested private organizations and individuals. A scoping meeting is not anticipated.

d. A public meeting will be held after release of the Draft SEIS; the exact location, date, and times will be announced in a public notice and local newspapers.

e. DSEIS Preparation: The 2nd DSEIS is expected to be available for public review in the fourth quarter of CY 2006.

Brenda S. Bowen,
Army Federal Register Liaison Officer.

[FR Doc. 06-6793 Filed 8-8-06; 8:45 am]

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

AUG 1 0 2006

Planning Division
Environmental Branch

TO ADDRESSEES ON THE ENCLOSED LIST:

The Jacksonville District, U.S. Army Corps of Engineers (Corps), is gathering information to help define issues and concerns that will be addressed in a 2nd Draft Supplement to the 1999 Draft Environmental Impact Statement (EIS) and 2005 Final Supplement Environmental Impact Statement (FEIS) on the Herbert Hoover Dike (HHD) Major Rehabilitation Evaluation Report. This 2nd Draft Supplement EIS will cover the areas of Reach 2 and 3. Reach 2 and 3 are located from west of Belle Glade, Palm Beach County to east of Moore Haven, Glades County, Florida (Figure 1). The proposed study area is approximately 26.7 miles (43 KM) along the Herbert Hoover Dike. The Flood Control Act of 1948 provided authority to construct the dike and authorized repairs and modifications. This Scoping Letter is intended to gather information to help define issues and concerns that will be addressed within the 2nd Draft Supplement EIS. The primary objective of the study is to evaluate various alternatives to stabilize the dike and ensure stability.

The proposed action will be a variant of the selected plan described in the July 2005 FEIS with the additional action of extending construction along Reaches 2 and 3 of the levee. The selected plan for Reach 1 included a hanging seepage cutoff wall on the landward side of the dike slope and a relief trench with an inverted filter and relief berm at the toe of the landward slope of the dike, stopping at the HHD's toe ditch. Alternatives to be considered separately for each Reach include alternative structural modifications to the existing levee which are currently under development.

The Corps solicits your views, comments and information about environmental and cultural resources, study objectives and important features with the described study area, as well as any suggested improvements. Letters of comments or inquiry should be addressed to the letterhead address to the attention of the Planning Division, Environmental Studies Section and received within thirty (30) days of the date of this letter.

Sincerely,

Stuart J. Appelbaum
Chief, Planning Division

Enclosures

10.0 LIST OF RECIPIENTS

FEDERAL AGENCIES

Bureau of Indian Affairs
Everglades National Park
Federal Emergency Management Administration
Federal Highway Administration
National Marine Fisheries Service
National Park Service
U.S. Environmental Protection Agency, Region 4
U.S. Army Corps of Engineers
U.S. Department of Agriculture
U.S. Department of Energy
U.S. Department of Housing and Urban Development
U.S. Department of the Interior
U.S. Department of Justice
U.S. Fish and Wildlife Service

STATE AGENCIES

Department of Agriculture and Consumer Services
Florida Department of Agriculture
Florida Department of Environmental Protection
Florida Department of Transportation
Florida Fish and Wildlife Conservation Commission
Florida Power & Light
South Florida Water Management District

ASSOCIATIONS

1000 Friends of Florida
Audubon Society of the Everglades
Caloosahatchee River Citizens Assoc.
Defenders of Wildlife
FADE
Florida Audubon Society
Florida Sportsman Conservation Association
Florida Wildlife Federation
Friends of Lake Okeechobee
Friends of the Everglades
Izaak Walton League
Lake Region Audubon Society
League of Women Voters, Broward
National Audubon Society
National Parks and Conservation Association
National Resources Def. Council
National Wildlife Federation
Ridge Audubon Society
Save the Manatee
Sierra Club, Loxahatchee
St. Lucie River Initiative
The Arthur R. Marshall Foundation and Florida Environmental Institute, Inc.
The Florida Biodiversity Project
The Nature Conservancy
The Wilderness Society
Tropical Audubon Society, Inc.
Trust for Public Lands
World Wildlife Fund

NATIVE AMERICAN TRIBES

Miccosukee Tribe of Indians
Seminole Tribe of Florida

FLORIDA LEGISLATIVE OFFICES

Governmental Responsibility Council
House Environmental Protection Committee
Legislative Library

AGRICULTURE INTERESTS

Dairy Farmers Inc.
Drake Ranch
Florida Cattleman's Association
Florida Citrus Mutual
Florida Sugar Cane League, Inc.
Flo-Sun, Inc.
Frierson Farm
Gulf Citrus Growers
Indian River Citrus League
Landers & Parsons
Lewis Friend Farms, Inc.
MacVicar, Frederico & Lamb, Inc.
McArthur Farm
South Florida Agricultural Council
Stitt Ranch Inc
Sugar Cane Growers Cooperative
United States Sugar Corp.

COUNTIES

Glades County Administration
Hendry County Administration
Martin County Administration
Metro-Dade Center, Office of the City Manager
Miami Dade County
Okeechobee County Administration
Osceola County Administration
Palm Beach County Administration
Polk County Administration
St. Lucie County Administration

COUNTY LIBRARIES

Barron Library
Belle Glade Branch Public Library
Clewiston Public Library
Glades County Public Library
Hendry County Library System
Highlands County Library System
Linda V. York Library
Martin County Library System
Okeechobee County Library
Osceola County Library System
Palm Beach County Library System
South Bay Public Library
St. Lucie County Library System

OTHER PUBLIC

Belle Glade Chamber of Commerce
Bill Mathis
City of Pahokee
LBFH Inc.
Marine Industries Association of Florida, Inc.
Mr. and Mrs. Clayton Diebel
Mr. Jack Mofer
Mr. John Geddie
Okeechobee Waterway Association
Pahokee Chamber of Commerce
Pahokee Marina

SAI# FL200608142711C

USACE - Scoping Notice - 2nd Draft Supplemental Environmental Impact Statement for the Herbert Hoover Dike (HHD) Major Rehabilitation Evaluation Report, Reaches 2 and 3 - Palm Beach, Hendry, And Glades Counties, Florida.

The above-referenced project was received by the Florida State Clearinghouse on 8/14/06, and has been forwarded to the appropriate reviewing agencies. The clearance letter and agency comments will be forwarded to you no later than 9/28/06, unless you are otherwise notified. Please refer to the State Application Identifier (SAI) number in all written correspondence with the Florida State Clearinghouse regarding this project. If you have any questions, please contact the Clearinghouse staff at (850) 245-2161.

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

3301 Gun Club Road, West Palm Beach, Florida 33406 • (561) 686-8800 • FL WATS 1-800-432-2045 • TDD (561) 697-2574
Mailing Address: P.O. Box 24680, West Palm Beach, FL 33416-4680 • www.sfwmd.gov

EX06-085

August 16, 2006

RECEIVED
21 Aug 06

Mr. Stuart J. Appelbaum
Chief, Planning Division
Department of the Army
Jacksonville District Corps of Engineers
P. O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Appelbaum:

Thanks for the opportunity to comment on the next repair phases of the Herbert Hoover Dike. However, we can not make any comment at this time other than to say that we do not believe that reach one, which is currently underway, is acceptable. You have convened an Independent Technical Review Team to evaluate the current repairs. We at South Florida Water Management District would ask that the same team evaluate the future phases from both a design and constructability view point. Once that process is complete and we understand all the issues, we would be willing to comment. That being said, our comments would be consistent with those presented in the report we commissioned from BCI Engineering.

- Cutoff wall should be deeper and taller
- Should be moved to center of dike
- Slurry consistency should be changed
- Tighter control standards should be in place; quality assurance/quality control
- Physical area linear feet of work should have tighter control; i.e., feet of trench and open bench need to be much smaller, "500 feet each."
- Shoreline protection needs to be considered

Sincerely,

George L. Horne

George L. Horne
Deputy Executive Director
Operations and Maintenance
South Florida Water Management District

GLH/dl

c: Carol Ann Wehle, Executive Director, SFWMD

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

RECEIVED
5 Sep 2006

September 1, 2006

District Engineer, Jacksonville
P.O. Box 4970
Jacksonville, FL 32232

ATTN: Mr. Stuart J. Appelbaum
Chief, Planning Division

Subject: **Second Draft Supplemental Environmental Impact Statement [DSEIS] for Herbert Hoover Dike [HHD] Rehabilitation, Reaches #2/3, Lake Okeechobee, Palm Beach and Martin Counties, Florida; August 2006**

Dear Sir:

Pursuant to your letter of August 10, 2006, EPA, Region 4 has reviewed the subject scoping request as regards the forthcoming evaluation of the consequences of restoring/upgrading the structural integrity of Reaches #2/3 of the HHD [a 26.7-mile segment from west of Belle Glade to east of Moore Haven]. Episodes of piping and sand boils along this segment have created concerns that a major breach was possible in the absence of some significant renovations. Stabilization of the HHD is essential since Lake Okeechobee is central to the region's water supply needs and is a fundamental element of the Comprehensive Everglades Restoration Plan [CERP]. As a planning objective, this and any remaining structural upgrades to the HHD should be consistent with the overall formulations associated with the CERP. Similar structural problems exist elsewhere along the HHD system and will be the subject of subsequent NEPA documentation.

Similar problems in Reach #1 were addressed by the Jacksonville District [District] via the use of a pervious hanging cut-off wall on the landward side of the dike together with a relief trench [including an inverted filter and relief berm] on the lakeward side. A variant of this alternative is proposed in this instance. We assume that a road will be built on top of the relief trench for routine access and subsequent maintenance as this design lessens the project's footprint and reduces adverse impacts to existing wetlands, wildlife habitat, and groundwater.

From the information provided, it appears that the proposed design option will meet the primary project objective, viz., preventing a catastrophic dike failure within the noted reaches. Moreover, based on our previous experience with the initial construction we believe that the noted structural components can be installed with acceptable adverse environmental consequences and operational efficiencies.

Thank you for the opportunity to comment on this proposed action. If we can be of further assistance, Chris Hoberg [404-562-9619] will serve as initial point of contact.

Sincerely,

HMueller

Heinz J. Mueller, Chief
NEPA Program Office

FLORIDA

Department of Environmental Protection

RECEIVED
13 oct 2006

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Jeb Bush
Governor

Colleen M. Castille
Secretary

October 6, 2006

Mr. Stuart J. Appelbaum, Chief
Planning Division, Jacksonville District
U.S. Army Corps of Engineers
P. O. Box 4970
Jacksonville, FL 32232-0019

RE: Department of the Army, Jacksonville District Corps of Engineers – Scoping Notice – 2nd Draft Supplemental Environmental Impact Statement for the Herbert Hoover Dike (HHD) Major Rehabilitation Evaluation Report, Reaches 2 and 3 – Palm Beach, Hendry, and Glades Counties, Florida.
SAI # FL200608142711C

Dear Mr. Appelbaum:

The Florida State Clearinghouse, pursuant to Presidential Executive Order 12372, Gubernatorial Executive Order 95-359, the Coastal Zone Management Act, 16, U.S.C. §§ 1451-1464, as amended, and the National Environmental Policy Act, 42 U.S.C. §§ 4231, 4331-4335, 4341-4347, as amended, has coordinated a review of the referenced Draft Supplemental Environmental Impact Statement (SEIS).

The Florida Department of Environmental Protection (DEP) has reviewed the Draft SEIS and concluded that it is essential that the Corps of Engineers repair and rehabilitate the dike to ensure the continued protection of property around the lake. A failure of the dike could threaten the safety of Floridians who live around the lake. DEP requests that the Corps accelerate the review of the work being done on Reach 1 and move forward with the remaining work as soon as possible. Staff also requests that the Corps work with DEP's Office of Greenways and Trails concerning the management of the Lake Okeechobee Scenic Trail during rehabilitation activities. If an alternative is chosen that affects lands outside of the existing dike footprint, DEP suggests that the Corps coordinate with the Division of State Lands concerning lands that may be owned by the state. Since the final rehabilitation design for Reaches 2 and 3 is unknown and could affect property beyond the current footprint of the HHD, the DEP may require the Corps to apply for the appropriate permit. Coordination with DEP's Southeast District Office in West Palm Beach is recommended regarding any state permitting requirements for rehabilitation activities. A final DEP permit determination will be made once rehabilitation design plans are received and reviewed. It is recommended that the Corps and the DEP continue to communicate and work cooperatively to facilitate the Dike's rehabilitation while also protecting the environment.

The Florida Department of Transportation (FDOT) advises that any project impacts to the Lake Okeechobee Scenic Trail recreational trail facilities, including trail surface, pedestrian bridges, berms, signage, mile markers, or other features installed by the State of Florida, must be replaced to like or higher standards by the U.S. Army Corps of Engineers. In addition, if the applicant performs excavation in FDOT right-of-way, any asbestos-containing material (ACM) encountered must be properly handled in accordance with all local, state and federal regulations. In no case shall ACM be crushed and buried within FDOT right-of-way.

The Florida Department of State (DOS) has reviewed its records and indicates that the Herbert Hoover Dike (Site # 8PB2028) is potentially eligible for listing in the *National Register of Historic Places*, due to its historically significant engineering design. The DOS looks forward to receiving the supplemental environmental documents and rehabilitation plans, and consulting with the Corps of Engineers regarding the rehabilitation of the dike to ensure stability. Please refer to the enclosed DOS letter for additional details.

Based on the information contained in the Draft SEIS and the enclosed state agency comments, the state has determined that, at this stage, the proposed activities are consistent with the Florida Coastal Management Program (FCMP). The concerns identified by the reviewing agencies must be addressed prior to project implementation. The state's continued concurrence with the project will be based, in part, on the adequate resolution of issues identified during this and subsequent reviews. The state's final review of the project's consistency with the FCMP will be conducted during the environmental permitting stage.

Thank you for the opportunity to review the proposed project. If you have any questions regarding this letter, please contact Mr. Christopher J. Stahl at (850) 245-2169.

Sincerely,

Sally B. Mann

Sally B. Mann, Director
Office of Intergovernmental Programs

SBM/cjs
Enclosures

cc: John Outland, DEP, MS 45
Greg Knecht, DEP, MS 3560
Tim Gray, DEP, Southeast District
Lisa Stone, FDOT
Laura Kammerer, DOS

Project Information	
Project:	FL200608142711C
Comments Due:	09/15/2006
Letter Due:	09/28/2006
Description:	DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT CORPS OF ENGINEERS - SCOPING NOTICE - 2ND DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE HERBERT HOOVER DIKE (HHD) MAJOR REHABILITATION EVALUATION REPORT, REACHES 2 AND 3 - PALM BEACH, HENDRY, AND GLADES COUNTIES, FLORIDA.
Keywords:	ACOE - HERBERT HOOVER DIKE REHABILITATION REACHES 2 & 3 - PALM BCH/HENDRY/GLADES
CFDA #:	12.106

Agency Comments:
SW FLORIDA RPC - SOUTHWEST FLORIDA REGIONAL PLANNING COUNCIL
No Comment
TREASURE COAST RPC - TREASURE COAST REGIONAL PLANNING COUNCIL
The project is consistent with the Strategic Regional Policy Plan. It supports Regional Goal 8.1 - Public Facilities which provide a high quality of life.
GLADES - GLADES COUNTY
HENDRY -
PALM BEACH -
COMMUNITY AFFAIRS - FLORIDA DEPARTMENT OF COMMUNITY AFFAIRS
FISH and WILDLIFE COMMISSION - FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
No Comments Received
STATE - FLORIDA DEPARTMENT OF STATE
A review of the Florida Department of State's (DOS) records indicates that the Herbert Hoover Dike (Site # 8PB2028) is potentially eligible for listing in the National Register of Historic Places, due to its historically significant engineering design. The DOS looks forward to receiving the supplemental environmental documents and rehabilitation plans, and consulting with the Corps of Engineers regarding the rehabilitation of the dike to ensure stability.
TRANSPORTATION - FLORIDA DEPARTMENT OF TRANSPORTATION
FDOT advises that any project impacts to the Lake Okeechobee Scenic Trail (LOST) recreational trail facilities, including trail surface, pedestrian bridges, berms, signage, mile markers, or other features installed by the State of Florida, must be replaced to like or higher standards by the U.S. Army Corps of Engineers. In addition, if the applicant performs excavation in FDOT right-of-way, any asbestos-containing material (ACM) encountered must be properly handled in accordance with all local, state and federal regulations. In no case shall ACM be crushed and buried within FDOT right-of-way.

ENVIRONMENTAL PROTECTION - FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
The DEP has reviewed the draft SEIS and concluded that it is essential that the Corps repair and rehabilitate the dike to ensure the continued protection of property around the lake. A failure of the dike could threaten the safety of Floridians who live around the lake. We ask that the Corps accelerate the review of the work being done on Reach 1 and move forward with the remaining work as soon as possible. DEP also requests that the Corps work with our Office of Greenways and Trails concerning the management of the Lake Okeechobee Scenic Trail during rehabilitation activities. If an alternative is chosen that affects lands outside of the existing dike footprint, we suggest that the Corps coordinate with our Division of State Lands concerning lands that may be owned by the state. Since the final rehabilitation design for Reaches 2 and 3 is unknown and could affect property beyond the current footprint of the HHD, the Department may require the Corps to apply for the appropriate permit. Coordination with our Southeast District Office in West Palm Beach is recommended regarding any state permitting requirements for rehabilitation activities. A final Department permit determination will be made once rehabilitation design plans are received and reviewed. It is recommended that the Corps and the Department continue to communicate and work cooperatively to facilitate the Dike's rehabilitation while also protecting the environment.
SOUTH FLORIDA WMD - SOUTH FLORIDA WATER MANAGEMENT DISTRICT
Released Without Comment

For more information please contact the Clearinghouse Office at:

3900 COMMONWEALTH BOULEVARD MS-47
TALLAHASSEE, FLORIDA 32399-3000
TELEPHONE: (850) 245-2161
FAX: (850) 245-2190

Visit the Clearinghouse Home Page to query other projects.

Memorandum

TO:	Florida State Clearinghouse
THROUGH:	Greg Knecht, Administrator Water Quality Standards & Special Projects Program
FROM:	John Outland and Stanley Ganthier
DATE:	September 26, 2006
SUBJECT:	Department of the Army, Jacksonville District Corps of Engineers – Scoping Notice – 2nd Draft Supplemental Environmental Impact Statement for the Herbert Hoover Dike Major Rehabilitation Evaluation Report, Reaches 2 and 3 – Palm Beach, Glades, and Hendry Counties, Florida.
SAI#:	FL06-2711C

RECEIVED
SEP 29 2006
OIP / OLGA

The Department has reviewed the above-referenced Notice of intent and offers the following comments:

Background

The Jacksonville Corps of Engineers is gathering information to help define issues and concerns for the rehabilitation of Reaches 2 and 3 of the Herbert Hoover Dike. This follows the July 2005 Final Supplemental Environmental Impact Statement for the Dike and rehabilitation of Reach 1. The preferred alternative for Reach 1 includes a pervious cutoff wall and relief trench on the landward slope of the dike constructed within the existing dike footprint. However, other alternatives will be considered separately for each Reach including alternative structural modifications to the existing level which are currently under development.

Comments

The following suggestions are offered for consideration in project planning:

It is our understanding that the intense hurricane seasons of 2004 and 2005 and resulting high lake levels have resulted in damage to the dike. Leaks, cracks, piping and boils are visible along several portions of the 143 mile water control system. After the water level in the lake rose to an alarming 17.2 feet following Hurricane Wilma, the U.S. Army Corps of Engineers was forced to release large volumes of water to protect people and property from potential flooding.

It is essential that the Corps repair and rehabilitate the dike to ensure the continued protection of property around the lake. A failure of the dike could threaten the safety of Floridians who live around the lake. We ask that the Corps accelerate the review of the work being done on Reach 1 and move forward with the remaining work as soon as possible.

We also ask that the Corps work with our Office of Greenways and Trails concerning the management of the Lake Okeechobee Scenic Trail during rehabilitation activities. If an alternative is chosen that affects lands outside of the existing dike footprint, we suggest that the Corps coordinate with our Division of State Lands concerning lands that may be owned by the state. Since the final rehabilitation design for Reaches 2 and 3 is unknown and could affect property beyond the current footprint of the HHD, the Department may require the Corps to apply for the appropriate permit. Coordination with our Southeast District Office in West Palm Beach is recommended regarding any state permitting requirements for rehabilitation activities. A final Department permit determination will be made once rehabilitation design plans are received and reviewed.

It is recommended that the Corps and the Department continue to communicate and work cooperatively to facilitate the Dike's rehabilitation while also protecting the environment.

If you have any questions regarding these comments, please feel free to contact Stan Ganthier at (561) 681-6759.

cc: John Outland (cc)
Greg Knecht (cc)
Frank Nearhoof (cc)
Tim Gray (cc)
Chad Kennedy (cc)

FLORIDA DEPARTMENT OF STATE
Sue M. Cobb
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Ms. Lauren Milligan
Florida Department of Environmental Protection
3900 Commonwealth Boulevard, MS #47
Tallahassee, Florida 32399-3000

September 20, 2006

Re: DHR No.: 2006-7553 / Received by DHR: August 17, 2006
SAI #: 200202261582C
Department of the Army – Jacksonville District Corps of Engineers
Scoping Notice – 2nd Draft Supplemental Environmental Impact Statement for the Herbert Hoover Dike Major Rehabilitation Evaluation Report, Reaches 2 and 3
Palm Beach, Hendry and Glades Counties

Dear Ms. Milligan:

Our office received and reviewed the above referenced project in accordance with Section 106 of the *National Historic Preservation Act of 1966* (Public Law 89-665), as amended in 1992, and *36 C.F.R., Part 800: Protection of Historic Properties*; Chapter 267, *Florida Statutes,* and Florida's Coastal Management Program, and implementing state regulations; for possible impact to historic properties listed, or eligible for listing, in the *National Register of Historic Places*, or otherwise of historical, architectural or archaeological value. The State Historic Preservation Officer is to advise and assist state and federal agencies when identifying historic properties, assessing effects upon them, and considering alternatives to avoid or minimize adverse effects.

We reviewed the referenced Scoping Letter indicating that that the Jacksonville District, U.S. Army Corps of Engineers (Corps) is preparing supplemental National Environmental Policy Act documents pertaining to the Herbert Hoover Dike (8PB2028). A review of our records indicates that the Herbert Hoover Dike is potentially eligible for listing in the National Register, because it considered historically significant for its engineering design. Therefore, we look forward to receiving the supplemental environmental documents and rehabilitation plans; and consulting with the Corps regarding the rehabilitation of the dike in order to ensure stability.

Provided the above condition regarding continued consultation with this office, the proposed activities will be consistent with the historic preservation laws of Florida's Coastal Management Program and the National Historic Preservation Act.

Ms. Lauren Milligan
September 20, 2006
Page 2

If there are any questions concerning our comments and recommendations, please contact Laura Kammerer, Deputy State Historic Preservation Officer or Review and Compliance at 850-245-6333. We look forward to assisting the City of Apalachicola in this effort.

Sincerely,

Frederick P. Gaske

Frederick P. Gaske, Director, and
State Historic Preservation Officer

Xc: Stuart J. Applebaum, Chief, Planning Division, Corps of Engineers - Jacksonville

Southwest Florida Regional Planning Council

1926 Victoria Avenue, Fort Myers, Florida 33901-3414
(239)338-2550 FAX (239)338-2560 SUNCOM (239)748-2550

September 15, 2006

Mr. Stuart J. Appelbaum, Chief
USACOE - Planning Division
Jacksonville District
PO Box 4970
Jacksonville, FL 32232-0019

RECEIVED
SEP 2 0 2006
OIP / OLGA

RE: IC&R Project #2006-074
State Clearinghouse #FL200608142711C

USACOE - Jacksonville District - Scoping Notice - 2nd Draft Supplemental Environmental Impact Statement for he Herbert Hoover Dike (HHD) Major Rehabilitation Evaluation Report, Reaches 2 and 3 - Palm Beach, Hendry, and Glades Counties, Florida.

Dear Mr. Appelbaum:

The staff of the Southwest Florida Regional Planning Council reviews various proposals, Notifications of Intent, Preapplications, permit applications, and Environmental Impact Statements for compliance with regional goals, objectives, and policies, as determined by the Strategic Regional Policy Plan. The staff reviews such items in accordance with the Florida Intergovernmental Coordination and Review Process (Chapter 29I-5, F.A.C.), and adopted regional clearinghouse procedures.

These designations determine Council staff procedure in regards to the reviewed project. The four designations are:

<u>Less Than Regionally Significant and Consistent</u> no further review of the project can be expected from Council.

<u>Less Than Regionally Significant and Inconsistent</u> Council does not find the project of regional importance, but will note certain concerns as part of its continued monitoring for cumulative impact within the noted goal area.

<u>Regionally Significant and Consistent</u> project is of regional importance, and appears to be consistent with Regional goals, objectives, and policies.

Regionally Significant and Inconsistent project is of regional importance and does not appear to be consistent with Regional goals, objectives, and policies. Council will oppose the project as submitted, but is willing to participate in any efforts to modify the project to mitigate the concerns.

The above referenced document has been reviewed by this office, based on the information contained in the document, and on local knowledge, staff wishes to provide **No Comment** at this time.

Should you or any other party request this finding to be reconsidered, please contact Nichole L. Gwinnett, IC&R Coordinator, with this request, or any questions concerning staff review of this item. This recommendation will be discussed at the next scheduled Council meeting. Should Council action differ from the staff recommendation, you will be notified.

Sincerely,

SOUTHWEST FLORIDA REGIONAL PLANNING COUNCIL

David Y. Burr
Executive Director

DYB/NLG

cc: Sally B. Mann, Florida State Clearinghouse Director

Herbert Hoover Dike Scoping Comments

Commenter	Comment Number	Comment	Corps Response
South Florida Water Management District	1	We at the South Florida Water Management District would ask that the Independent Technical Review Team evaluate the future phases from both a design and constructability view point.	Comment Noted
	2	Cutoff wall should be deeper and taller (compared to that in Reach 1).	Will be addressed during design.
	3	Cutoff wall should be moved to center of dike (compared to that in Reach 1).	Will be addressed during design.
	4	Slurry consistence of cutoff wall should be changed (compared to Reach 1).	Will be addressed during design and construction.
	5	Tighter control standards should be in place; quality assurance/quality control	Will be addressed during construction.
	6	Physical area linear feet of work should have tighter control; i.e., feet of trench and open bench need to be much smaller, "500 feet each."	Construction phasing to be addressed during plans & specs.
	7	Shoreline protection needs to be considered.	Concur. State consistency review will be performed during the coordination of the draft EIS with FDEP. This project will be consistent with the Coastal Zone Management Act of 1972.
Florida Department of State, Division of Historic Resources	1	A review of our records indicates that the Herbert Hoover Dike is potentially eligible for listing in the National Register because it is considered significant for its engineering design. Therefore, we look forward to working with the Corps regarding the rehabilitation of the dike in order to ensure stability.	The Corps looks forward to working with the Division of Historic Resources relative to the historic nature of the Herbert Hoover Dike.
	2	Provided the above condition regarding continued consultation with this office, the proposed activities will be consistent with the historic preservation laws of Florida's Coastal Management Program and National Historic Preservation Act.	Comment Noted
Florida Department of Environmental Protection	1	DEP requests that the Corps work with DEP's Office of Greenways and Trails concerning the management of the Lake Okeechobee Scenic Trail during rehabilitation activities.	Concur. The Corps will coordinate with FDEP as well as FDOT on this matter.

Commenter	Comment Number	Comment	Corps Response
	2	If an alternative is chosen that affects lands outside of the existing dike footprint, DEP suggests that the Corps coordinate with the Division of State Lands concerning lands that may be owned by the state.	Coordination with the Division of State Lands will be initiated if any lands outside the existing footprint are affected.
	3	Since the final rehabilitation design for Reaches 2 and 3 is unknown and could affect property beyond the current footprint of HHD, the DEP may require the Corps to apply for the appropriate permit. Coordination with DEP's Southeast District Office in West Palm Beach is recommended regarding any state permitting requirements of rehabilitation activities.	The Corps fully intends to maintain coordination with the DEP Southeast District Office for all applicable permitting considerations.
	4	A final DEP permit determination will be made once rehabilitation design plans are received and reviewed.	Comment Noted
Florida Department of Transportation	1	FDOT advises that any project impacts to the Lake Okeechobee Scenic Trail (LOST) recreational trail facilities, including trail surface, pedestrian bridges, berms, signage, mile markers, or other features installed by the State of Florida, must be replaced to like or higher standards by the U.S. Army Corps of Engineers.	The Corps of Engineering will return any recreational features impacted by the project to their original condition located along the lake Okeechobee Scenic Trail in Reach 2 and 3.
	2	If the applicant performs excavation in the FDOT right-of-way, any asbestos-containing material (ACM) encountered must be properly handled in accordance with all local, state, and federal regulations. In no case shall ACM be crushed and buried within FDOT right-of-way.	If any ACM is encountered, the Corps will comply with all applicable laws and regulations. No ACM will be buried within FDOT right-of-way.
Environmental Protection Agency	1	Stabilization of HHD is essential since Lake Okeechobee is central to the region's water supply needs and is a fundamental element of the Comprehensive Everglades Restoration Plan (CERP). As a planning objective, this and any remaining structural upgrades to the HHD should be consistent with the overall formulations associated with CERP.	It is the intent of the Corps to maintain consistency with CERP.
	2	We assume that a road will be built on top of the relief trench for routine access and subsequent maintenance as this design lessens the project's footprint and reduces adverse impacts to existing wetlands, wildlife habitat, and groundwater.	Project is being designed with safety of public in mind and as top priority over environmental impacts. In addition to final design, permanent operations & maintenance access will be acquired.

Commenter	Comment Number	Comment	Corps Response
	3	Based on our previous experience with the initial construction, we believe that the noted structural components can be installed with acceptable adverse environmental consequences and operational efficiencies.	Comment Noted
Southwest Florida Regional Planning Council	1	Based on the information contained in the document, and on local knowledge, staff wishes to provide **No Comment** at this time.	Comment Noted

Appendix F

UNIFORM MITIGATION ASSESSMENT METHOD

UMAM EVALUATION

HERBERT HOOVER DIKE
MAJOR REHABILITATION EVALUATION REPORT

Prepared by:
Nancy P. Allen
U.S. Army Corps of Engineers
Jacksonville District
Jacksonville, Florida

Attachment 1: Florida Administrative Code Chapter 62-345 Uniform Mitigation Assessment Method

Attachment 2: Maps of Assessment Areas for Reaches 2 and 3 of Herbert Hoover Dike

Attachment 3: Part I, Qualitative Assessment of Impact Area

Attachment 4: Part II, Quantitative Assessment of Impact Area

Attachment 5: Plant Species of Herbert Hoover Dike Assessment Areas, Reaches 2 and 3

Attachment 6: Photographs of Assessment Areas

Attachment 7: UMAM for Mitigation Bank

I. INTRODUCTION

The Herbert Hoover Dike (HHD) is a component of the Central and Southern Florida (C&SF) Project and consists of a series of levees, gated culverts and locks located around the perimeter of Lake Okeechobee in south Florida. The Corps constructed the dike for flood protection, water supply, and navigation purposes between 1932 and 1938. Major culvert modifications were accomplished in the 1970s, but since then, repairs have been made on an as-needed basis. The existing HHD system is approximately 143 miles (230 km) long, and is divided into eight segments or "Reaches" for planning purposes. Two southern segments, Reaches 2 and 3, are the focus of the present study.

In recent years, signs of instability in the HDD such as boils and pipings have occurred, indicating that major renovations are now necessary, especially along its southeastern reaches. The purpose of this project is to reconstruct and rehabilitate Reaches 2 and 3 of the HHD to prevent a catastrophic failure of the system and contain the lake waters for flood protection, water supply, and navigation.

Previous designs were developed, evaluated, and modified through the 1999 Draft EIS for the HHD Major Rehabilitation Evaluation Report (MRR) and the 2005 Final EIS, Proposed Rehabilitation of the HHD MRR Reach 1. Designs were further evaluated by a 2002 Value Engineering Study and reviewed in 2005-2006 by an Independent Technical Review Team. The Recommended Plan consists of a seepage cutoff wall placed in the center of the dike and a seepage berm expanded to fill in an existing toe ditch. All construction would be restricted to the footprint of the existing project in Reaches 2 and 3 in Glades, Hendry, and Palm Beach counties.

Because construction would be confined to the existing footprint, environmental impacts would be minimal. Impacts caused by filling wetlands along the toe ditch would be mitigated through compensation. No other long-term adverse effects of the project are anticipated.

II. METHODOLOGY

On November 7 and 8, 2006, an interagency team of biologists from U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), and U.S. Environmental Protection Agency (USEPA) used the Uniform Mitigation Assessment Method (UMAM) to evaluate the quality of wetlands potentially affected by the Recommended Plan. The UMAM is a standardized procedure for assessing the functions provided by wetlands and other surface waters, the amount that those functions are reduced by a proposed impact, and the amount of mitigation necessary to offset that loss. A full explanation of the UMAM procedure as provided by the Florida Administrative Code, Chapter 62-345 is appended in Attachment 1.

The first step in the UMAM process is to determine the assessment area(s). As defined in F.A.C. 62-345.200, an assessment area is all or part of a wetland or surface water impact site, or a mitigation site that is sufficiently homogeneous in character, impact, or mitigation benefits to be assessed as a single unit. The overall area of potential impact was defined as land within 150 feet landward of the toe of the dike in Reach 3 and eastern Reach 2. A total of 229.5 acres were assessed. Western Reach 2 between S77 and S4 was not assessed because the toe of the dike borders a borrow ditch that will not be affected during project construction. Additionally, John Stretch Park was not assessed because no wetlands are present. The remaining portions of Reaches 2 and 3 were divided into assessment areas of similar conditions (Attachment 2). Reach 2 was separated into five areas:

1) Reach 2 - West;
2) Reach 2 - East 1;
3) Reach 2 - East 2;
4) Reach 2 - East 3; and
5) Reach 2 - East 4.

Reach 3 was divided into four areas:

1) Reach 3 - John Stretch Park, East 1;
2) Reach 3 - John Stretch Park, East 2;
3) Reach 3 - Southbay West; and
4) Reach 3 - Southbay.

The team met at the USACE South Florida Operations Office in Clewiston, Florida, to conduct the qualitative characterization of both the impact and mitigation assessment areas (UMAM Part I). The purpose of the qualitative characterization was to identify the functions provided by the area to fish and wildlife and their habitat and to establish a framework for quantitative assessment (F.A.C. 62-345.300(3)(a)). The qualitative characterization (Part I) is appended in Attachment 3.

The team then started at the western extent of the area to be assessed (Reach 2 – West) to conduct the quantitative assessment (UMAM Part II) of the impact area. The quantitative characterization is appended in Attachment 4. Over a process of two days, all nine areas were assessed and scored.

The UMAM scores three wetland parameters: 1) location and landscape support, 2) water environment, and 3) community structure for vegetation and/or benthic communities. The parameters are scored on a scale of one to 10, with one being "not present" and 10 being "optimal," for both with-project implementation condition and current condition. The assumption was made for the with-project implementation condition that the entire 150-foot assessment area would be impacted and would no longer function as a wetland.

Once the impact areas were scored, it was possible to calculate the functional loss of wetlands from the proposed project. In order to determine the functional loss of wetlands, the change in wetland function was first calculated as the projected functional value of the wetlands after project implementation minus the current functional value of the wetlands. This delta value was then multiplied by the assessment area acreage to give a functional loss value. No jurisdictional determination was performed prior to the UMAM assessment. Therefore, the assessment acreage potentially includes non-wet areas. Where US 27 is located within the 150-foot assessment area, the roadway was deleted from the assessment acreage by calculating the area between the toe of dike and the edge of pavement.

III. FINDINGS

According to the UMAM, the dominant plant species for the entire assessment area include melaleuca (*Melaleuca quinquenervia*), Brazilian pepper (*Schinus terebinthifolius)*, Australian pine (*Casuarina equisetifolia*), leather fern (*Acrostichum danaeifolium*), cattails (*Typha* sp.), duck potato (*Sagittaria* sp.), primrose willow (*Ludwigia peruviana)*, common reed (*Phragmites australis)*, giant foxtail (*Setaria magna*), sawgrass (*Cladium jamaicense*), water-lettuce (*Pistia stratiotes*), and royal palm (*Roystonea elata*). See Attachment 5 for a more complete list of common plant species in the project area. The following offers a brief description of the key characteristics of each of the nine assessment areas. Attachment 6 includes pictures of each assessment area described.

Reach 2 – West was dominated by melaleuca. The stand was recently sprayed, but still had a visible understory of leather fern and sawgrass. The soils were hydric with a dark, organic layer, and there were areas of standing, dark-colored water within the assessment area. The area had a decent vegetated buffer between it and the road. Wildlife observed include cattle egrets, a red-shouldered hawk, cormorant, great blue heron, tri-colored heron, great egret, boat-tailed grackle, sunfish, mosquitoes, and butterflies as well as deer and hog tracks. The assessment area was scored a five for location and landscape support, six for water environment, and two for community structure.

Reach 2 – East 1 also had a high incidence of exotic and invasive plants. The dominant plant species were Brazilian pepper, water lettuce, Australian pine, duck potato, leather fern, willow, and melaleuca. The assessment area had a vegetative buffer between it and the road on the west, but abutted US 27 on the east. The toe ditch had standing water. It was noted that the soil had lost some of its organic content. Wildlife observed include tadpoles, dragonflies, mosquito fish, heron, cormorant, cattle egret, great egret, turkey vultures, and monarch butterfly. The assessment area was scored a four for location and landscape support, five for water environment, and four for community structure.

Reach 2 – East 2 incorporated the highway into the 150 foot buffer so the assessment area receives direct runoff from the road. Aquatic and submerged vegetation was present with the dominant plant species being cattails and *Ludwigia* sp. The assessment area was scored a two for location and landscape support, four for water environment, and five for community structure.

Reach 2 – East 3 also includes US 27 within the polygon, and some stretches of the reach are completely maintained (mowed). Four discharge culverts from sugarcane fields were observed, and the assessment area receives direct run-off from the road. The dominant plant species include sagittaria, cattail, and *Phragmites* sp. Wildlife observed include spiders, cattle egrets, and a great egret. The assessment area was scored a two for location and landscape support, two for water environment, and three for community structure.

Reach 2 – East 4 had a small vegetated buffer from the highway, and the assessment area abuts John Stretch Park on the east. Muck soils were noted, as well as a sawgrass understory. Areas of standing water were visible. The dominant plant species include melaleuca, Brazilian pepper, and sawgrass. No wildlife usage was observed. The assessment area was scored a four for location and landscape support, five for water environment, and five for community structure.

Reach 3 – John Stretch Park East 1 had a minimal vegetated buffer from US 27 on the western extent, and approximately one-third of the area included a commercial nursery. Open water in the toe ditch was observed, and one culvert discharged into the assessment area from a sugarcane field. Many exotic and invasive species had escaped the nursery into the remaining portions of the assessment area. The dominant plant species was giant foxtail. The assessment area was scored a three for location and landscape support, three for water environment, and two for community structure.

Reach 3 – John Stretch Park East 2 incorporated US 27. For the majority of the assessment area, wetlands were isolated into a three-foot-wide ditch. Nine culverts discharged into the ditch from agriculture fields. No dominants were identified. Wildlife observed includes mosquito fish, damsel fly, white butterflies, cattle egrets, swallow, and osprey. The assessment area was scored a two for location and landscape support, one for water environment, and one for community structure.

Reach 3 – South Bay West is adjacent to a park but situated off the highway slightly. The assessment area includes deeper water in a man-made lake that is buffered approximately 50 percent with vegetation. No dominant plant species were noted. Wildlife observed include ibis, butterflies, alligator, dragonflies, mosquito fish, sunfish, and bass. The assessment area was scored a two for location and landscape support, two for water environment, and four for community structure.

Reach 3 – South Bay is situated in sugarcane fields. Five agricultural ditches discharge into the toe. Wildlife observed include a hawk, swallow, osprey, heron, and doves. The assessment area was scored a three for location and landscape support, two for water environment, and two for community structure.

Because it was assumed that the entire 150-foot buffer would be impacted and no longer function as a wetland, all three parameters were scored as zero for the with-project implementation values.

Table 1 illustrates the functional loss for each assessment area. The total functional loss of wetlands from improvements to Reaches 2 and 3 of HHD is calculated as 73.21

TABLE 1. UMAM SCORES FOR WETLANDS LANDWARD OF HHD

Assessment Area	*Delta*	*Acres*	*Functional Loss (Delta X #acres)*
Reach 2			
West	-0.43	61.38	-26.39
East 1	-0.43	17.69	-7.61
East 2	-0.37	39.29	-14.54
East 3	-0.23	22.72	-5.22
East 4	-0.47	9.26	-4.35
Total Reach 2		150.34	-58.11
Reach 3			
John Stretch Park East 1	-0.27	10.15	-2.74
John Stretch Park East 2	-0.13	39.46	-5.13
Southbay West	-0.33	4.31	-1.42
Southbay	-0.23	25.23	-5.80
Total Reach 3		79.16	-15.10
Total Reach 2 and 3		229.50	-73.21

IV. MITIGATION

The USACE created a mitigation bank between 2000 and 2004 through wetlands grading, tree planting and melaleuca (*Melaleuca quinquenervia*) removal. Melaleuca, Brazilian pepper (*Schinus terebinthifolius),* and Australian pine (*Casuarina equisetifolia*) were all treated and removed in Reach 4 from Old Sportsman's Village to just north of the Marina (Attachment 7, Photographs 1 - 2). Additionally, native wetland trees including cypress, red maple, and pond apple were planted along the toe of HHD in the mitigation area in June of 2004 (Attachment 7, Photographs 3 - 6). The UMAM was used to assess the value of habitat created. The tree planting resulted in 1 credit of mitigation. Worksheets and determination formulas are included in Attachment 7.

Other mitigation was created through the removal of 57 acres of melaleuca adjacent to Reach 2 (near the Alvin Ward Boat Ramp) and continued maintenance of this area. The UMAM scored the habitat value as equivalent to 26.32 credits (Attachment 7).

The total mitigation created in the two areas is 27.32 (Table 2). A portion of this mitigation (3.8 acres) was used for Reach 1 improvements, leaving a total of 23.52 mitigation credits available for Reach 2 and 3 impact areas. The UMAM for Reach 2 and 3 impact assessment areas showed that the total number of credits needed is 73.21. Therefore, an additional 49.69 mitigation credits are required to offset the proposed 229.50 acres of impacts in Reaches 2 and 3.

Table 2. Mitigation Credits

Mitigation Credits Needed for Reaches 2 and 3	*Total Mitigation Credits Created*	*Mitigation Required for Reach 1*	*Mitigation Credits Available*	*Additional Mitigation Credits Needed for Reaches 2 and 3*
73.21	27.32	3.8	23.52	49.69

V. CONCLUSIONS

The total functional loss of wetlands from improvements to Reaches 2 and 3 of HHD is calculated as 73.21, using UMAM Part II. Mitigation was performed in two different areas adjacent to HHD and included wetlands grading, tree planting, and melaleuca removal. The UMAM was then performed on the mitigation site to determine a total gain in wetland function of 27.32. A total of 23.52 credits are available for Reach 2 and 3 assessment areas. The additional amount of mitigation required to offset the functional loss of wetlands from the proposed project 49.69 credits.

ATTACHMENT 1:

FLORIDA ADMINISTRATIVE CODE
CHAPTER 62-345
UNIFORM MITIGATION ASSESSMENT METHOD

CHAPTER 62-345 UNIFORM MITIGATION ASSESSMENT METHOD

62-345.100 Intent and Scope.

(1) The intent of this rule is to fulfill the mandate of subsection 373.414(18), F.S., which requires the establishment of a uniform mitigation assessment method to determine the amount of mitigation needed to offset adverse impacts to wetlands and other surface waters and to award and deduct mitigation bank credits. This chapter shall apply to those impacts subject to review under Section 373.414, F.S., excluding subparagraphs 373.414(1)(a)1., 3., 5., 6. and (b)3., F.S.

(2) Except as specified above, the methodology in this chapter provides a standardized procedure for assessing the functions provided by wetlands and other surface waters, the amount that those functions are reduced by a proposed impact, and the amount of mitigation necessary to offset that loss. It does not assess whether the adverse impact meets other criteria for issuance of a permit, nor the extent that such impacts may be approved. This rule supersedes existing ratio guidelines or requirements concerning the amount of mitigation required to offset an impact to wetlands or other surface waters. Upon a determination that mitigation is required to offset a proposed impact, the methodology set forth in this rule shall be used to quantify the acreage of mitigation, or the number of credits from a mitigation bank or regional offsite mitigation area, required to offset the impact. This method is also used to determine the degree of improvement in ecological value of proposed mitigation bank activities. When applying this method, reasonable scientific judgment must be used.

(3) This method is not applicable to:

(a) Activities for which mitigation is not required;

(b) Activities authorized under general permits under Part IV of Chapter 373, F.S., for which special forms of mitigation are specified in the rule establishing the general permit;

(c) Activities in North Trail Basin and Bird Drive Basin in Miami-Dade County for which mitigation is specified in Department of Environmental Protection Permit Number 132416479, issued February 15, 1995 to Everglades National Park for a mitigation bank in the Hole in the Donut, which is incorporated by reference herein;

(d) Activities for which mitigation is determined under Section 373.41492, F.S.;

(e) Florida Department of Transportation permit applications where mitigation is provided under a plan developed by a water management district and approved by Department of Environmental Protection final order pursuant to Section 373.4137, F.S., prior to the effective date of this rule;

(f) Activities for which mitigation is determined under Section 338.250, F.S. (Central Florida Beltway);

(g) Impacts that are offset under the net improvement provision of subparagraph 373.414(1)(b)3., F.S.;

(h) Fishing or recreational values, pursuant to subparagraph 373.414(1)(a)4., F.S.; or

(i) Mitigation for mangrove trimming and alteration as required and implemented in accordance with Section 403.9332, F.S.

(4) This method is not intended to supersede or replace existing rules regarding cumulative impacts, the prevention of secondary impacts, reduction and elimination of impacts, or to determine the appropriateness of the type of mitigation proposed.

(5) For the following types of secondary impacts, the amount and type of mitigation required to offset these impacts shall include measures such as the implementation of management plans, participation in a wildlife management park established by the Florida Fish and Wildlife Conservation Commission, incorporation of culverts or bridged crossings designed to facilitate wildlife movement, fencing to limit access, reduced speed zones, plans to protect significant historical or archeological resources, or other measures designed to offset the secondary impact, rather than the implementation of Rules 62-345.400 through 62-345.600, F.A.C.:

(a) Secondary impacts to fish or wildlife caused by collision with boat traffic, automobile traffic, or towers;

(b) Secondary impacts to aquatic or wetland dependent listed animal species caused by impacts to uplands used by such species for nesting or denning; or

(c) Secondary impacts to historical or archeological resources.

(6) Pursuant to paragraph 373.414(18)(b), F.S., an entity that has received a mitigation bank permit issued by the Department of Environmental Protection or a water management district under Sections 373.4135 and 373.4136, F.S., prior to the adoption of this rule must have impact sites assessed for the purpose of deducting bank credits using the credit assessment method, including any functional assessment methodology, that was in place when the bank was permitted. A permitted mitigation bank has the option to modify the mitigation bank permit to have its credits re-assessed under the method in this chapter, and thereafter have its credits deducted using the method adopted in this chapter. In accordance with Section 373.4136 and paragraph 373.414(18)(b), F.S., the number of credits awarded must be based on the degree of improvement in ecological value expected to result from the establishment and operation of the mitigation bank, as determined using the assessment methodology in this chapter.

(7) An application for a permit or other authorization involving mitigation that is pending on or before the effective date of this chapter shall be reviewed under the applicable rules, ordinances, and special acts in effect before the effective date of this chapter, unless the applicant elects to amend the application to be reviewed under this chapter.

(8) Applications to modify a conceptual, standard, standard general or individual permit issued prior to the effective date of this chapter, shall be evaluated under the applicable mitigation assessment criteria in effect at the time the permit was issued, unless the applicant elects to have the application reviewed under this chapter or unless the proposed modification is reasonably expected to lead to substantially different or substantially increased water resource impacts.

(9) An application for a permit under part IV of Chapter 373, F.S., for an activity associated with mining operations that qualifies for the exemption in subsection 373.414(15), F.S., shall be reviewed under the applicable rules identified in subsection 373.414(15), F.S.

(10) The Department and Water Management Districts shall develop and conduct training workshops for agency staff, local governments, and the public on the application of this rule, prior to the effective date of this rule.

Specific Authority 373.026(7), 373.043, 373.414(9), (18) FS. Law Implemented 373.414(18) FS. History–New 2-2-04.

62-345.200 Definitions.

(1) "Assessment area" means all or part of a wetland or surface water impact site, or a mitigation site, that is sufficiently homogeneous in character, impact, or mitigation benefits to be assessed as a single unit.

(2) "Reviewing agency" means the Florida Department of Environmental Protection, or any water management district, local government or other governmental agency required by subsection 373.414(18), F.S., to use this methodology.

(3) "Ecological value" means the value of functions performed by uplands, wetlands, and other surface waters to the abundance, diversity, and habitats of fish, wildlife, and listed species. Included are functions such as providing cover and refuge; breeding, nesting, denning, and nursery areas; corridors for wildlife movement; food chain support; natural water storage, natural flow attenuation, and water quality improvement which enhances fish, wildlife, and listed species utilization.

(4) "Impact site" means wetlands and other surface waters as delineated pursuant to Chapter 62-340, F.A.C., that would be impacted by the project. Uplands shall not be included as part of the impact site.

(5) "Indicators" means physical, chemical, or biological indications of wetland or other surface waters function.

(6) "Invasive Exotic" for purposes of this rule means animal species that are outside of their natural range or zone of dispersal and have or are able to form self-sustaining and expanding populations in communities in which they did not previously occur, and those plant species listed in the Florida Exotic Pest Plant Council's 2001 List of Invasive Species Category I and II, which is incorporated by reference herein, and may be found on the Internet at www.fleppc.org or by writing to the Bureau of Beaches and Wetland Resources, Department of Environmental Protection, 2600 Blair Stone Road, MS 2500, Tallahassee, FL 32399-2400.

(7) "Listed species" means those animal species that are endangered, threatened or of special concern and are listed in Rules 68A-27.003, 68A-27.004, and 68A-27.005, F.A.C., and those plant species listed in 50 Code of Federal Regulations 17.12, when such plants are located in a wetland or other surface water.

(8) "Mitigation credit" or "credit" means a standard unit of measure which represents the increase in ecological value resulting from restoration, enhancement, preservation, or creation activities.

(9) "Mitigation site" means wetlands and other surface waters as delineated pursuant to Chapter 62-340, F.A.C., or uplands, that are proposed to be created, restored, enhanced, or preserved by the mitigation project.

(10) "With impact assessment" means the reasonably anticipated outcome at an assessment area assuming the proposed impact is conducted.

(11) "With mitigation assessment" means the outcome at an assessment area assuming the proposed mitigation is successfully conducted.

(12) "Without preservation assessment" means the reasonably anticipated outcome at an assessment area assuming the area is not preserved.

Specific Authority 373.026(7), 373.043, 373.414(9), (18) FS. Law Implemented 373.414(18) FS. History–New 2-2-04.

62-345.300 Assessment Method Overview and Guidance.

(1) When an applicant proposes mitigation for impacts to wetlands and surface waters as part of an environmental resource permit or wetland resource permit application, the applicant will be responsible for submitting the necessary supporting information for the application of Rules 62-345.400-.600, F.A.C., of this chapter and the reviewing agency will be responsible for verifying this information and applying this assessment method to determine the amount of mitigation necessary to offset the proposed impacts. When an applicant submits a mitigation bank or regional mitigation permit application, the applicant will be responsible for submitting the necessary supporting information for the application of Rules 62-345.400-.600, F.A.C., of this chapter and the reviewing agency will be responsible for verifying this information and applying this assessment method to determine the potential amount of mitigation to be provided by the bank or regional mitigation area.

(2) To determine the value of functions provided by impact and mitigation sites, the method incorporates the following considerations: current condition (see subsection 62-345.500(6), F.A.C.); hydrologic connection (see paragraph 62-345.400(1)(d), F.A.C.); uniqueness (see paragraph 62-345.400(1)(f), F.A.C.); location (see subsections 62-345.400(1) and 62-345.500(7), F.A.C.); fish and wildlife utilization (see paragraph 62-345.400(1)(h), F.A.C.); time lag (see subsection 62-345.600(1), F.A.C.); and mitigation risk (see subsection 62-345.600(2), F.A.C.).

(3) The assessment method is designed to be used in any type of impact site or mitigation site in any geographic region of the state. The inherent flexibility required for such a method is accomplished in a multi-part approach that consists of the following processes:

(a) Conduct qualitative characterization of both the impact and mitigation assessment areas (Part I) that identifies the functions provided by the area to fish and wildlife and their habitat and establishes a framework for quantitative assessment.

(b) Conduct quantitative assessment (Part II) of the impact and mitigation sites and use the numerical scores to compare the reduction of ecological value due to proposed impacts and the gain in ecological value due to proposed mitigation and to determine whether a sufficient amount of mitigation is proposed.

(c) Adjust the gain in ecological value from either upland or wetland preservation in accordance with subsection 62-345.500(3), F.A.C.

(d) For mitigation assessment areas, assess the proposed mitigation for time lag and risk.

(e) The functional gain or loss for mitigation and impact assessment areas, respectively, is determined by applying the formulas in subsection 62-345.600(3), F.A.C., to ascertain the number of mitigation bank credits to be awarded and debited and the amount of mitigation needed to offset the impacts to wetlands and other surface waters.

(4) Part I of this method provides a descriptive framework to characterize the assessment area and the functions provided by that area. Part II of this method provides indicators of wetland and other surface water function, which are scored based on the framework developed in Part I. Part I must be completed and referenced by the user of this method when scoring the assessment area in Part II. An impact or mitigation site may contain more than one assessment area, each of which shall be independently evaluated under this method.

(5) The degree of ecological change on a site must be determined for both the impact and mitigation assessment areas by the mathematical difference in the Part II scores established pursuant to Rule 62-345.500, F.A.C., between the current condition and with-impact condition assessment, and between the current condition or without preservation and the with mitigation condition assessments. This difference is termed the "delta." This formula must be applied to all assessment areas within both proposed impact sites and mitigation sites (including mitigation banks and regional offsite mitigation areas when applicable).

Specific Authority 373.026(7), 373.043, 373.414(9), (18) FS. Law Implemented 373.414(18) FS. History–New 2-2-04.

62-345.400 Qualitative Characterization - Part I.

(1) An impact or mitigation assessment area must be described with sufficient detail to provide a frame of reference for the type of community being evaluated and to identify the functions that will be evaluated. When an assessment area is an upland proposed as mitigation, functions must be related to the benefits provided by that upland to fish and wildlife of associated wetlands or other surface waters. Information for each assessment area must be sufficient to identify the functions beneficial to fish and wildlife and their habitat that are characteristic of the assessment area, based on currently available information, such as aerial photographs, topographic maps, geographic information system data and maps, site visits, scientific articles, journals, other professional reports, field verification when needed, and reasonable scientific judgment. The information provided by the applicant for each assessment area must address the following, as applicable:

(a) Special water classifications, such as whether the area is in an Outstanding Florida Water, an Aquatic Preserve, a Class II water approved, restricted, conditionally approved, conditionally restricted for shellfish harvesting, or an Area of Critical State Concern;

(b) Significant nearby features that might affect the values of the functions provided by the assessment area, such as areas with regionally significant ecological resources or habitats (national or state parks, forests, or reserves; Outstanding National Resource Waters and associated watershed; Outstanding Florida Waters and associated watershed; other conservation areas), major industry, or commercial airport;

(c) Assessment area size;

(d) Geographic relationship and hydrologic connection between the assessment area and any contiguous wetland or other surface waters, or uplands, as applicable;

(e) Classification of assessment area, including description of past alterations that affect the classification. Classification shall be based on Florida Land Use, Cover and Form Classification System (1999) (FLUCC) codes, which is incorporated by reference herein. In addition, the applicant may further classify the assessment area using the 26 Communities of Florida, Soils Conservation Service (February 1981), which is incorporated by reference herein; A Hydrogeomorphic Classification for Wetlands, Wetland Research Program Technical Report WRP-DE-4, Mark M. Brinson (August 1993), which is incorporated by reference herein; or other sources that, based on reasonable scientific judgment, describe the natural communities in Florida;

(f) Uniqueness when considering the relative rarity of the wetland or other surface water and floral and faunal components, including listed species, on the assessment area in relation to the surrounding regional landscape;

(g) Functions performed by the assessment area. Functions to be considered are: providing cover, substrate, and refuge; breeding, nesting, denning, and nursery areas; corridors for wildlife movement; food chain support; and natural water storage, natural flow attenuation, and water quality improvement, which enhances fish, wildlife, and listed species utilization;

(h) Anticipated wildlife utilization and type of use (feeding, breeding, nesting, resting, or denning), and applicable listing classifications (threatened, endangered, or species of special concern as defined by Rules 68A-27.003, 68A-27.004, and 68A-27.005, F.A.C.). The list developed for the assessment area need not include all species which use the area, but must include all listed species in addition to those species that are characteristic of the area and the functions provided by the area, considering the size and location of the assessment area. Generally, wildlife surveys will not be required. The need for a wildlife survey will be determined by the likelihood that the site is used by listed species, considering site characteristics and the range and habitat needs of such species, and whether the proposed system will impact that use;

(i) Whether any portion of the assessment area has been previously used as mitigation for a prior issued permit; and

(j) Any additional information that is needed to accurately characterize the ecological values of the assessment area and functions provided.

Specific Authority 373.026(7), 373.043, 373.414(9), (18) FS. Law Implemented 373.414(18) FS. History–New 2-2-04.

62-345.500 Assessment and Scoring - Part II.

(1) Utilizing the frame of reference established in Part I, the information obtained under this part must be used to determine the degree to which the assessment area provides the functions identified in Part I and the amount of function lost or gained by the project. Each impact assessment area and each mitigation assessment area must be assessed under two conditions.

(a) Current condition or, in the case of preservation mitigation, without preservation – For assessment areas where previous impacts that affect the current condition are temporary in nature, consideration will be given to the inherent functions of these areas relative to seasonal hydrologic changes, and expected vegetation regeneration and projected habitat functions if the use of the area were to remain unchanged. When evaluating impacts to a previously permitted mitigation site that has not achieved its intended function, the reviewing agency shall consider the functions the mitigation site was intended to offset and any delay or reduction in offsetting those functions that may be caused by the project. Previous construction or alteration undertaken in violation of Part IV, Chapter 373, F.S., or Sections 403.91-.929, F.S. (1984 Supp.), as amended, or rule, order or permit adopted or issued thereunder, will not be considered as having diminished the condition and relative value of a wetland or surface water, when assigning a score under this part. When evaluating wetlands or other surface waters that are within an area that is subject to a recovery strategy pursuant to Chapter 40D-80, F.A.C., impacts from water withdrawals will not be considered when assigning a score under this part.

(b) "With mitigation" or "with impact" – The "with mitigation" and "with impact" assessments are based on the reasonably expected outcome, which may represent an increase, decrease, or no change in value relative to current conditions. For the "with impact" and "with mitigation" assessments, the evaluator will assume that all other necessary regulatory authorizations required for the proposed project have been obtained and that construction will be consistent with such authorizations. The "with mitigation" assessment will be scored only when reasonable assurance has been provided that the proposed plan can be conducted.

(2) Upland mitigation assessment areas shall be scored using the location and community structure indicators listed in subsection 62-345.500(6), F.A.C. Scoring of these indicators for the upland assessment areas shall be based on benefits provided to the fish and wildlife of the associated wetlands or other surface waters, considering the current or anticipated ecological value of those wetlands and other surface waters.

(a) For upland preservation, the gain in ecological value is determined by the mathematical difference between the score of the upland assessment area with the proposed preservation measure and the upland assessment area without the proposed preservation measure. The resulting delta is then multiplied by the preservation adjustment factor contained in subsection 62-345.500(3), F.A.C.

(b) For upland enhancement or restoration, the value provided shall be determined by the mathematical difference between the score of the upland assessment area with the proposed restoration or enhancement measure and the current condition of the upland assessment area.

(c) For uplands proposed to be converted to wetlands or other surface waters through creation or restoration measures, the upland areas shall be scored as "zero" in their current condition. Only the "with mitigation" assessment shall be scored in accordance with the indicators listed in subsection 62-345.500(6), F.A.C.

(3)(a) When assessing preservation, the "with mitigation" assessment shall consider the potential of the assessment area to perform current functions in the long term, considering the protection mechanism proposed, and the "without preservation" assessment shall evaluate the assessment area's functions considering the extent and likelihood of what activities would occur if it were not preserved, the temporary or permanent effects of those activities, and the protection provided by existing easements, restrictive covenants, or state, federal, and local rules, ordinances and regulations. The gain in ecological value is determined by the mathematical difference between the Part II scores for the "with mitigation" and "without preservation" (the delta) multiplied by a preservation adjustment factor. The preservation adjustment factor shall be scored on a scale from 0 (no preservation value) to 1 (optimal preservation value), on one-tenth increments. The score shall be assigned based on the applicability and relative significance of the following considerations:

1. The extent to which proposed management activities within the preserve area promote natural ecological conditions such as fire patterns or the exclusion of invasive exotic species.

2. The ecological and hydrological relationship between wetlands, other surface waters, and uplands to be preserved.

3. The scarcity of the habitat provided by the proposed preservation area and the degree to which listed species use the area.

4. The proximity of the area to be preserved to areas of national, state, or regional ecological significance, such as national or state parks, Outstanding Florida Waters, and other regionally significant ecological resources or habitats, such as lands acquired or to be acquired through governmental or non-profit land acquisition programs for environmental conservation, and whether the areas to be preserved include corridors between these habitats.

5. The extent and likelihood of potential adverse impacts if the assessment area were not preserved.

(b) The preservation adjustment factor is multiplied by the mitigation delta assigned to the preservation proposal to yield an adjusted mitigation delta for preservation.

(4) The evaluation must be based on currently available information, such as aerial photographs, topographic maps, geographic information system data and maps, site visits, scientific articles, journals, other professional reports, and reasonable scientific judgment.

(5) Indicators of wetland and other surface water function listed in this part are scored on a relative scale of zero to ten, based on the level of function that benefits fish and wildlife. For the purpose of providing guidance, descriptions are given for four general categories of scores: optimal (10), moderate (7), minimal (4), and not present (0). Any whole number score between 0-10 may be used that is a best fit to a single or combination of descriptions and in relation to the optimal level of function of that community type or habitat.

(6) Three categories of indicators of wetland function (location and landscape support, water environment and community structure) listed below are to be scored to the extent that they affect the ecological value of the assessment area. Upland mitigation assessment areas shall be scored for location and community structure only.

(a) Location and Landscape Support – The value of functions provided by an assessment area to fish and wildlife are influenced by the landscape position of the assessment area and its relationship with surrounding areas. While the geographic location of the assessment area does not change, the ecological relationship between the assessment area and surrounding landscape may vary from the current condition to the "with impact" and "with mitigation" conditions. Many species that nest, feed or find cover in a specific habitat or habitat type are also dependent in varying degrees upon other habitats, including upland, wetland and other surface waters, that are present in the regional landscape. For example, many amphibian species require small isolated wetlands for breeding pools and for juvenile life stages, but may spend the remainder of their adult lives in uplands or other wetland habitats. If these habitats are unavailable or poorly connected in the landscape or are degraded, then the value of functions provided by the assessment area to the fish and wildlife identified in Part I is reduced. The location of the assessment area shall be considered to the extent that fish and wildlife utilizing the area have the opportunity to access other habitats necessary to fulfill their life history requirements. The availability, connectivity, and quality of offsite habitats, and offsite land uses which might adversely impact fish and wildlife utilizing these habitats, are factors to be considered in assessing the location of the assessment area. The location of the assessment area shall be considered relative to offsite and upstream hydrologic contributing areas and to downstream and other connected waters to the extent that the diversity and abundance of fish and wildlife and their habitats is affected in these areas. The opportunity for the assessment area to provide offsite water quantity and quality benefits to fish and wildlife and their habitats downstream and in connected waters is assessed based on the degree of hydrologic connectivity between these habitats and the extent to which offsite habitats are affected by discharges from the assessment area. It is recognized that isolated wetlands lack surface water connections to downstream waters and as a result, do not perform certain functions (e.g., detrital transport) to benefit downstream fish and wildlife; for such wetlands, this consideration does not apply.

1. A score of (10) means the assessment area is ideally located and the surrounding landscape provides full opportunity for the assessment area to perform beneficial functions at an optimal level. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

a. Habitats outside the assessment area represent the full range of habitats needed to fulfill the life history requirements of all wildlife listed in Part I and are available in sufficient quantity to provide optimal support for these wildlife.

b. Invasive exotic or other invasive plant species are not present in the proximity of the assessment area.

c. Wildlife access to and from habitats outside the assessment area is not limited by distance to these habitats and is unobstructed by landscape barriers.

d. Functions of the assessment area that benefit downstream fish and wildlife are not limited by distance or barriers that reduce the opportunity for the assessment area to provide these benefits.

e. Land uses outside the assessment area have no adverse impacts on wildlife in the assessment area as listed in Part I.

f. The opportunity for the assessment area to provide benefits to downstream or other hydrologically connected areas is not limited by hydrologic impediments or flow restrictions.

g. Downstream or other hydrologically connected habitats are critically or solely dependent on discharges from the assessment area and could suffer severe adverse impacts if the quality or quantity of these discharges were altered.

h. For upland mitigation assessment areas, the uplands are located so as to provide optimal protection of wetland functions.

2. A score of (7) means that, compared to the ideal location, the location of the assessment area limits its opportunity to perform beneficial functions to 70% of the optimal ecological value. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

a. Habitats outside the assessment area are available in sufficient quantity and variety to provide optimal support for most, but not all, of the wildlife listed in Part I, or certain wildlife populations may be limited due to the reduced availability of habitats needed to fulfill their life history requirements.

b. Some of the plant community composition in the proximity of the assessment area consists of invasive exotic or other invasive plant species, but cover is minimal and has minimal adverse effect on the functions provided by the assessment area.

c. Wildlife access to and from habitats outside the assessment area is partially limited, either by distance or by the presence of barriers that impede wildlife movement.

d. Functions of the assessment area that benefit fish and wildlife downstream are somewhat limited by distance or barriers that reduce the opportunity for the assessment area to provide these benefits.

e. Land uses outside the assessment area have minimal adverse impacts on fish and wildlife identified in Part I.

f. The opportunity for the assessment area to provide benefits to downstream or other hydrologically connected areas is limited by hydrologic impediments or flow restrictions such that these benefits are provided with lesser frequency or lesser magnitude than would occur under optimal conditions.

g. Downstream or other hydrologically connected habitats derive significant benefits from discharges from the assessment area and could suffer substantial adverse impacts if the quality or quantity of these discharges were altered.

h. For upland mitigation assessment areas, the uplands are located so as to provide significant, but suboptimal, protection of wetland functions.

3. A score of (4) means that, compared to the ideal location, the assessment area location limits its opportunity to perform beneficial functions to 40% of the optimal ecological value. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

a. Availability of habitats outside the assessment area is fair, but fails to provide support for some species of wildlife listed in Part I, or provides minimal support for many of the species listed in Part I.

b. The majority of the plant community composition in the proximity of the assessment area consists of invasive exotic or other invasive plant species that adversely affect the functions provided by the assessment area.

c. Wildlife access to and from habitats outside the assessment area is substantially limited, either by distance or by the presence of barriers which impede wildlife movement.

d. Functions of the assessment area that benefit fish and wildlife downstream are limited by distance or barriers which substantially reduce the opportunity for the assessment area to provide these benefits.

e. Land uses outside the assessment area have significant adverse impacts on fish and wildlife identified in Part I.

f. The opportunity for the assessment area to provide benefits to downstream or other hydrologically connected areas is limited by hydrologic impediments or flow restrictions, such that these benefits are rarely provided or are provided at greatly reduced levels compared to optimal conditions.

g. Downstream or other hydrologically connected habitats derive minimal benefits from discharges from the assessment area but could be adversely impacted if the quality or quantity of these discharges were altered.

h. For upland mitigation assessment areas, the uplands are located so as to provide minimal protection of wetland functions.

4. A score of (0) means that the location of the assessment area provides no habitat support for wildlife utilizing the assessment area and no opportunity for the assessment area to provide benefits to fish and wildlife outside the assessment area. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

a. No habitats are available outside the assessment area to provide any support for the species of wildlife listed in Part I.

b. The plant community composition in the proximity of the assessment area consists predominantly of invasive exotic or other invasive plant species such that little or no function is provided by the assessment area.

c. Wildlife access to and from habitats outside the assessment area is precluded by barriers or distance.

d. Functions of the assessment area that would be expected to benefit fish and wildlife downstream are not present.

e. Land uses outside the assessment area have a severe adverse impact on wildlife in the assessment area as listed in Part I.

f. There is negligible or no opportunity for the assessment area to provide benefits to downstream or other hydrologically connected areas due to hydrologic impediments or flow restrictions that preclude provision of these benefits.

g. Discharges from the assessment area provide negligible or no benefits to downstream or hydrologically connected areas and these areas would likely be unaffected if the quantity or quality of these discharges were altered.

h. For upland mitigation assessment areas, the uplands are located so as to provide no protection of wetland functions.

(b) Water Environment – The quantity of water in an assessment area, including the timing, frequency, depth and duration of inundation or saturation, flow characteristics, and the quality of that water, may facilitate or preclude its ability to perform certain functions and may benefit or adversely impact its capacity to support certain wildlife. Hydrologic requirements and tolerance to hydrologic alterations and water quality variations vary by ecosystem type and the wildlife utilizing the ecosystem. Hydrologic conditions within an assessment area, including water quantity and quality, must be evaluated to determine the effect of these conditions on the functions performed by area and the extent to which these conditions benefit or adversely affect wildlife. Water quality within wetlands and other surface waters is affected by inputs from surrounding and upstream areas and the ability of the wetland or surface water system to assimilate those inputs. Water quality within the assessment area can be directly observed or can be inferred based on available water quality data, on-site indicators, adjacent land uses and estimated pollutant removal efficiencies of contributing surface water management systems. Hydrologic conditions in the assessment area are a result of external hydrologic inputs and the water storage and discharge characteristics of the assessment area. Landscape features outside the assessment area, such as impervious surfaces, borrow pits, levees, berms, swales, ditches, canals, culverts, or control structures, may affect hydrologic conditions in the assessment area. Surrounding land uses may also affect hydrologic conditions in the assessment area if these land uses increase discharges to the assessment area, such as agricultural discharges of irrigation water, or decrease discharges, such as wellfields or mined areas.

1. A score of (10) means that the hydrology and water quality fully supports the functions and provides benefits to fish and wildlife at optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

a. Water levels and flows appear appropriate, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects.

b. Water level indicators are distinct and consistent with expected hydrologic conditions for the type of system being evaluated.

c. Soil moisture is appropriate for the type of system being evaluated, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects. No evidence of soil desiccation, oxidation or subsidence is observed.

d. Soil erosion or deposition patterns are not atypical or indicative of altered flow rates or points of discharge.

e. Evidence of fire history does not indicate atypical fire frequency or severity due to excessive dryness.

f. Vegetation or benthic community zonation in all strata are appropriate for the type of system being evaluated and does not indicate atypical hydrologic conditions.

g. Vegetation shows no signs of hydrologic stress such as excessive mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with hydrologic stress.

h. Presence or evidence of use by animal species with specific hydrologic requirements is consistent with expected hydrologic conditions for the system being evaluated.

i. Plant community composition is not characterized by species tolerant of and associated with water quality degradation or alterations in frequency, depth, and duration in inundation or saturation.

j. Direct observation of standing water indicates no water quality degradation such as discoloration, turbidity, or oil sheen.

k. Existing water quality data indicates conditions are optimal for the type of community and would fully support the ecological values of the area.

l. Water depth, wave energy, currents and light penetration are optimal for the type of community being evaluated.

2. A score of (7) means that the hydrology and water quality supports the functions and provides benefits to fish and wildlife at 70% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

a. Water levels and flows are slightly higher or lower than appropriate, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects.

b. Water level indicators are not as distinct or as consistent as expected for hydrologic conditions for the type of system being evaluated.

c. Although soil oxidation or subsidence is minimal, soils are drier than expected for the type of system being evaluated, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects.

d. Soil erosion or deposition patterns indicate minor alterations in flow rates or points of discharge.

e. Fire history evidence indicates that fire frequency or severity may be more than expected for the type of system being evaluated, possibly due to dryness.

f. Vegetation or benthic community zonation in some strata is inappropriate for the type of system being evaluated, indicating atypical hydrologic conditions.

g. Vegetation has slightly greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with some hydrologic stress.

h. Presence or evidence of use by animal species with specific hydrologic requirements is less than expected or species present have more generalized hydrologic requirements.

i. Some of the plant community composition consists of species tolerant of and associated with moderate water quality degradation or alterations in frequency, depth, and duration in inundation or saturation.

j. Direct observation of standing water indicates slight water quality degradation such as discoloration, turbidity, or oil sheen.

k. Existing water quality data indicates slight deviation from what is normal, but these variations in parameters, such as salinity or nutrient loading, are not expected to cause more than minimal ecological effects.

l. Water depth, wave energy, currents and light penetration are generally sufficient for the type of community being evaluated but are expected to cause some changes in species, age classes and densities.

3. A score of (4) means that the hydrology and water quality supports the functions and provides benefits to fish and wildlife at 40% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

a. Water levels and flows are moderately higher or lower than appropriate, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects.

b. Water level indicators are not distinct and are not consistent with the expected hydrologic conditions for the type of system being evaluated.

c. Soil moisture has deviated from what is appropriate for the type of system being evaluated, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects. Strong evidence of soil desiccation, oxidation or subsidence is observed.

d. Soil erosion or deposition patterns are strongly atypical and indicative of alterations in flow rates or points of discharge.

e. Fire history evidence indicates that fire frequency or severity may be much more than expected for the type of system being evaluated, possibly due to dryness.

f. Vegetation or benthic community zonation in most strata is inappropriate for the type of system being evaluated, indicating atypical hydrologic conditions.

g. Vegetation has strong evidence of greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease associated with hydrologic stress.

h. Presence or evidence of use by animal species with specific hydrologic requirements is greatly reduced from expected or those species present have more generalized hydrologic requirements.

i. Much of the plant community composition consists of species tolerant of and associated with moderate water quality degradation or alterations in frequency, depth, and duration in inundation or saturation.

j. Direct observation of standing water indicates moderate water quality degradation such as discoloration, turbidity, or oil sheen.

k. Existing water quality data indicates moderate deviation from normal for parameters such as salinity or nutrient loading, so that ecological effects would be expected.

l. Water depth, wave energy, currents and light penetration are not well suited for the type of community being evaluated and are expected to cause significant changes in species, age classes and densities.

4. A score of (0) means that the hydrology and water quality does not support the functions and provides no benefits to fish and wildlife. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

a. Water levels and flows exhibit an extreme degree of deviation from what is appropriate, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects.

b. Water level indicators are not present or are greatly inconsistent with expected hydrologic conditions for the type of system being evaluated.

c. Soil moisture has deviated from what is appropriate for the type of system being evaluated, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects. Strong evidence of substantial soil desiccation, oxidation or subsidence is observed.

d. Soil erosion or deposition patterns are greatly atypical or indicative of greatly altered flow rates or points of discharge.

e. Fire history indicates great deviation from typical fire frequency or severity, due to extreme dryness.

f. Vegetation or benthic community zonation in all strata is inappropriate for the type of system being evaluated, indicating atypical hydrologic conditions.

g. Vegetation has strong evidence of much greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with hydrologic stress.

h. Presence or evidence of use by animal species with specific hydrologic requirements is lacking and those species present have generalized hydrologic requirements.

i. The plant community composition consists predominantly of species tolerant of and associated with highly degraded water or alterations in frequency, depth, and duration in inundation or saturation.

j. Direct observation of standing water indicates significant water quality degradation such as obvious discoloration, turbidity, or oil sheen.

k. Existing water quality data indicates large deviation from normal for parameters such as salinity or nutrient loading, so that adverse ecological effects would be expected.

l. Water depth, wave energy, currents and light penetration are inappropriate for the type of community (species, age classes and densities) being evaluated.

(c) Community Structure – Each impact and mitigation assessment area is evaluated with regard to its characteristic community structure. In general, a wetland or other surface water is characterized either by plant cover or by open water with a submerged benthic community. Wetlands and surface waters characterized by plant cover will be scored according to subparagraph 62-345.500(6)(c)1., F.A.C., while benthic communities will be assessed in accordance with subparagraph 62-345.500(6)(c)2., F.A.C. If the assessment area is a mosaic of relatively equal parts of submerged plant cover and a submerged benthic community, then both of these indicators will be scored and those scores averaged to obtain a single community structure score.

1. Vegetation and structural habitat – The presence, abundance, health, condition, appropriateness, and distribution of plant communities in surface waters, wetlands, and uplands can be used as indicators to determine the degree to which the functions of the community type identified are provided. Vegetation is the base of the food web in any community and provides many additional structural habitat benefits to fish and wildlife. In forested systems, for example, the vertical structure of trees, tree cavities, standing dead snag, and fallen logs provide forage, nesting, and cover habitat for wildlife. Topographic features, such as flats, deeper depressions, hummocks, or tidal creeks also provide important structure for fish and wildlife habitat. Overall condition of a plant community can often be evaluated by observing indicators such as dead or dying vegetation, regeneration and recruitment, size and

age distribution of trees and shrubs, fruit production, chlorotic or spindly plant growth, structure of the vegetation strata, and the presence, coverage and distribution of inappropriate plant species. Human activities such as mowing, grazing, off-road vehicle activity, boat traffic, and fire suppression constitute more direct and easily observable impacts affecting the condition of plant communities. Although short-term environmental factors such as excessive rainfall, drought, and fire can have temporary impacts, human activities such as flooding, drainage via groundwater withdrawal and conveyance canals, or construction of permanent structures such as seawalls in an aquatic system can permanently damage these systems. The plant community should be evaluated to consider whether natural successional patterns for the community type are permanently altered. Inappropriate plants, including invasive exotic species, other invasive species, or other species atypical of the community type being evaluated, do not support the functions attributable to that community type and can out-compete and replace native species. Native upland and wetland vegetation, such as wax myrtle, pines and willow, which are not typically considered as invasive, can occur in numbers and coverage not appropriate for the community type and can serve as indicators of disturbance. The relative degree of coverage by inappropriate species, inappropriate vegetation strata, condition of vegetation, and both biotic and abiotic structure all provide an indication of the degree to which the functions anticipated for the community type identified are being provided.

a. A score of (10) means that the vegetation community and physical structure provide conditions which support an optimal level of function to benefit fish and wildlife utilizing the assessment area as listed in Part I. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

I. All or nearly all of the plant cover is by appropriate and desirable plant species in the canopy, shrub, or ground stratum.

II. Invasive exotic or other invasive plant species are not present.

III. There is strong evidence of normal regeneration and natural recruitment.

IV. Age and size distribution is typical of the system, with no indication of deviation from normal successional or mortality pattern.

V. The density and quality of coarse woody debris, snag, den, and cavity provide optimal structural habitat for that type of system.

VI. Plants are in good condition, with very little to no evidence of chlorotic or spindly growth or insect damage.

VII. Land management practices are optimal for long term viability of the plant community.

VIII. Topographic features, such as refugia ponds, creek channels, flats or hummocks, are present and normal for the area being assessed.

IX. If submerged aquatic plant communities are present, there is no evidence of siltation or algal growth that would impede normal aquatic plant growth.

X. If an upland mitigation assessment area, the plant community and physical structure provide an optimal level of habitat and life history support for fish and wildlife in the associated wetlands or other surface waters.

b. A score of (7) means that the level of function provided by plant community and physical structure is limited to 70% of the optimal level. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

I. Majority of plant cover is by appropriate and desirable plant species in the canopy, shrub, or ground stratum.

II. Invasive exotic or other invasive plant species are present, but cover is minimal.

III. There is evidence of near-normal regeneration or natural recruitment.

IV. Age and size distribution approximates conditions typical of that type of system, with no indication of permanent deviation from normal successional or mortality pattern, although there may have been temporary deviations or impacts to age and size distribution.

V. Coarse woody debris, snags, dens, and cavities have either slightly lower than or slightly greater than normal quantity due to deviation from expected age structure or land management.

VI. Plant condition is generally good condition, with little evidence of chlorotic or spindly growth or insect damage.

VII. Land management practices are generally appropriate, but there may be some fire suppression or water control features that have caused a shift in the plant community.

VIII. Topographic features, such as refugia ponds, creek channels, flats or hummocks, are slightly less than optimal for the area being assessed.

IX. In submerged aquatic plant communities, there is a minor degree of siltation or algal growth that would impede normal aquatic plant growth.

X. If an upland mitigation assessment area, the plant community and physical structure provide high, but less than optimal, level of habitat and life history support for fish and wildlife in the associated wetlands or other surface waters.

c. A score of (4) means that the level of function provided by the plant community and physical structure is limited to 40% of the optimal level. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

I. Majority of plant cover is by inappropriate or undesirable plant species in the canopy, shrub, or ground stratum.

II. Majority of the plant cover and presence is comprised of invasive exotic or other invasive plant species.

III. There is minimal evidence of regeneration or natural recruitment.

IV. Age and size distribution is atypical of the system and indicative of permanent deviation from normal successional pattern, with greater than expected amount of dead or dying vegetation.

V. Coarse woody debris, snags, dens, and cavities are either not present or greater than normal because the native vegetation is dead or dying.

VI. Generally poor plant condition, such as chlorotic or spindly growth or insect damage.

VII. Land management practices have resulted in partial removal or alteration of natural structures or introduction of some artificial features, such as furrows or ditches.

VIII. Reduction in extent of topographic features, such as refugia ponds, creek channels, flats or hummocks, from what is normal for the area being assessed.

IX. In submerged aquatic plant communities, there is a moderate degree of siltation or algal growth.

X. If an upland mitigation assessment area, the plant community and physical structure provide moderate level of habitat and life history support for fish and wildlife in the associated wetlands or other surface waters.

d. A score of (0) means that the vegetation communities and structural habitat do not provide functions to benefit fish and wildlife. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

I. No appropriate or desirable plant species in the canopy, shrub, or ground stratum.

II. High presence and cover by invasive exotic or other invasive plant species.

III. There is no evidence of regeneration or natural recruitment.

IV. High percentage of dead or dying vegetation, with no typical age and size distribution.

V. Coarse woody debris, snags, dens, and cavities are either not present or exist only because the native vegetation is dead or dying.

VI. Overall very poor plant condition, such as highly chlorotic or spindly growth or extensive insect damage.

VII. Land management practices have resulted in removal or alteration of natural structure or introduction of artificial features, such as furrows or ditches.

VIII. Lack of topographic features such as refugia ponds, creek channels, flats or hummocks, that are normal for the area being assessed.

IX. In submerged aquatic plant communities, there is a high degree of siltation or algal growth.

X. If an upland mitigation assessment area, the plant community and physical structure provide little or no habitat and life history support for fish and wildlife in the associated wetland or other surface waters.

2. Benthic Communities – This indicator is intended to be used in marine or freshwater aquatic systems that are not characterized by a plant community, and is not intended to be used in wetlands that are characterized by a plant community. The benthic communities within nearshore, inshore, marine and freshwater aquatic systems are analogous to the vascular plant communities of terrestrial wetland systems in that they provide food and habitat for other biotic components of the system and function in the maintenance of water quality. For example, oyster bars and beds in nearshore habitats and estuaries filter large amounts of particulate matter and provide food and habitat for a variety of species, such as boring sponges, mollusks, and polycheate worms. Live hardbottom community composition varies with water depths and substratum, but this community type contributes to the food web, as well as providing three-dimensional structure through the action of reef-building organisms and rock-boring organisms and water quality benefits from filter-feeding organisms. The distribution and quality of coral reefs reflect a balance of water temperature, salinity, nutrients, water quality, and presence of nearby productive mangrove and seagrass communities. Coral reefs contribute to primary productivity of the marine environment as well as creating structure and habitat for a large number of organisms. Even benthic infauna of soft-bottom systems stabilize the substrate, provide a food source, and serve as useful indicators of water quality. All of these communities are susceptible to human disturbance through direct physical damage, such as dredging, filling, or boating impacts, and indirect damage through changes in water quality, currents, and sedimentation.

a. A score of (10) means that the benthic communities are indicative of conditions that provide optimal support for all of the functions typical of the assessment area and provide optimal benefit to fish and wildlife. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

I. The appropriate species number and diversity of benthic organisms are optimal for the type of system.

II. Non-native or inappropriate species are not present and the site is not near an area with such species.

III. Natural regeneration, recruitment, and age distribution are optimal.

IV. Appropriate species are in good condition, with typical biomass.

V. Structural features are typical of the system with no evidence of past physical damage.

VI. Topographic features, such as relief, stability, and interstitial spaces for hardbottom and reef communities or snags and coarse woody debris in riverine systems, are typical of that type of habitat and optimal for the benthic community being evaluated.

VII. Spawning or nesting habitats, such as rocky or sandy bottoms, are optimal for the community type.

b. A score of (7) means that, relative to ideal habitat, the benthic communities of the assessment area provide functions at 70% of the optimal level. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

I. Majority of the community is composed of appropriate species; the number and diversity of benthic organisms slightly less than typical.

II. Any non-native or inappropriate species present represent a minority of the community or the site is immediately adjacent to an area with such species.

III. Natural regeneration or recruitment is slightly less than expected.

IV. Appropriate species are in generally good condition, with little reduction in biomass from what is optimal.

V. Structural features are close to that typical of the system, or little evidence of past physical damage.

VI. Topographic features, such as relief, stability, and interstitial spaces for hardbottom and reef communities or snags and coarse woody debris in riverine systems, indicate slight deviation from what is expected and is less than optimal for the benthic community being evaluated.

VII. Spawning or nesting habitats, such as rocky or sandy bottoms, are less than expected.

c. A score of (4) means that, relative to ideal habitat, the benthic communities of the assessment area provide functions to 40% of the optimal level. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

I. Appropriate species number or diversity of benthic organisms is greatly decreased from typical.

II. Majority of species present is non-native or inappropriate species or the site is immediately adjacent to an area heavily infested by such species.

III. Natural regeneration or recruitment is minimal.

IV. Substantial number of appropriate species are dying or in poor condition, resulting in much lower than normal biomass.

V. Structural features are atypical of the system, or there is evidence of great or long term physical damage.

VI. Topographic features, such as relief, stability, and interstitial spaces for hardbottom and reef communities or snags and coarse woody debris in riverine systems, are greatly reduced from what is expected and is not appropriate for the benthic community being evaluated.

VII. Few spawning or nesting habitats, such as rocky or sandy bottoms, are available.

d. A score of (0) means that the benthic communities do not support the functions identified and do not provide benefits to fish and wildlife. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

I. Lack of appropriate species and diversity of those species; any appropriate species present are in poor condition.

II. Non-native or inappropriate species are dominant.

III. There is no indication of natural regeneration or recruitment.

IV. Structural integrity is very low or non-existent, or there is evidence of serious physical damage.

V. Topographic features, such as relief, stability, and interstitial spaces for hardbottom and reef communities or snags and coarse woody debris in riverine systems, are lacking.

VI. No spawning or nesting habitats, such as rocky or sandy bottoms, are present.

(7) The Part II score for an impact, wetland, or surface water mitigation assessment area shall be determined by summing the scores for each of the indicators and dividing that value by 30 to yield a number between 0 and 1. For upland mitigation assessment areas, the Part II score shall be determined by summing the scores for the location and community structure indicators and dividing that value by 20 to yield a number between 0 and 1.

Specific Authority 373.026(7), 373.043, 373.414(9), (18) FS. Law Implemented 373.414(18) FS. History–New 2-2-04.

62-345.600 Time Lag, Risk, and Mitigation Determination.

(1) Time lag shall be incorporated into the gain in ecological value of the proposed mitigation as follows:

(a) The time lag associated with mitigation means the period of time between when the functions are lost at an impact site and when those functions are replaced by the mitigation. In general, the time lag varies by the type and timing of mitigation in relation to the impacts. Wetland creation generally has a greater time lag to establish certain wetland functions than most enhancement activities. Forested systems typically require more time to establish characteristic structure and function than most herbaceous systems. Factors to consider when assigning time lag include biological, physical, and chemical processes associated with nutrient cycling, hydric soil development, and community development and succession. There is no time lag if the mitigation fully offsets the anticipated impacts prior to or at the time of impact.

(b) The time lag factor under this section shall be scored as 1 when evaluating mitigation for proposed phosphate and heavy mineral mining activities in accordance with this rule to determine compliance with Section 373.414(6)(b), F.S.

(c) For the purposes of this rule, the time lag, in years, is related to a factor (T-factor) as established in Table 1 below, to reflect the additional mitigation needed to account for the deferred replacement of wetland or surface water functions.

(d) The "Year" column in Table 1 represents the number of years between the time the wetland impacts are anticipated to occur and the time when the mitigation is anticipated to fully offset the impacts, based on reasonable scientific judgment of the proposed mitigation activities and the site specific conditions.

TABLE 1.	
Year	T-factor
< or = 1	1
2	1.03
3	1.07
4	1.10
5	1.14
6-10	1.25
11-15	1.46
16-20	1.68
21-25	1.92
26-30	2.18
31-35	2.45
36-40	2.73
41-45	3.03
46-50	3.34
51-55	3.65
>55	3.91

(2) Mitigation risk shall be evaluated to account for the degree of uncertainty that the proposed conditions will be achieved, resulting in a reduction in the ecological value of the mitigation assessment area. In general, mitigation projects which require longer periods of time to replace lost functions or to recover from potential perturbations will be considered to have higher risk that those which require shorter periods of time. The assessment area shall be scored on a scale from 1 (for no or de minimus risk) to 3 (high risk), on quarter-point (0.25) increments. A score of one would most often be applied to mitigation conducted in an ecologically viable landscape and deemed successful or clearly trending towards success prior to impacts, whereas a score of three would indicate an extremely low likelihood of success based on the ecological factors below. A single risk score shall be assigned, considering the applicability and relative significance of the factors below, based upon consideration of the likelihood and the potential severity of reduction in ecological value due to these factors.

(a) The vulnerability of the mitigation to and the extent of the effect of different hydrologic conditions than those proposed, considering the degree of dependence on mechanical or artificial means to achieve proposed hydrologic conditions, such as pumps or adjustable weirs, effects of water withdrawals, diversion or drainage features, reliability of the hydrologic data, modeling, and design, unstable conditions due to waves, wind, or currents, and the hydrologic complexity of the proposed community. Systems with relatively simple and predictable hydrology, such as tidal wetlands, would entail less risk than complex hydrological systems such as seepage slopes or perched wetlands;

(b) The vulnerability of the mitigation to the establishment and long-term viability of plant communities other than that proposed, and the potential reduction in ecological value which might result, considering the compatibility of the site soils and hydrologic conditions with the proposed plant community, planting plans, and track record for community or plant establishment method;

(c) The vulnerability of the mitigation to colonization by invasive exotic or other invasive species, considering the location of recruitment sources, the suitability of the site for establishment of these species, the degree to which the functions provided by plant community would be affected;

(d) The vulnerability of the mitigation to degraded water quality, considering factors such as current and future adjacent land use, and construction, operation, and maintenance of surface water treatment systems, to the extent that ecological value is affected by these changes;

(e) The vulnerability of the mitigation to secondary impacts due to its location, considering potential land use changes in surrounding area, existing protection provided to surrounding areas by easements, restrictive covenants, or federal, state, or local regulations, and the extent to which these factors influence the long term viability of functions provided by the mitigation site; and

(f) The vulnerability of the mitigation to direct impacts, considering its location and existing and proposed protection provided to the mitigation site by easements, restrictive covenants, or federal, state, or local regulations, and the extent to which these measures influence the long term viability of the mitigation site.

(3) The relative gain of functions provided by a mitigation assessment area must be adjusted for time lag and risk using the following formula: Relative functional gain (RFG) = Mitigation Delta (or adjusted mitigation delta for preservation)/(risk x t-factor). The loss of functions provided by impact assessment areas is determined using the following formula: Functional loss (FL) = Impact Delta x Impact Acres.

(a) To determine the number of potential mitigation bank credits a bank or regional offsite mitigation area can provide, multiply the relative functional gain (RFG) times the acres of the mitigation bank or regional offsite mitigation assessment area scored. The total amount of credits is the summation of the potential RFG for each assessment area.

(b) To determine the number of mitigation bank credits or amount of regional offsite mitigation needed to offset impacts, when the bank or regional offsite mitigation area is assessed in accordance with this rule, calculate the functional loss (FL) of each impact assessment area. The total number of credits required is the summation of the calculated functional loss for each impact assessment area. Neither time lag nor risk is applied to determining the number of mitigation bank credits or amount of mitigation necessary to offset impacts when the bank or regional offsite mitigation area has been assessed under this rule.

(c) To determine the acres of mitigation needed to offset impacts when not using a bank or a regional offsite mitigation area as mitigation, divide functional loss (FL) by relative functional gain (RFG). If there is more than one impact assessment area or more than one mitigation assessment area, the total functional loss and total relative functional gain is determined by summation of the functional loss and relative functional gain for each assessment area.

Specific Authority 373.026(7), 373.043, 373.414(9), 373.414(18) FS. Law Implemented 373.414(18) FS. History–New 2-2-04.

62-345.900 Forms.

The forms used for the Uniform Mitigation Assessment Method are adopted and incorporated by reference in this section. The forms are listed by rule number, which is also the form number, and with the subject title and effective date. Copies of these forms may be obtained by writing to the Department of Environmental Protection, Division of Water Resource Management, Bureau of Beaches and Wetland Resources, MS 2500, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, or any local district or branch office of the Department.

(1) Part I – Qualitative Description, 2-2-04.

(2) Part II – Quantification of Assessment Area (impact or mitigation), 2-2-04.

(3) Mitigation Determination Formulas, 2-2-04.

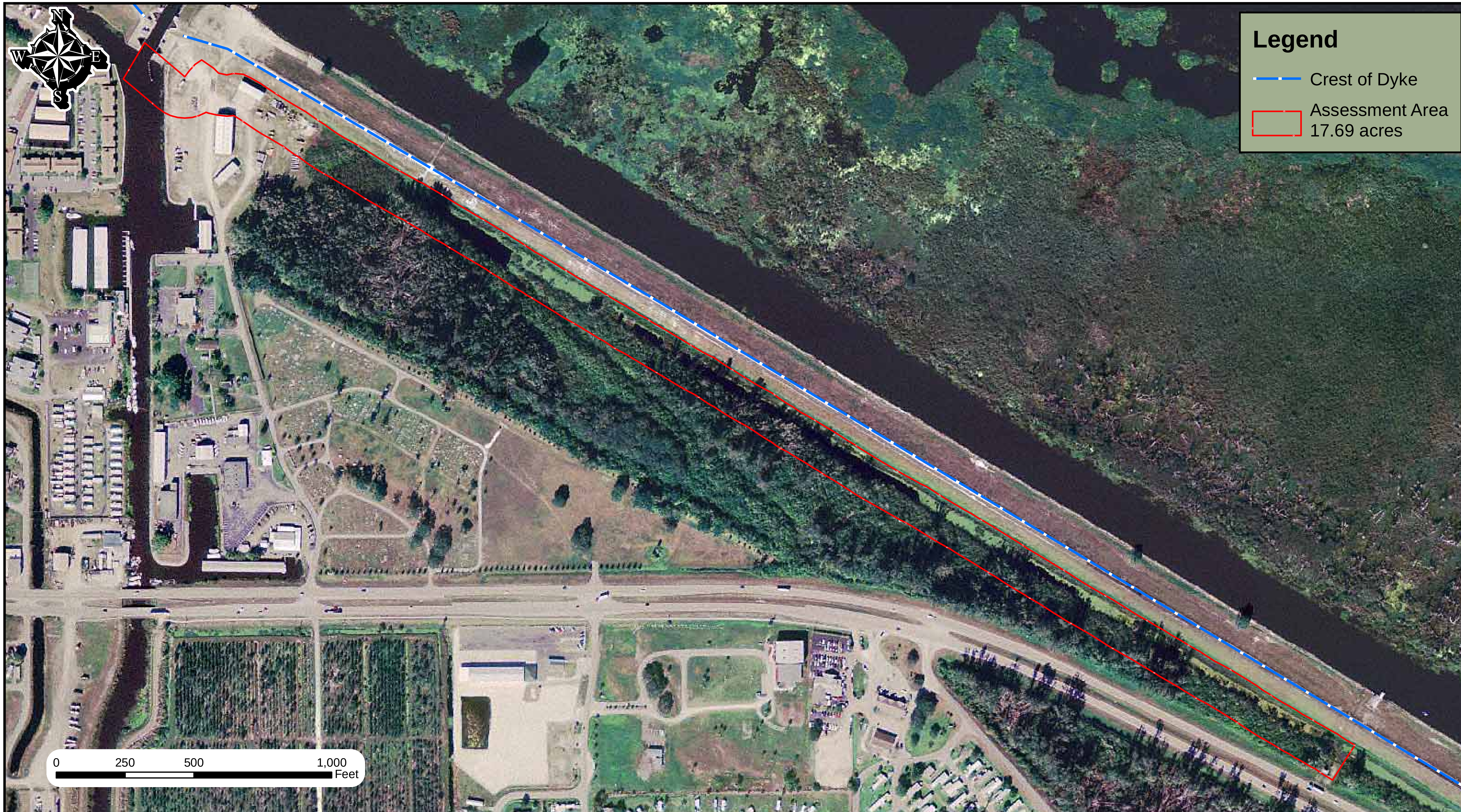
Specific Authority 373.026(7), 373.043, 373.414(9), 373.414(18) FS. Law Implemented 373.414(18) FS. History–New 2-2-04.

ATTACHMENT 2:

MAPS OF ASSESSMENT AREAS FOR HERBERT HOOVER DIKE REACHES 2 AND 3

WEST
UMAM ASSESSMENT AREA
REACH 2

GEC
Figure: 1
Date: November 2006
Scale:1:17,000
Source: USACE
Map Author: D.Shearer



EAST 1

UMAM ASSESSMENT AREA

REACH 2

GEC

Figure: 2
Date: November 2006
Scale:1:4,000
Source: USACE
Map Author: D.Shearer

EAST 2

UMAM ASSESSMENT AREA

REACH 2

GEC

Figure: 3

Date: November 2006

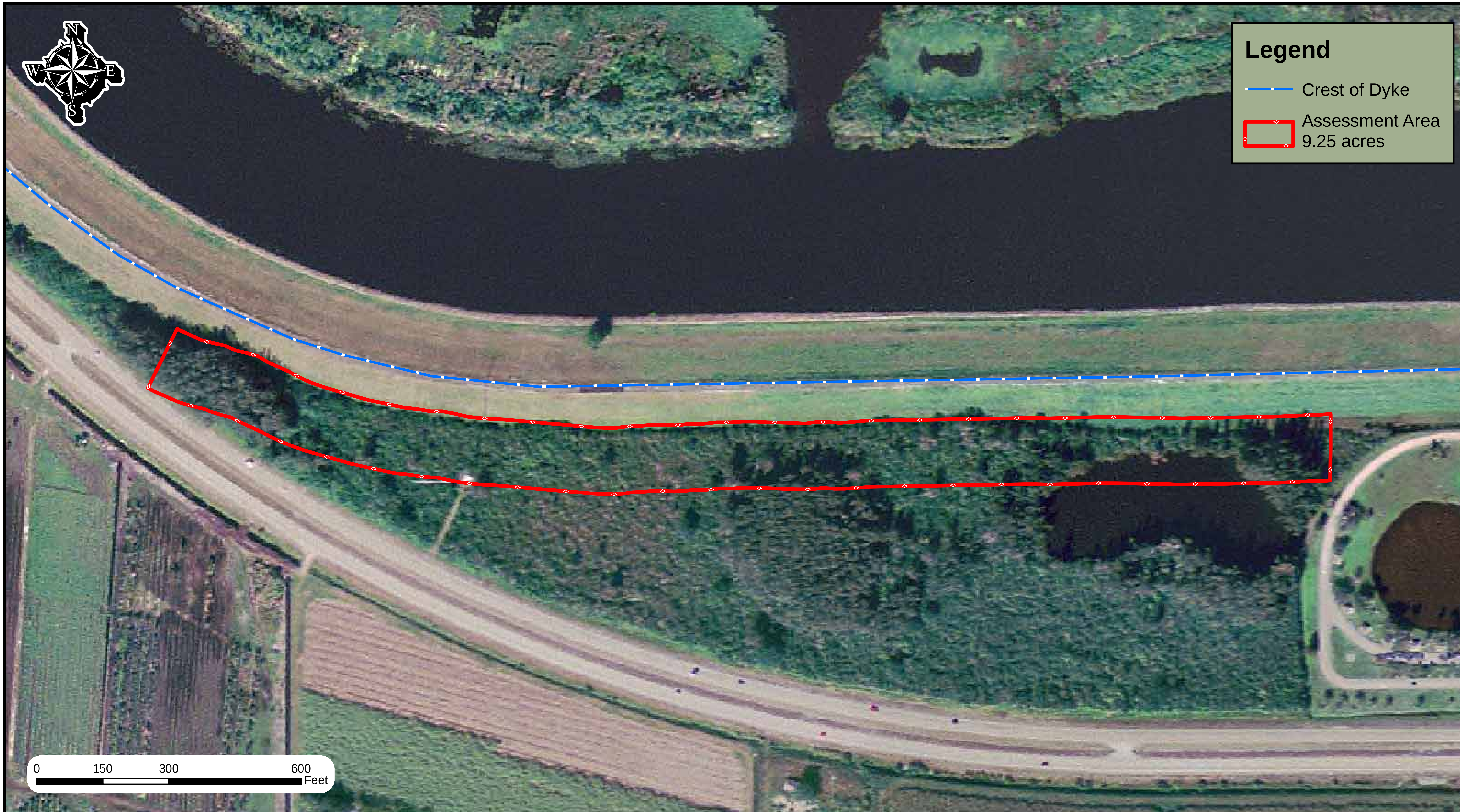
Scale:1:15,000

Source: USACE

Map Author: D.Shearer

EAST 3
UMAM ASSESSMENT AREA
REACH 2

GEC
Figure: 4
Date: November 2006
Scale:1:16,000
Source: USACE
Map Author: D.Shearer



EAST 4

UMAM ASSESSMENT AREA

REACH 2

GEC

Figure: 5

Date: November 2006

Scale:1:2,500

Source: USACE

Map Author: D.Shearer

JOHN STRETCH PARK EAST 1

UMAM ASSESSMENT AREA

REACH 3

GEC

Figure: 6

Date: November 2006

Scale:1:2,500

Source: USACE

Map Author: D.Shearer

JOHN STRETCH PARK EAST 2

UMAM ASSESSMENT AREA

REACH 3

GEC

Figure: 7
Date: November 2006
Scale:1:18,000
Source: USACE
Map Author: D.Shearer

SOUTHBAY WEST

UMAM ASSESSMENT AREA

REACH 3

GEC

Figure: 8

Date: November 2006

Scale:1:2,500

Source: USACE

Map Author: D.Shearer

SOUTHBAY

UMAM ASSESSMENT AREA

REACH 3

GEC

Figure: 9

Date: November 2006

Scale:1:9,000

Source: USACE

Map Author: D.Shearer

ATTACHMENT 3:

PART I, QUALITATIVE ASSESSMENT OF IMPACT AREA

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Herbert Hoover Dike		Reaches 2 and 3

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
		Impact	26 miles

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
Lake Okeechobee	III (drinking water)	Federal navigation

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Seepage (connection) between assessment area and Lake Okeechobee

Assessment area description

Reaches 2 and 3, toe ditch and wetlands within 150 feet of toe of dike

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Lake Okeechobee scenic trail, highway, agricultural areas	N/A

Functions	Mitigation for previous permit/other historic use
Stormwater treatment from agricultural water supply, minimal habitat	N/A

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
Otter, alligator, turtles, wading birds, frogs, dicky birds, fish, aquatic invertebrates	Caracara, burrowing owls, indigo snake, eagle, woodstork

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Above list observed in Reach 1

Additional relevant factors:

Assessment conducted by:	Assessment date(s):
USACE, USEPA, USFWS, GEC	11/7/06-11/8/06

ATTACHMENT 4:

PART II,
QUANTITATIVE ASSEMENT
OF IMPACT AREA

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Herbert Hoover Dike		Reach 2, West
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	USACE, USEPA, USFWS, Interagency Team	7-Nov-06

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

Indicator	w/o pres or current	with	Notes
.500(6)(a) Location and Landscape Support	5	0	Assumption for "with" score = All 150' would be impacted and function altered.
.500(6)(b)Water Environment (n/a for uplands)	6	0	Presence of dark colored water. Growth of malaleuca, hydric soils, dark organic layer, understory strong (leather fern, sawgrass). Downed trees due to hurricane or spraying, most probably not disease.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	2	0	**Plants:** common reed (*Phragmites australis*), primrose willow (*Ludwigia peruviana*), melaleuca* (*Melaleuca quinquinervia*), Brazilian pepper (*Schinus terebinthifolius*), cattails* (*Typha* sp.), leatherfern (*Acrostichum danaeifolium*), unknown palm tree, white vine (*Sarcostemma clausum*), elderberry (*Sambucus nigra* subsp. *canadensis*), shield fern (*Thelypteris* sp.), duck potato (*Sagittaria* sp.), sawgrass (*Cladium jamaicense*), royal palm (*Roystonea elata*), strangler fig (*Ficus aurea*), ragweed (*Ambrosia artemisiifolia*) Toe of Dike Zone Dominants: Ludwigia, cattail, palm Beyond Zone - Rest of 150 foot Dominants: Melaleuca, groundcover - leather fern **Animals:** Cattle egrets (*Bubulcus ibis*), red-shouldered hawk (*Buteo lineatus*), double-crested cormorant (*Phalacrocorax auritus*), great blue heron (*Ardea herodias*), anhinga (*Anhinga anhinga*), great egret (*Ardea alba*), boat-tailed grackle (*Quiscalus major*), hog (tracks), tricolored heron (*Egretta tricolor*), sunfish, deer tracks (scat), mosquitoes, butterflies *Dominant species Note: Sprayed recently so no native groundcover coming up yet

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.43	0

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
-0.43

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Herbert Hoover Dike		Reach 2, East 1
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	Interagency Team (USFWS, USEPA, USACE)	7-Nov-06

Scoring Guidance	**Optimal (10)**	**Moderate(7)**	**Minimal (4)**	**Not Present (0)**
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

Indicator	w/o pres or current	with	Notes
.500(6)(a) Location and Landscape Support	4	0	Assumption for "with" score = All 150' would be impacted and function altered. Better barrier to west, abuts highway at east So took average
.500(6)(b)Water Environment (n/a for uplands)	5	0	Run-off from road Soil has lost some of organics
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	4	0	**Plants:** Brazilian pepper (*Schinus terebinthifolius*)*, water lettuce (*Pistia stratiotes*)*, Australian pine (*Casuarina equisetifolia*)*, red ludwigia (*Ludwigia repens*), primrose willow (*Ludwigia peruviana*), common reed (*Phragmites australis*), duck potato (*Sagittaria* sp.)*, bahia grass (*Paspalum notatum)*, alligator weed (*Alternanthera philoxeroides*), pennywort (*Hydrocotyle* sp.), *Cyperus* sp., leatherfern (*Acrostichum danaeifolium*)*, marshmallow (*Kosteletzkya virginica*), dayflower (*Commelina* sp.), pond apple (*Annona glabra*), southern willow (*Salix caroliniana*) *, melaleuca (*Melaleuca quinquenervia*)*, torpedo grass (*Panicum repens*), duckweed (*Lemna* sp.), royal palm (*Roystoneaelata*) , smartweed (*Polygonum* sp.), bulrush (*Scirpus* sp.) **Animals:** tadpoles, dragonflies, mosquito fish (*Gambusia*), great blue heron (*Ardea herodias*), double-crested cormorant (*Phalacrocorax auritus*), cattle egret (*Bubulcus ibis*), great egret (*Ardea alba*), turkey vultures (*Cathartes aura*), monarch butterfly (*Danaus plexippus*). Toe Ditch dominants: aquatic vegetation; Beyond Dominants: Australian pine, leatherfern. Good strata niches. * Dominant Species

Score = sum of above scores/30 (if uplands, divide by 20)

current or w/o pres	with
0.43	0

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
-0.43

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

Form 62-345.900(2), F.A.C. [effective date 02-04-2004]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Herbert Hoover Dike		Reach 2, East 2
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	Interagency Team (USFWS, USEPA, USACE)	7-Nov-06

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

Indicator	w/o pres or current	with	Description
.500(6)(a) Location and Landscape Support	2	0	Assumption for "with" score = All 150' would be impacted and function altered. Highway is within 150 feet of toe.
.500(6)(b)Water Environment (n/a for uplands)	4	0	Runoff from road Very little buffer to filter runoff Aquatic and submerged vegetation present
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	5	9	**Plants:** Cattails (*Typha* sp.)*, duck potato (*Sagittaria* sp.), common reed (*Phragmites australis*), red ludwigia (*Ludwigia repens*)*, primrose willow (*Ludwigia peruviana*)*, pennywort (*Hydrocotyle* sp.), climbing hempvine (*Mikania scandens*), pond-cypress (*Taxodium ascendens*), leatherfern (*Acrostichum danaeifolium*), Brazilian pepper (*Schinus terebinthifolius*), spatterdock (*Nuphar* sp.), malaleuca (*Melaleuca quinquenervia*), algae, bladderwort (*Utricularia* sp.), camphorweed (*Pluchea* sp.), torpedo grass (*Panicum repens*), smartweed (*Polygonum* sp.), bacopa (*Bacopa* sp.), naiad (*Najas marina*), **Animals**: mosquito fish (*Gambusia*), anhinga (*Anhinga anhinga*), apple snail eggs (native variety, *Pomacea paludosa*) Exotics not as prevalent, do have invasive dominant (cattail) *Dominant sp

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.37	0

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
-0.37

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Herbert Hoover Dike		Reach 2, East 3
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	Interagency Team (USFWS, USEPA, USACE)	7-Nov-06

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

Indicator	w/o pres or current	with	Notes
.500(6)(a) Location and Landscape Support	2	0	Assumption for "with" score = All 150' would be impacted and function altered. Some stretches are completely maintained (mowed) Highway within 150 feet of toe
.500(6)(b)Water Environment (n/a for uplands)	2	0	Discharge (4 culverts under highway) from sugar cane field; serving as stormwater treatment from highway (no to minimal buffer) Vegetated areas not contiguous
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	3	0	**Plants:** duck potato (*Sagittaria* sp.)*, pickerelweed (*Pontederia* sp.), primrose willow (*Ludwigia peruviana*), alligator weed (*Altnernanthera philoxeroides*), cattail (*Typha* sp.)*, common reed (*Phragmites australis*)*, climbing hempvine (*Mikania scandens*), pennywort (*Hydrocotyle* sp.), dayflower (*Commelina* sp.), buttonweed (*Diodia virginiana*), creeping cucumber (*Melothria pendula*), broomsedge (*Andropogon* sp.), bulrush (*Scirpus* sp.), spikerush (*Eleocharis* sp.), white vine (*Sarcostemma clausum*), wild papaya (*Carica papaya*). **Animals:** Spiders, cattle egrets (*Bubulcus ibis)*, great egret (*Ardea alba*). * Dominant sp.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.23	0

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
-0.23

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Herbert Hoover Dike		Reach 2, East 4
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	Interagency Team (USFWS, USEPA, USACE)	7-Nov-06

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

Indicator	w/o pres or current	with	Notes
.500(6)(a) Location and Landscape Support	4	0	Assumption for "with" score = All 150' would be impacted and function altered. Buffer between polygon and road Includes John Stretch Park
.500(6)(b)Water Environment (n/a for uplands)	5	0	Muck soils, good sawgrass understory, areas of standing water, separated from road runoff
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	5	0	**Plants:** Melaleuca (*Melaleuca quinquenervia*)*, Brazilian pepper (*Schinus terebinthifoliu* s)*, common reed (*Phragmites australis*), water hemlock (*Cicuta maculata*), pond apple (*Annona glabra*), *Baccharis* sp., southern willow (*Salix caroliniana*), sawgrass (*Cladium jamaicense*)*, shield fern (*Thelypteris* sp.), duck potato (*Sagittaria* sp.), unknown aster, Australian pine (*Casuarina equisetifolia*) Good sawgrass understory *Dominant sp.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.47	0

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
-0.47

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Herbert Hoover Dike		Reach 3 - John Stretch Park, East 1
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	Interagency Team (USFWS, USEPA, USACE)	8-Nov-06

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

Indicator	w/o pres or current	with	Notes
.500(6)(a) Location and Landscape Support	3	0	Assumption for "with" score = All 150' would be impacted and function altered. Minimum buffer between polygon and road 1/3 of polygon is nursery Contains a lot of invasive/exotic sp. escaped from nursery
.500(6)(b)Water Environment (n/a for uplands)	3	0	Open water toe ditch Culvert from sugar cane field across road (1)
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	2	0	**Plants:** common reed (*Phragmites australis*), palm trees, potato vine (*Solanum* sp.), banana trees (*Musa* sp.), papaya (*Carica papaya*), *Philodendron* sp, leatherfern (*Acrostichum danaeifolium*), giant foxtail* (*Setaria magna*), Brazilian pepper (*Schinus terebinthifolius*), pond apple (*Annona glabra*), mulberry (*Morus* sp.), guava (*Psidium* sp.), unknown tree (collected), elephant's ears (*Xanthosoma sagittifolium*), Washingtonian palm, melaleuca (*Melaleuca quinquenervia*), shield fern (*Thelypteris spp.*), cassia (*Cassia* sp.), southern willow (*Salix* caroliniana), royal palm (*Roystonea elata*), yellow flower - exotic (collected), nursery - queen palm (*Syagrus romanzoffianum*). Part of site includes a tree nursery. **Animals:** owl (?), cattle egrets (*Bubulcus ibis*), vultures (Cathartes aura), great egret (*Ardea alba*), mosquitoes.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.27	0

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
-0.27

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Herbert Hoover Dike		Reach 3 - John Stretch Park, East 2
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	Interagency Team (USFWS, USEPA, USACE)	8-Nov-06

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

Indicator	w/o pres or current	with	Notes
.500(6)(a) Location and Landscape Support	2	0	Assumption for "with" score = All 150' would be impacted and function altered. Highway is within 150 feet
.500(6)(b)Water Environment (n/a for uplands)	1	0	9 culverts from ag fields Wetlands isolated in 3 feet wide ditch At eastern extent, near spillway, ditch becomes wider and has standing water Stormwater runoff from road
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	1	0	**Plants:** Primrose willow (*Ludwigia peruviana*), duck potato (*Sagittaria* spp.), naiad (*Najas marina*), algae, bacopa (*Bacopa* sp.), spikerush (*Eleocharis* sp.), camphorweed (*Pluchea* sp.), torpedo grass (*Panicum repens*), royal palm (*Roystonea elata*), exotic tree. **Animals:** cattle egrets (*Bubulcus ib* is), unknown swallow, osprey (*Pandion haliaetus*), damsel fly, white butterflies, mosquito fish (*Gambusia*).

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.13	0

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
-0.13

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Herbert Hoover Dike		Reach 3 - South Bay West
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	Interagency Team (USFWS, USEPA, USACE)	8-Nov-06

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

Indicator	w/o pres or current	with	Notes
.500(6)(a) Location and Landscape Support	2	0	Assumption for "with" score = All 150' would be impacted and function altered. Adjacent to park but off highway slightly
.500(6)(b)Water Environment (n/a for uplands)	4	0	Fish Deepwater Shrub buffer - 50 percent
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	4	0	**Plants**: torpedo grass (*Panicum repens*), aquatic grass, dahoon holly (*Ilex cassine*), spikerush (E*leocharis* sp.), cattails (*Typha* sp.), chara (*Chara* sp.), bald cypress (*Taxodium distichum*), algae, red maple (*Acer rubrum*), strangler fig (*Ficus aurea*), *Schefflera* sp., cabbage palm (*Sabal palmetto*), Brazilian pepper (*Schinus terebinthifolius*), common reed (*Phragmites australis*) **Animals:** alligator (*Alligator mississippiensis*), cattle egret (*Bubulcus ibis*), mosquito fish (*Gambusia*), sunfish, bass, monarch butterfly (*Danaus plexippus*), dragonflies, unnamed butterflies.

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.33	0

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
-0.33

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

Form 62-345.900(2), F.A.C. [effective date 02-04-2004]

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Herbert Hoover Dike		Reach 3 - South Bay
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Impact	Interagency Team (USFWS, USEPA, USACE)	8-Nov-06

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

Indicator	w/o pres or current	with	Notes
.500(6)(a) Location and Landscape Support	3	0	Assumption for "with" score = All 150' would be impacted and function altered. Toe of slope abuts sugar cane fields
.500(6)(b)Water Environment (n/a for uplands)	2	0	5 ag ditches perpendicular to toe
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	2	0	**Plants:** common reed (*Phragmites australis*), Australian pine (*Casuarina equisetifoli* a), broomsedge (*Andropogon* sp.), water hemlock (*Cicuta maculata*), sugar cane (*Saccharum officinarum*). **Animals:** hawk, swallow, osprey (*Pandion haliaetus*), great blue heron (*Ardea herodias*), red-shouldered hawk (*Buteo lineatus*), doves.

Score = sum of above scores/30 (if uplands, divide by 20)

current or w/o pres	with
0.23	0

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

Delta = [with-current]
-0.23

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

ATTACHMENT 5:

PLANT SPECIES OF
HERBERT HOOVER DIKE ASSESSMENT AREAS
REACHES 2 AND 3

Plants Species of UMAM Assessment Areas
Herbert Hoover Dike, Reaches 2 and 3

Common Name	*Scientific Name*
alligator flag	*Thalia geniculata*
alligatorweed	*Alternanthera philoxeroides*
Australian pine	*Casuarina equisetifolia*
bahia grass	*Paspalum notatum*
banana	*Musa* sp.
baccharis	*Baccharis* sp.
bladderwort	*Utricularia* sp.
Brazilian pepper	*Schinus terebinthifolius*
broomsedge	*Andropogon* sp.
bulrush	*Scirpus* sp.
buttonweed	*Diodia virginiana*
cabbage palm	*Sabal palmetto*
camphorweed	*Pluchea* sp.
cattail	*Typha* sp.
climbing hempvine	*Mikania scandens*
common reed	*Phragmites australis*
creeping cucumber	*Melothria pendula*
dayflower	*Commelina* sp.
duck potato	*Sagittaria* sp.
duckweed	*Lemna* sp.
elderberry	*Sambucus nigra subsp. canadensis*
elephant ears	*Xanthosoma sagittifolium*
golden pothos	*Epipremnum pinnatum*
guava	*Psidium* sp.
leatherfern	*Acrostichum danaeifolium*
marshmallow	*Kosteletzkya virginica*
Napier grass	*Pennisetum purpureum*
papaya	*Carica papaya*
pennywort	*Hydrocotyle* sp.
pickerelweed	*Pontederia* sp.
pond apple	*Annona glabra*
pond-cypress	*Taxodium ascendens*
primrose willow	*Ludwigia peruviana*
punk tree	*Melaleuca quinquenervia*
queen palm	*Syagrus romanzoffiana*
ragweed	*Ambrosia artemisiifolia*
red primrose willow	*Ludwigia repens*
royal palm	*Roystonea regia*
sawgrass	*Cladium jamaicense*
schefflera	*Schefflera* sp.
shield fern	*Thelypteris* sp.
smartweed	*Polygonum* sp.
southern willow	*Salix caroliniana*
spatterdock	*Nuphar* sp.
spikerush	*Eleocharis* sp.
strangler fig	*Ficus aurea*
sugarcane	*Saccharum officinarum*
torpedo grass	*Panicum repens*
unknown palm	
water hemlock	*Cicuta maculata*
water lettuce	*Pistia stratiotes*
white vine	*Sarcostemma clausum*

ATTACHMENT 6:

PHOTOGRAPHS
OF ASSESSMENT AREAS

Photograph 1. Reach 2, West

Photograph 2. Reach 2, East 1

Photograph 3. Reach 2, East 2

Photograph 4. Reach 2, East 3

Photograph 5. Reach 2, East 4 (in background, John Stretch Park in foreground)

Photograph 6. Reach 3, John Stretch Park East 1

Photograph 7. Reach 3, John Stretch Park East 2

Photograph 8. Reach 3, South Bay West


Photograph 9. Reach 3, South Bay

ATTACHMENT 7:

UMAM FOR MITIGATION BANK

- Photographs of Mitigation Area
- Part I, Qualitative Assessment of Mitigation Area
- Part II, Quantitative Assessment of Mitigation Area
- Part III, Mitigation Determination Formulas


Photograph 1. Pre-mitigation conditions in Reach 4 at Sportsman's Village, from Structure C-5A looking east (Note: melaleuca).


Photograph 2. Pre-project conditions in Reach 4 at Sportsman's Village looking east from HHD (north of Structure C-5A).

Photograph 3. Post-wetlands restoration – Reach 4, Sportsman's Village at C-5A. Planting done at water's edge. (July 2, 2004).

Photograph 4. Planting of wetland vegetation along HHD borrow canal between S-77 and Sportsman's Village. (June 25, 2005).

Photograph 5. Planting of wetland vegetation along HHD borrow canal in Reach 4 between S-77 and Sportsman's Village. (June 25, 2005).

Photograph 6. Planting of wetland vegetation along HHD borrow canal in Reach 4 between S-77 and Sportsman's Village. (June 25, 2005).

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Herbert Hoover Dike		Reach 4 and 2

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
		Mitigation	8 acres + 56 acres = 64 acres

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
Lake Okeechobee	III Drinking water	Federal navigation

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

seepage connection, along Lake Okeechobee shoreline

Assessment area description

Reach 4 = McTush to Moore Haven (tree planting): 8 acres. Reach 2 = Melaleuca Removal (1 mile east from west end) : 56 acres.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
HHD, Lake O Scenic Trail, highway, agricultural areas, park	N/A

Functions	Mitigation for previous permit/other historic use
minimal habitat	N/A

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
otter, alligator, turtle, wading birds, dicky birds, fish, aquatic invertebrates	caracara, burrowing owls, indigo snakes, woodstork, bald eagle

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Above list observed in Reach 1

Additional relevant factors:

Hendry and Glades counties

Assessment conducted by:	Assessment date(s):
Angie Heubner, Corps	11/7/2006

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Reach 2 HHD		melaleuca removal
Impact or Mitigation	Assessment conducted by:	Assessment date:
mitigation	Angie Huebner	10/31/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

Indicator	w/o pres or current	with
.500(6)(a) Location and Landscape Support	4	7
.500(6)(b)Water Environment (n/a for uplands)	4	7
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	4	7

Score = sum of above scores/30 (if uplands, divide by 20)

current or w/o pres	with
0.26	0.7

If preservation as mitigation,

Preservation adjustment factor =

Adjusted mitigation delta =

For impact assessment areas

FL = delta x acres =

Delta = [with-current]

0.44

If mitigation

Time lag (t-factor) = 1.07

Risk factor = 1

For mitigation assessment areas

RFG = delta/(t-factor x risk) = .47

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Reach 4 HHD		McTush to Moore Haven, tree planting
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
mitigation	Angie Huebner	10/31/2006

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

Indicator	w/o pres or current	with
.500(6)(a) Location and Landscape Support	7	8
.500(6)(b)Water Environment (n/a for uplands)	7	8
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	7	8

Score = sum of above scores/30 (if uplands, divide by 20)	
current or w/o pres	with
0.7	0.8

If preservation as mitigation,

Preservation adjustment factor =

Adjusted mitigation delta =

For impact assessment areas

FL = delta x acres =

Delta = [with-current]
0.1

If mitigation

Time lag (t-factor) = 1.27

Risk factor = 1

For mitigation assessment areas

RFG = delta/(t-factor x risk) = .125

Form 62-345.900(2), F.A.C. [effective date 02-04-2004]

Mitigation Determination Formulas
(See Section 62-345.600(3), F.A.C.)

For each impact assessment area:

(FL) Functional Loss = Impact Delta X Impact acres

For each mitigation assessment area:

(RFG) Relative Functional Gain = Mitigation Delta (adjusted for preservation, if applicable)/((t-factor)(risk))

(a) Mitigation Bank Credit Determination

The total potential credits for a mitigation bank is the sum of the credits for each assessment area where assessment area credits equal the RFG times the acres of the assessment area scored

Bank Assessment Area	RFG	X	Acres	=	Credits
example					
a.a.1	0.47		56		26.32
a.a.2					
total					

(b) Mitigation needed to offset impacts, when using a mitigation bank

The number of mitigation bank credits needed, when the bank or regional offsite mitigation area is assessed in accordance with this rule, is equal to the summation of the calculated functional loss for each impact assessment area.

Impact Assessment Area	FL	=	Credits needed
example			
a.a.1	-73.21		73.21
a.a.2			
total			

(c) Mitigation needed to offset impacts, when not using a bank

To determine the acres of mitigation needed to offset impacts when not using a bank or a regional offsite mitigation area as mitigation, divide functional loss (FL) by relative functional gain (RFG). If there are more than one impact assessment area or more than one mitigation assessment area, the total functional loss and total relative functional gain is determined by summation of the functional loss (FL) and relative functional gain (RFG) for each assessment area.

	FL	/	RFG	=	Acres of Mitigation
example					
a.a.1					
a.a.2					
total					

Form 62-345.900(3), F.A.C. [effective date 02-04-2004]

Mitigation Determination Formulas
(See Section 62-345.600(3), F.A.C.)

For each impact assessment area:
(FL) Functional Loss = Impact Delta X Impact acres

For each mitigation assessment area:
(RFG) Relative Functional Gain = Mitigation Delta (adjusted for preservation, if applicable)/((t-factor)(risk))

(a) Mitigation Bank Credit Determination

The total potential credits for a mitigation bank is the sum of the credits for each assessment area where assessment area credits equal the RFG times the acres of the assessment area scored

Bank Assessment Area	RFG	X	Acres	=	Credits
example					
a.a.1	0.125		8		1
a.a.2					
total					

(b) Mitigation needed to offset impacts, when using a mitigation bank

The number of mitigation bank credits needed, when the bank or regional offsite mitigation area is assessed in accordance with this rule, is equal to the summation of the calculated functional loss for each impact assessment area.

Impact Assessment Area	FL	=	Credits needed
example			
a.a.1	-73.21		73.21
a.a.2			
total			

(c) Mitigation needed to offset impacts, when not using a bank

To determine the acres of mitigation needed to offset impacts when not using a bank or a regional offsite mitigation area as mitigation, divide functional loss (FL) by relative functional gain (RFG). If there are more than one impact assessment area or more than one mitigation assessment area, the total functional loss and total relative functional gain is determined by summation of the functional loss (FL) and relative functional gain (RFG) for each assessment area.

	FL	/	RFG	=	Acres of Mitigation
example					
a.a.1					
a.a.2					
total					

Form 62-345.900(3), F.A.C. [effective date 02-04-2004]

Appendix G

ENGINEERING ANALYSIS

This document is a draft partial Engineering Analysis. A final Engineering Analysis will be provided as an appendix to the Final Supplemental Environmental Impact Statement.

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APPENDIX G
GEOTECHNICAL EVALUATION

TABLE OF CONTENTS

1. INTRODUCTION.

1.1. Background.

1.1.1 In the 1920's, agricultural dikes were constructed along the south side of Lake Okeechobee. In the 1930's these levees were raised and extended using the authority provided by the River and Harbor Act of July 3, 1930. In the 1960's, the levees were again raised and extended using the authority of the Flood Control Act of June 30, 1948. The levee system now fully encircles the lake and has crest elevations ranging from about +33 to +45 feet. Due primarily to observed wave generated erosion of the levee, studies were carried out in the 1980's to evaluate the stability of the levee. A Reconnaissance Report in 1986 and a Special Report in 1993 determined there were stability concerns with the Levee.

1.1.2. In 1994, a compressive plan was initiated to acquire Geotechnical data and perform a detailed engineering analysis of the Levee. Due to the 140-mile length of the levee, the levee was subdivided into 8 reaches with priorities of study assigned to each. Priorities were assigned based on the estimated damage potential for each Reach of the levee. Reach #1 would be the initial Reach of the levee studied. The plan was to study each additional Reach of the levee in turn. The study of Reach #1 was under way when a 1995 high water event (+18.6) occurred in which serious seepage and piping events were observed along the southern and southeastern portions of the levee. Limited emergency repairs were made to distressed sections of the levee. A second high water event in 1998 again demonstrated seepage and piping problems.

1.1.3. From 1995 to 1999, studies and analyses were conducted to support efforts to prepare a Major Rehabilitation and Evaluation Report for submittal to Congress. That report, authorized in November of 2000, documented a risk-based analytical approach to estimate the combined probabilities of breach versus lake elevations for each Reach of HHD. The MRR mainly focused on Reach 1 due to its priority and the fact that more data existed in that reach, but it also touched on the other seven reaches. It is necessary to reiterate the table of combined probabilities of breach from the MRR below:

Table G-1.1: Combined Probabilities of Breach From MRR

	Base Conditions at Herbert Hoover Dike							
Reach and	Probability of Breach at selected Lake Elevations (* = Adjusted).							
Section	14	15	16	17	18 *	21	24	27
Reach 1A, Line 25	0.0030%	0.015%	0.030%	0.120%	0.75%	45.0%	100.0%	100.0%
Reach 1B, Line 25	0.0030%	0.015%	0.030%	0.120%	0.75%	39.0%	100.0%	100.0%
Reach 1C, Line 18	0.0580%	0.290%	0.580%	2.320%	12.00%	91.0%	100.0%	100.0%
Reach 1C, Line 9	0.0000%	0.000%	0.000%	0.000%	3.00%	49.0%	100.0%	100.0%
Reach 1C, Line 6	0.0310%	0.155%	0.310%	1.240%	7.88%	68.0%	80.0%	92.0%
Reach 2	0.1000%	0.500%	1.000%	4.000%	12.00%	89.0%	99.0%	100.0%
Reach 3	0.0770%	0.385%	0.770%	3.080%	14.00%	100.0%	100.0%	100.0%
Reach 4	0.0010%	0.005%	0.010%	0.040%	0.25%	5.0%	10.0%	15.0%
Reach 5	0.0010%	0.005%	0.010%	0.040%	0.25%	5.0%	10.0%	15.0%
Reach 6 A	0.0004%	0.002%	0.004%	0.002%	0.13%	2.0%	4.0%	6.0%
Reach 6 B	0.0006%	0.003%	0.006%	0.003%	0.20%	3.1%	6.4%	9.6%
Reach 7	0.0050%	0.025%	0.050%	0.200%	5.96%	99.0%	100.0%	100.0%
Reach 8	0.0010%	0.005%	0.010%	0.040%	0.25%	5.0%	10.0%	15.0%
Combined Probability	0.2807%	1.398%	2.781%	10.749%	45.46%	100.0%	100.0%	100.0%

1.2. Current Study.

1.2.1. In a memorandum dated 26 June 2006, CESAD-RB provided guidance on preparing future supplemental MRR's. Paragraph 4 of that memorandum states ". . . repairs of the HHD system proposed in Reach 1 [were] justified solely on the potential loss of life, not economic justification. Therefore, the Supplemental MRR(s) will provide a qualitative economic description of damages occurring from a failure of the HHD System (base condition). In addition, no additional Risk & Reliability as outlined in Appendix B and F of EP 1130-2-500 will be performed . . . ".

1.2.2. This report documents the current Geotechnical study of the levee. The field explorations and analysis were primarily carried out for Reach #2; but, limited explorations and analysis were also preformed for Reach 3, Four geologic sections were analyzed in Reach 3 and seven geologic sections were analyzed for Reach 2.

1.2.3. The field work included core borings, visual classifications of materials, and surveys.

1.2.4. Office work included the creation of geologic profiles, geotechnical models, analysis of piezometric data, and the analysis of representative levee sections using SEEP/W, and SLOPE/W.

1.3. Purpose Of Study.

1.3.1. The ultimate purpose of the Geotechnical analysis was to simulate, through models, scenarios that were representative of known seepage incidents occurring in the vicinity. This analysis was used to demonstrate that the models were in effect "calibrated" to the existing conditions, that is to demonstrate that existing factors of safety with regards to piping were not adequate.

1.3.2. Previous Geotechnical evaluations of the levee have concluded that the levee would breach due to piping at a lake elevation of +21 feet. An engineering firm contracted to perform an independent analysis of the seepage problem also determined there was a significant risk of breach of the levee. A board of consultants reviewed both the Corps of Engineers analysis and the independent engineering firm analysis and concluded that an unacceptable risk of levee failure existed. The consultants recommended rehabilitation of the levee in 1998.

1.4. Notice of Previously Documented Embankment Failures or Near Failures in the Lake Okeechobee Area.

It should be pointed out that there have been two embankment failures and two near embankment failures in the Lake Okeechobee region. The two failures (breaches) were Structure 154 which located on the north side of Lake Okeechobee in the Reach 5 portion of the embankment (LD-4), and the Florida Power and Light dam located two miles northeast of Port Mayaca. The two near failures were in Reach 3 near Lake Harbor and Culvert 10 areas of the Herbert Hoover Dike, and several sites along Embankment L-8 which is located southeast of Port Mayaca. Descriptions of these failures and their likely causes (piping) are documented in the original MRR, Appendix H, and are not repeated in this report.

2. HIGH WATER EVENTS

There have been four events since 1938 that can be considered "High Water Events". These were peak lake levels of 18.8 in 1947, 18.6 in 1995, 18.4 in 1998 and 18.3 in 1983. During each of these events the lake was above elevation 18.0 for a sustained period of time (as opposed to a short duration storm surge). The condition of the embankment system was not documented during the 1947 and 1983 events in the same manner as the 1995 and 1998 events. There was a report of a near breach of the embankment south of Pahokee due to wave attack during the 1947 hurricane. However, this was not a seepage problem. The primary focus of this section of the report is to document seepage related distress.

2.1 1995 High Water Event

2.1.1 Hydrology. (Refer to Figure H-7.1.) Two wet tropical events (Tropical Storm Chantal and Hurricane Erin) during the last half of July more than compensated for a dry first half. Rainfall averaged 8.22 inches which was 115% of average. The wet season total of 18.26 inches was 119% of average, while the year-to-date rainfall was 107% of average at 31.63 inches. Lake Okeechobee rose above its non-harmful release schedule this month. The Corps began Level II pulse releases from the lake on 31 July. Because of high stages in the water conservation areas (WCA's), SFWMD did not make releases from the lake into the WCA's. Direct hits from Hurricane and Tropical Storm Jerry combined to produce very heavy rainfall over most of the project. August rainfall averaged 11.65 inches; that was 167% of average. The wet season total of 29.92 inches was 134% of average, while the year-to-date rainfall was 118% of average at 43.28 inches. Lake Okeechobee rose substantially this month. The lake ended the month in Flood Regulation Zone B. The Corps increased regulatory releases from the lake from Level II pulse releases to Zone C releases and then to Zone B releases. A wet first ten days of the month was more than counterbalanced by a relatively dry last half of September. Rainfall averaging 6.43 inches was 86% of the average. The wet season total of 36.35 inches was 122% of average, while the year-to-date rainfall was 113% of average at 49.71 inches. Lake Okeechobee rose to near its Flood Regulation Zone A at the middle of the month. Then the lake began to decline. It ended the month in Flood Regulation Zone C. The Corps decreased regulatory releases from the lake from Zone B releases to Zone C releases. Heavy rains attributable to Hurricane Opal and a stalled front produced one of the wettest October's on record along the west and east coasts, respectively. Rainfall averaging 10.17 inches was 219% of the average. The wet season total of 46.52 inches was 135% of average, while the year-to-date rainfall was 123% of average at 59.88 inches. The extreme rainfall event this month prompted the Corps and SFWMD to make many operational changes during the second half of the month. Lake Okeechobee rose from its Flood Regulation Zone C to Zone A during the second half of the month. The lake peaked at 18.64 feet on 26 October. The Corps increased regulatory releases from the lake from Zone C releases to Zone B and then to Zone A releases. November was the driest month in two years was a welcome relief following record rains during the wet season. A lack of active frontal boundaries and no tropical systems allowed only 0.84 inches, which was 43% of average. Year-to-date rainfall of 60.72 inches was 120% of average. The dry November provided good opportunity to recover from the past wet period. Lake Okeechobee declined from slightly below Flood Regulation Zone A to Level III pulse release zone during the month. The Corps decreased regulatory releases from the lake from Zone A through Zones B and C releases to Level III pulse releases. The driest month in three years continued a relief trend following some record rains during the wet season. A lack of active frontal boundaries ion December allowed only 0.78 inches to fall; that was 45% of average. Annual rainfall of 61.50 inches was 117% of average. Lake Okeechobee declined from Level III to Level I pulse release zone during the month. The Corps decreased regulatory releases from the lake according to the lake's regulation schedule.

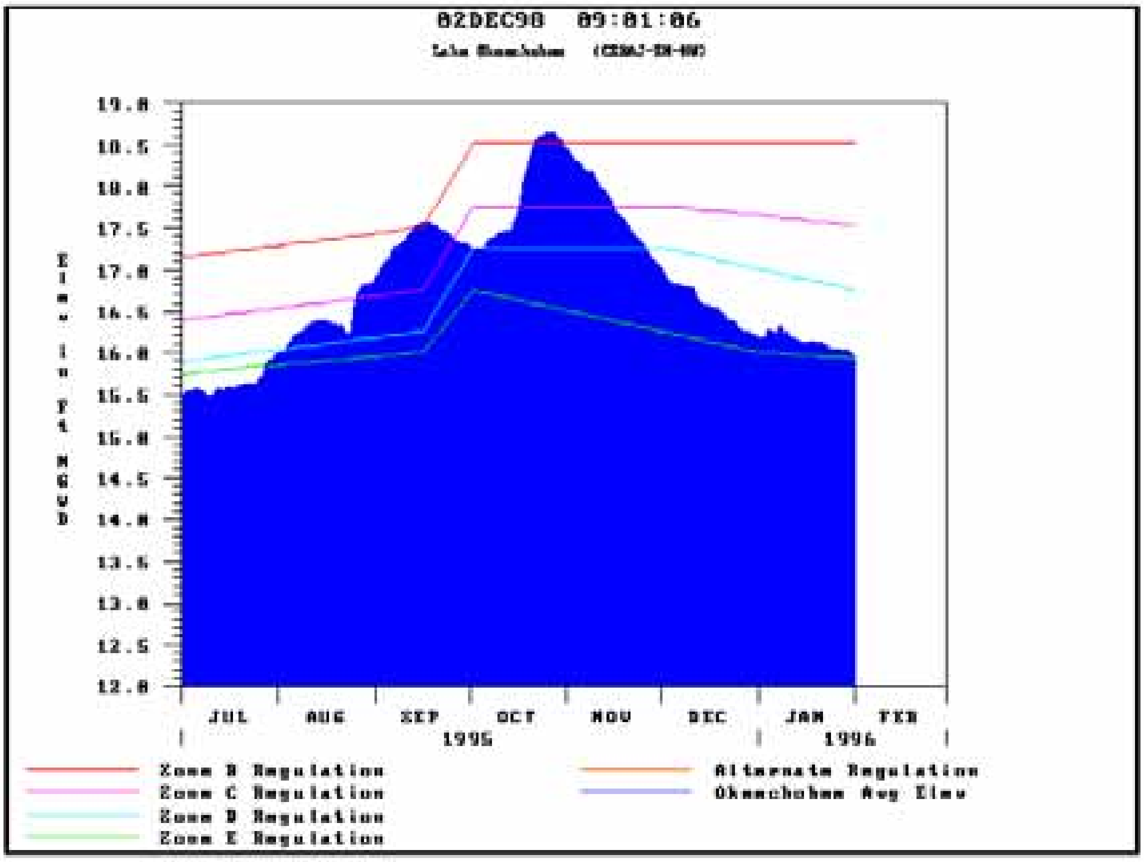

Figure G-2.1. Lake Okeechobee 10-Station Average water surface elevation.

2.1.2 <u>Event Chronology</u>.

This high water event began on 25 August 1995 (Day 1), when the average elevation of Lake Okeechobee exceeded 16.5. The event extended through 20 December 1995 (Day 118) when the average elevation of Lake Okeechobee dropped below EL 16.5.

The provisions of the Emergency Action Plan for monitoring the project were implemented. This consists of three levels of monitoring as follows:

Level I: Between lake elevations of 16.5 and 17.5 feet, monitoring is to consist of monthly inspections of the project by South Florida Operations Office (SFOO) staff.

Level II: For limited local flooding next to Lake Okeechobee and lake levels above 17.5 feet, monitoring is to consist of weekly inspections of the project by SFOO staff and monthly inspection by CESAJ-EN and CESAJ-CO staff.

Level III: For widespread local flooding and lake levels above EL 18.5, monitoring is to consist of daily inspections of the project by SFOO staff and daily inspection by CESAJ-EN and CESAJ-CO staff until the lake recedes back to EL 18.5.

2.1.2.1. Level 1 Monitoring.

During this period, SFOO inspected the Herbert Hoover Dike from Clewiston to Port Mayaca on 5-7 September (Days 12-14). SFOO inspected the entire Herbert Hoover Dike on 28-29 September (Days 35 and 36).

LEVEL 1. The average elevation of Lake Okeechobee is between EL 16.5 and EL 17.5.

Day 1. On 25 August 1995, the average elevation of Lake Okeechobee exceeded EL 16.5.

Days 2 Through 19. The average elevation of Lake Okeechobee continued to rise.

LEVEL 1, SECOND TIME. The average elevation of Lake Okeechobee is between EL 16.5 and EL 17.5.

Day 29. On 21 September the average elevation of Lake Okeechobee dropped below EL 17.5.

Days 30 Trough 50. The average elevation of Lake Okeechobee remained above EL 16.5.

LEVEL 1, THIRD TIME. The average elevation of Lake Okeechobee is between EL 16.5 and EL 17.5.

Day 90. On 22 November the average elevation of Lake Okeechobee dropped below EL 17.5.

Days 91 Through 117. The average elevation of Lake Okeechobee remained above EL 16.5.

2.1.2.2. Level 2 Monitoring.

The first weekly inspection occurred on 21-22 September (Days 28-29). There was an increase in ponded and wet areas since the first Level 1 inspection, but there was no change in the "small water boil". Tony: any weekly inspections by SFOO during Days 69-90 (1 Nov - 22 Nov)? CESAJ-EN and CESAJ-CO staff did not do any monthly inspection since Level 2 monitoring was less than 30 days.

After the lake level dropped below EL 18.5 on Day 68, a daily inspection of the entire Herbert Hoover Dike occurred on Day 69. After that, daily inspections continued from Clewiston easterly towards Port Mayaca to observe the active seeps. Three weekly inspections of the entire Herbert Hoover Dike occurred until the lake dropped below EL 17.5 (Day 90).

LEVEL 2. The average elevation of Lake Okeechobee is between EL 17.5 and EL 18.5.

Day 20. On 13 September the average elevation of Lake Okeechobee exceeded EL 17.5.

Days 21 Through 28. The average elevation of Lake Okeechobee remained above EL 17.5.

LEVEL 2, SECOND TIME. The average elevation of Lake Okeechobee is between EL 17.5 and EL 18.5.

Day 51. On 14 October the average elevation of Lake Okeechobee again exceeded EL 17.5.

Days 52 Through 57. The average elevation of Lake Okeechobee remained above EL 17.5

LEVEL 2, THIRD TIME. The average elevation of Lake Okeechobee is between EL 17.5 and EL 18.5.

Day 68. On 31 October the average elevation of Lake Okeechobee dropped below EL 18.5.

Days 69 Through 89. The average elevation of Lake Okeechobee remained above EL 17.5.

2.1.2.3. Level 3 Monitoring.

A special Dam Safety Comittee meeting was held on 19 October 1995 prior to implementing Level III monitoring. The monitoring was initially accomplished with six inspection teams divided as follows:

Team 1 - Clewiston (S-310) west to Fisheating Creek and Harney Pond Canal (S-131)
Team 2 – Harney Pond Canal (S-131) north to Okeechobee (S-193)
Team 3 - Okeechobee (S-193) south to Port Mayaca (S-308)
Team 4 - Port Mayaca (S-308) south to Canal Point (S-352)
Team 5 - Canal Point (S-352) south to Belle Glade (S-351)
Team 6 - Belle Glade (S-351) west to Clewiston (S-310)

LEVEL 3. The average elevation of Lake Okeechobee is between EL 17.5 and EL 18.5.

Day 58. On 21 October the average elevation of Lake Okeechobee exceeded EL 18.5.
Days 59 Through 67. The average elevation of Lake Okeechobee remained above EL 18.5.

DAY 58. On 21 October the average elevation of Lake Okeechobee exceeded EL 18.5.

DAY 60. Monday morning, 23 October, five engineers from Engineering Division departed from the District office for daily monitoring. SFOO personnel were doing the daily dike inspection; District personnel arrived at Okeechobee at 1500 hours and accompanied SFOO personnel for remainder of the day's inspection. Inspection in several areas was difficult because of high grass. Observed clear seepage north of Spillway S-352.

At approximately 18:15 two COE engineers returning to Clewiston along US.27 spotted several areas where the berm had collapsed between C-4A and Spillway S-354 (Lake Harbor). They stopped immediately to make a closer inspection. The collapses were caused by piping of berm material into the toe ditch. Although the flow rate was small (about 1 gpm per pipe) the volume of material (fine sand) that had piped was alarming (up to about 1 cuyd at some pipes). The Chief, SFOO was contacted immediately, and personnel with sandbags were sent to the site. Chief, Geotechnical Branch was contacted that evening. Extensive sandbagging operations were postponed until the morning due to the safety hazard of working next to U.S. 27 in the dark and the flow rates were not increasing.

DAY 61. Tuesday, 24 October, two representatives from SFWMD arrived in Clewiston to monitor the situation; they accompanied an inspection team. A Corps drill crew mobilized to the area; they began exploratory borings. Two Corps representatives (public affairs and hydraulics) from the District deployed to work in the SFWMD Emergency Operations Center; they provided technical assistance and answered questions from the public about lake releases. Two other Corps representatives (geotechnical) from the District deployed to help SFWMD in their inspection of levees that were in areas of widespread local flooding.

SFOO and District personnel and two SFWMD representatives performed the daily dike inspection. Inspection of several areas was difficult because of tall grass; priority areas to mow were given. The new inspection teams had difficulty locating previously reported wet areas; the areas were not all staked and their locations not accurately recorded.

A sinkhole was observed on the crest above the area of piping near Lake Harbor. This was cause for concern since it was above the area where the piping and berm collapses were observed

A farmer reported a boil on the east side of S.R. 715, just north of Paul Rardin Park; an inspection team inspected and recorded the boil.

Sandbagging in the morning consisted of building cross dikes in the toe ditch to raise water levels. By late afternoon water in the toe ditch had risen about 6 to 12 inches; piping had slowed in most pipes, but two pipes still were moving material. Additional sandbags were placed around the active pipes and plans were developed to pump water (next day) into the toe ditch to reduce the differential head.

SFWMD established a phone bank on 24 October for citizens to call with questions or concerns.

DAY 62. Wednesday, 25 October, SFOO and District personnel and one SFWMD representative did the daily dike inspection. A citizen reported the location of deposits of sand in the toe ditch; an inspection team inspected and recorded the area. The mowing crews mowed a large area; this made it possible to inspect areas that were previously inaccessible. The Corps accepted SFWMD's offer of manpower and vehicles to help the Corps inspection teams. Another person from the District office deployed for technical assistance to SFWMD for widespread local flooding problems.

DAY 63. Thursday, 26 Oct, Corps and SFWMD personnel together performed the best detailed inspection to date. The locations of condition 1-4 areas were staked and recorded for future inspection teams.

DAY 64. Daily inspections continued.

DAYS 65-66. The Corps staffed a phone line at the Clewiston office over the weekend (28-29 October) for anyone who noticed new and unusual conditions on or around the Herbert Hoover Dike. Daily inspections continued. Many wet spots and ponded areas that were previously recorded were drying.

DAY 67. Daily inspections continued. Wet spots and ponded areas continued to dry.

DAY 68. On 31 October the average elevation of Lake Okeechobee dropped below EL 18.5. Daily inspections continued. Wet spots and ponded areas were drying; active seeps with clear flow were monitored with no changes.

DAY 69. Even though the lake level was below EL 18.5, the entire Herbert Hoover Dike was inspected. Wet spots and ponded areas continued to dry. This was the last time that the entire dike was inspected daily.

DAY 70. Only Areas 3, 4, and 5 (Clewiston to Port Mayaca) were inspected; teams from Areas 1, 2, and 3 helped the other teams. Closer inspection of the toe ditches was possible because of dryer conditions. This enabled the inspectors to locate additional seeps. These seeps were minor and clear. This was the last day that CESAJ-EN staff performed inspections for the high water event.

2.1.3. SFWMD Assistance.

During the first four days of Level 3 monitoring, the Corps did the daily inspections without assistance from SFWMD. On the fourth day, the Corps accepted SFWMD's offer of manpower and vehicles to help the Corps inspection teams; this totaled approximately 384 man-hours (8 days X 12 hours/day X 4 men). Now the inspection teams could consist of a minimum of two people. The two-person teams discovered more seepage locations, staked and recorded those locations, and used the "buddy system" to stay safe. Additional SFWMD personnel were on site or at SFWMD's headquarters monitoring the situation. The personnel who were on site gained experience in recognizing seeps and knowing what corresponding action to take.

2.1.4. Observations Of Distress.

Consistent evaluation of observed seepage among the different inspectors was extremely important. Very early in the inspection process a method for rating the severity of seepage was implemented. Seepage locations were rated as follows:

Condition 1: Wet spot, saturated ground, no ponded water.
Condition 2: Ponded area with standing water, no visible flow.
Condition 3: Active seep, visible flow, no movement (piping) of material.
Condition 4: Active seep with movement of material.

The project had already been divided into reaches based on work performed for the Major rehabilitation Report (MRR). This system of reaches was ultimately adopted for the numbering sequence of observed distress. The division of reaches is shown in Figure G-2.2.

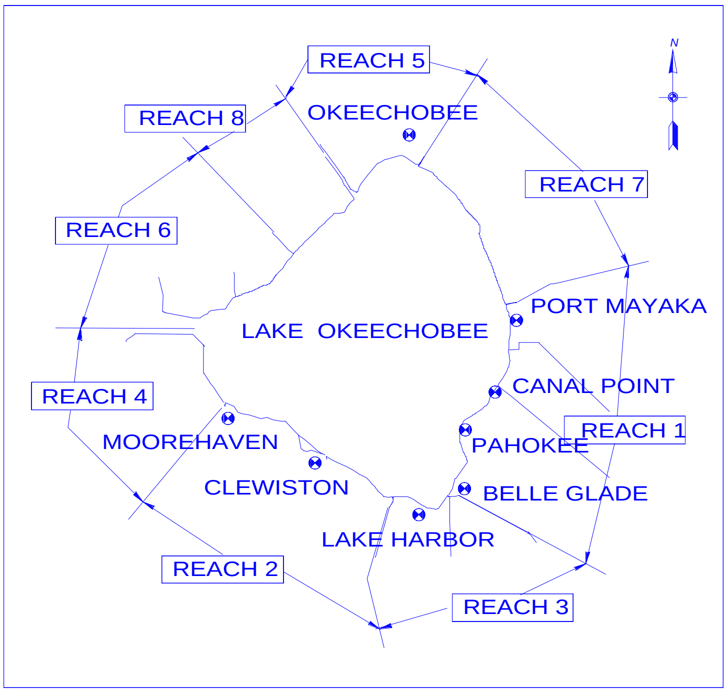

Figure G-2.2. Project Reach Divisions.

2.1.4.1. Reach 3 Sites.

There was one conditon 4 site and five condition 3 sites reported and monitored in Reach 3. Refer to Figure G-2.3.

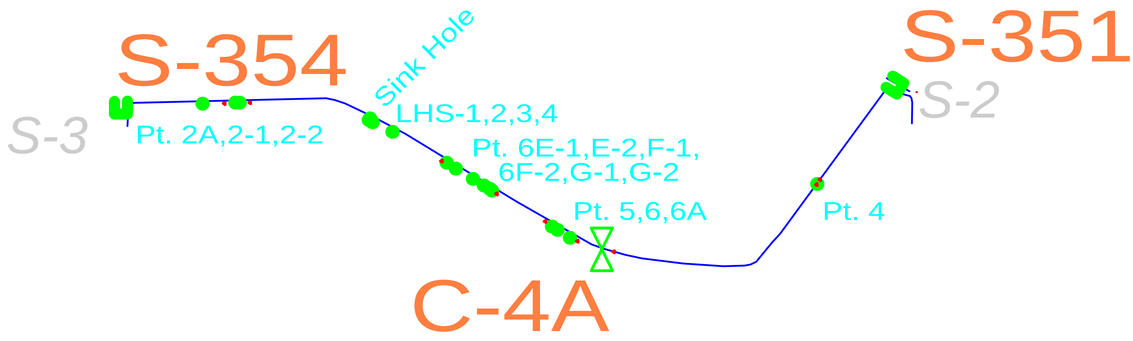

Figure G-2.3. Reach 3 Condition 3 and 4 sites.

<u>Condition 4 Site</u>. The site labeled "Sinkhole" and LHS -1,2,3,4 were located midway between Spillway S-354 and Culvert 4A. The landside berm above the toe ditch was damaged for approximately ¼ mile. The berm had collapsed in several areas and the ditch slopes that were next to the embankment had sloughed in several areas. A sinkhole was observed in the levee crest above the areas where piping occurred. Boils were also observed in the bottom of the toe ditch. No odor or white staining was present in the boils. The piping was considered caused from through seepage.

<u>Condition 3 Sites</u>. There were five condition 3 sites identified in Reach 3. These sites (west to east) were labeled Point 2A, Point 2-1 & 2-2, Point 6 E, F & G, Point 5, 6 & 6A, and Point 4.

Point 2A was an area with a small cond. 3 seep on the berm. Points 2-1 & 2-2 were an area with strong seepage over an area 1000 feet long exiting on the berm at approximately elevation 15. This area was impassible by vehicle or foot.

Points 6 E, F & G: This was an area extending for approximately 2500 feet. The sepage was exiting high on the berm (approximately elevation 15 – 17). The berm was wet, but not saturated. The flow rate was not nearly as great as at point 2.

The point 5 area contained seeps over about a 1500 foot area. This was centered at a boil on the berm which had piped material. The elevation of the boil was measured with a level as 15.7 referenced to the water's edge and an assumed lake elevation of 18.5. In any case, the boil piped on the berm with 2.8 feet of head and a 280 foot seepage length.

Point 4 was located approximately 1 mile south of S-351. Damage consisted of seepage exiting on the berm at elevation 10.6 (based on a lake elevation of 18.5) and several boils in the ditch bottom over approximately 250 feet. Seepage exiting the ditch bottom was unusual in that it caused a white staining upon contact with peat, and that there was a strong sulfur odor. This was attributed to seepage below the confining layer (silt – clay layer below the peat) reaching the surface through cracks or fractures.

2.1.4.2. Reach 1 Sites.

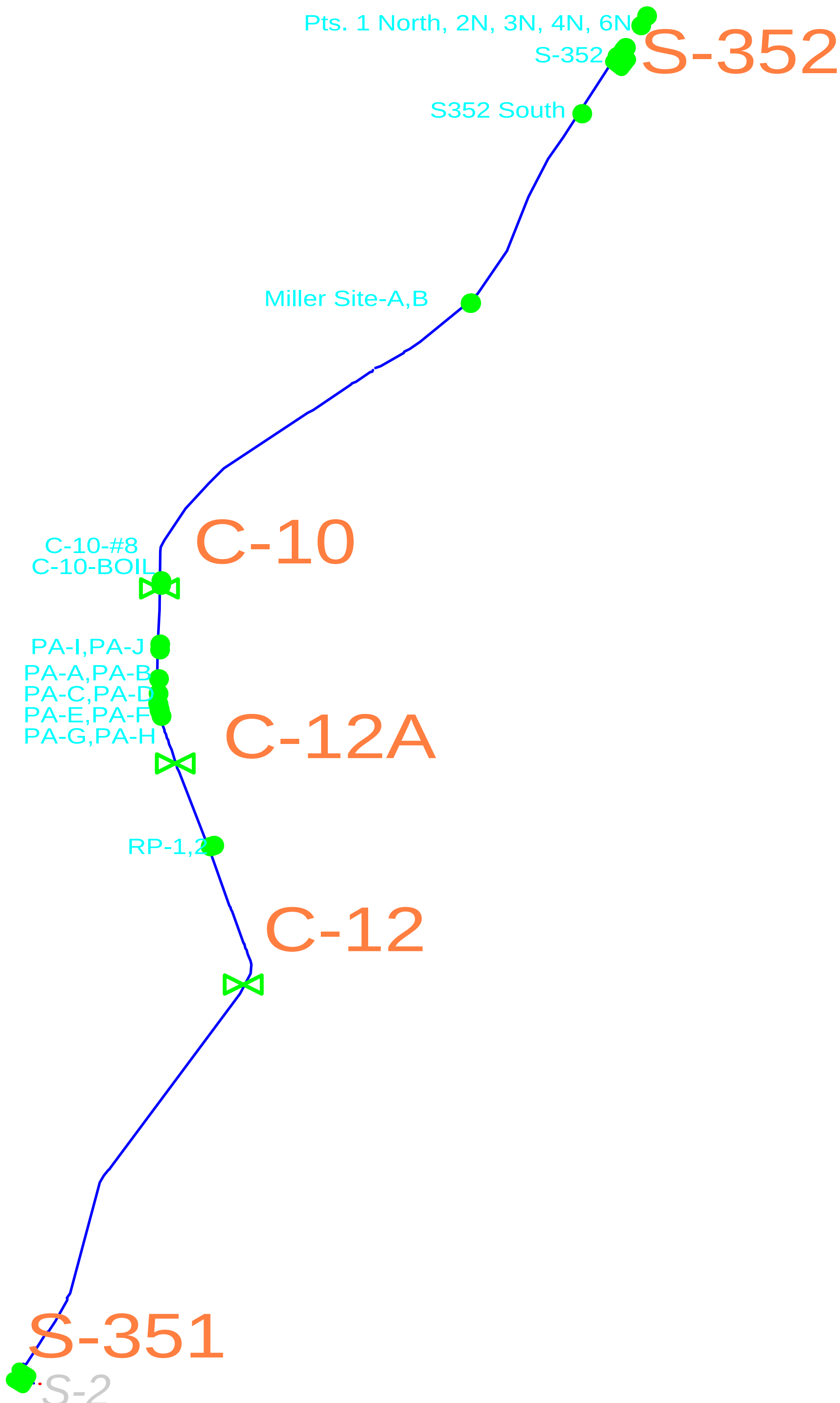

Figure G-2.4. Reach 1 condition 3 and 4 Sites.

Condition 4 Sites.
Culvert 10. This site is just north of culvert structure C-10. The landside toe of the embankment at the bottom of the ditch was damaged due to piping at several locations and collapses of the ditch slope on the lake side of the ditch. No odor or white staining was present in the boils. The piping was considered caused from through seepage.
Miller Site. This site located behind 1565 E. Main Street, Pahokee. The landside slope of the toe ditch was damaged. Three locations were observed where the material that piped out, slid down the slope of the toe ditch; an estimate that 2 to 3 cubic feet of material piped at each point. No odor or white staining was present. The piping was considered caused from through seepage.
Condition 3 Sites.
Pahokee Airport Ditch. This site was located immediately adjacent to the airport property in the ditch between the embankment and airport. Several seeps exited the lakeside slope of the toe ditch at the base of the ditch. There was no detectable sulfur smell, but some white staining was noticed.
Rardin Park. This site was located just south of Pahokee, immediately north of Paul Rardin Park. Two boils were found, one at the toe of the embankment and one across SR 715 on a berm in the cane fields. Upon obtaining the locations with GPS, these boils were determined to be old core borings that were not properly backfilled and grouted.
S-352 North and South sites. Seepage at these sites consisted of blocks of peat being pushed out at the water level in the toe ditch. Generally, a block of peat about one cubic foot in diameter would be pushed out and clear seepage would exit. One such site was located to the south of S-352 and several sites were located to the north of S-352.

2.1.5. Emergency Actions.

Condition 4 Sites. The objective was to stop loss of embankment material.
Lake Harbor. (Sinkhole Site) The area where piping was occurring extended for approximately 1500 feet. Initial attempts to sandbag the individual pipes exiting the sides of the ditch and boils in the bottom of the ditch proved to be ineffective. The sand being piped was so fine that it passed between the sandbags or when some head was built up in the sandbag containment, the head caused material under the sandbags to pipe. Also, there were so many pipe and boil locations these could not be ringed fast enough and working conditions were such that personnel working in the ditch bottom sunk up to their waists and made conditions worse.
A second attempt was to compartmentalize areas containing boils and pipes by constructing small check dams across the ditch bottom. This was partially effective, but the volume of the ditch to fill was such that filling by seepage proved to be too slow and ineffective.
The third and final attempt was construction of higher check dams and setting up a large pump at C-4A to fill up the entire length of toe ditch. Refer to the photos. This method proved to be effective in stopping the piping. Once instructions were given it took approximately two days to set up the equipment and pump enough water to fill the two miles of ditch.

Culvert 10. The area where piping was occurring extended for approximately 500 feet. A similar method was employed at this site. Due to the nature of the pipe (a broad area of piping through a shelly sand seam about 3 inches thick) sandbags were not considered. The ditch bottom was also very soft. Fortunately, a discharge culvert into the local drainage canal was approximately 200 feet downstream. A gate was fabricated from a sheet of plywood, stakes and sandbags. Water levels rose above the level of the pipes within a few hours.

Miller Site. The piping at the Miller Site had sealed itself off after moving 1 – 2 cubic feet of sand at each of the three pipe locations. This site was monitored, but no remedial action was required.
Condition 3 Sites. The objective was to prevent these sites from becoming condition 4 sites. These sites were monitored, but no remedial action was required. At Pahokee Airport Ditch a culvert at the south end of the ditch was blocked by a gate fabricated from plywood, stakes and sandbags as a preventative measure.

7.1.6. Reporting.

During Level 1 monitoring, CESAD and SFWMD were notified that Level I monitoring was being performed and that several wet areas were identified, including the Lake Harbor area.
During Level 2 monitoring, the District Engineer, CESAD and SFWMD officials, and Local Drainage District and County Emergency Management Officials were briefed on the condition of the Herbert Hoover Dike. The Dam Safety Committee met, and CESAJ-PA made a press release describing Corps and other agencies' coordination of flood protection actions. This level also included pre-positioning of materials, equipment, etc. as a precautionary measure. Corps Emergency Operations officials issued the first situation report one day before starting Level 3 monitoring.
During Level 3 monitoring, interagency coordination intensified with CESAD, SFWMD, Local Drainage Districts, Florida Division of Emergency Management, County Emergency Management Agencies, and County Sheriff's Offices. The Dam Safety Committee met regularly and CESAJ-PA provided press releases on Corps activities. SITREP 7 stated "conference calls were held over the weekend with SFWMD, local, area, and State Emergency Management officials on HHD and L.O. releases. Conference calls were made daily at 1600 hours between SFOO, the District office, and SFWMD for an update on the situation and to discuss the plan of action for the next day. Subsequent situation reports (2 through 8) were issued 22-24, 26-27, 29, and 31 October by Corps Emergency Operations officials.

2.1.7. Media Exposure.

The District Public Affairs office mounted an aggressive media program to inform the public about Corps activities in connection with the high level of water at Lake Okeechobee and the problems at Herbert Hoover Dike. A public affairs specialist was on site to help the technical teams and operations personnel and to work closely with the SFWMD. Media interest was high with most Florida papers and the Los Angeles Times, and many local television stations and CNN carrying the story. A story in The Miami Herald was especially noteworthy. It characterized the on-site project manager as the "little Dutch boy who stuck his finger in the dike to hold back the flood". It also discussed the vigilant efforts that the Corps and others made to ensure safety. Corps Public Affairs officials released news releases about the Level III Monitoring on 26 and 27 October. Corps Public Affairs officials released other news releases about water discharges from Lake Okeechobee on 29 August and 23, 25, 26, and 27 October.

2.1.8. Post High Water Inspection.

On 5 and 6 February 1996, personnel from Headquarters, Division and District Offices, and SFOO participated in the post high water inspection of Herbert Hoover Dike. The purpose of the inspection was to review with higher authority the events of October and November 1995, to discuss the evidence of distress on the embankment, and to convey the need to repair the damages to the project before the next hurricane season.

2.1.9. Implementation Of Repairs.

During the event, Corps drill crews began core boring operations at the condition 3 and 4 sites in the Lake Harbor area. Explorations were also performed at the Reach 3 Point 4 site, Pahokee Airport Ditch, C-10, Miller site and S-352 North sites. Piezometers were installed several sites, and gradations of select samples were obtained. A summary of the E&D effort and repair costs is provided in Table G-2.1. Detailed models were developed for repairs in Reach 3 and Reach 1.

Table G-2.1. 1995 High Water Event Repair Cost Summary.
HERBERT HOOVER DIKE EMERGENCY REPAIRS SUMMARY

SITE	Site	Mat.l	Actual Unit	Mat.l	Other Material	Equip.	E & D	SFOO	Total per
	Length, ft	TONS	Cost / ton	COST	Cost	Rental	COST	Labor (**)	Site
Lake Harbor (1000') Initial	1000	9500	9.75	92625	0	11000	20657	52356	176638
Lake Harbor (500') Remaining	500	5000	9.75	48750	0	8000	10328	26178	93256
C-10 Cond. 4	500	4500	6.28	28260	34532	0	10328	26178	99298
Miller Cond. 4	100	400	6.28	2512	0	0	2066	5236	9813
Lake Harbor Pt. 2 Cond. 3	1000	9000	5.45	49050	0	14000	20657	52356	136063
Lake Harbor Pt.5,6,6A Cond 3	1500	13500	5.45	73575	0	21000	30985	78534	204094
Lake Harbor Pt 6E, F,G Cond 3	2500	22500	5.45	122625	0	35000	51641	130890	340156
Reach 3, Pt. 4, Cond. 3	250	1100	5.73	6303	0	0	5164	13089	24556
S-352 North & South Sites, Cond. 3	2200	3200	6.83	21856	0	0	45444	115183	182484
TOTALS	9550	68700		$ 445,556		$ 89,000	$197,270	$500,000	$ 1,266,358

* Cost based on COEMIS report 5/25/96 (labor, PD, drilling equipment & supplies), total = $197,270 pro rated per foot of site

* *Cost based on total of $500,000 available pro rated per foot of site

2.1.10. Photographs. The following pages are photographs taken of evidence of distress during the event and subsequent repairs.

2.1.10.1. Lake Harbor Sites.

Photo G-2.1 Lake Harbor piping, ditch with sandbags

Photo G-2.2 Lake Harbor piping, ditch with sandbags, close-up

Photo G-2.3 Lake Harbor piping, ditch with sandbags & drill rig

Photo G-2.4 Lake Harbor piping, ditch with sandbags & drill rig, distance shot

Photo G-2.5 Lake Harbor sinkhole, Larry in hole

Photo G-2.6 Lake Harbor sinkhole, Onlookers

Photo G-2.7 Lake Harbor, C-4A pumping

Photo G-2.8 Lake Harbor, C3, sandbag stockpile

Photo G-2.9 Lake Harbor Point 2; overview looking east

Photo G-2.10 Lake Harbor Point 2; overview looking west

Photo G-2.11 Lake Harbor Point 2; overview

Photo G-2.12 Lake Harbor Point 2; closeup of seepage

Photo G-2.13 Lake Harbor Point 6; overview looking west

Photo G-2.14 Lake Harbor Point 5; overview

Photo G-2.15 Lake Harbor Point 5; closeup

Photo G-2.16 Lake Harbor Point 5; large closeup

Photo G-2.17 Lake Harbor Point 2; overview of sandbag weir

Photo G-2.18 Lake Harbor Point 2; overview of sandbag weir, closeup

Photo G-2.19 Lake Harbor Pt 6 EFG Site; berm repair, excavating thru toe ditch

Photo G-2.20 Lake Harbor Pt 6 EFG Site; berm repair, berm peat stripped

Photo G-2.21 Lake Harbor Pt 6 EFG Site; backfilling berm & ditch

Photo G-2.22 Lake Harbor Pt 6 EFG Site; replacing topsoil

Photo G-2.23 Lake Harbor Pt 6 EFG Site; ready for grassing

Photo G-2.24 Lake Harbor Sinkhole site; stripping peat on berm

Photo G-2.25 Lake Harbor Sinkhole site; excavating pipes above sandbag sites

Photo G-2.26 Lake Harbor Sinkhole site; excavating pipes above sandbag sites, close-up

Photo G-2.27 Lake Harbor Sinkhole site; note liquified material (4' survey rod pushed into berm)

2.1.10.2. Reach 3 Point 4 Area.

Photo G-2.28 Reach 3 point 4; Seepage on berm

Photo G-2.29 Reach 3 point 4; overview

Photo G-2.30 Reach 3 point 4; close up of white staining from culvert discharge

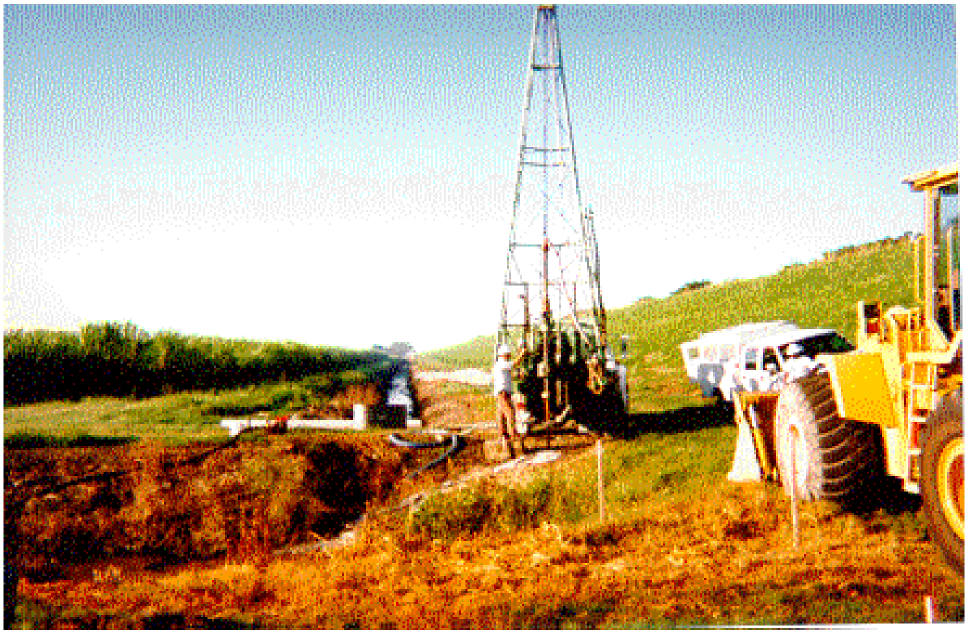
Photo G-2.31 Reach 3 point 4; drilling vertical drains


Photo G-2.32 Reach 3 point 4; filling drains with #10 stone


Photo G-2.33 Reach 3 point 4; excavating drain cap and laterals to ditch


Photo G-2.34 Reach 3 point 4; vertical drains on 15' centers

4. PROJECT GEOLOGY

4.1. Geologic History of the Lake Okeechobee Region

Most of the geologic history significant to the current study of Herbert Hoover dike has occurred in the last 1,000,000 years. The lake Okeechobee region is part of the Florida Platform which is a stable structure 400 miles wide and 600 miles long. The lake Okeechobee region has historically been a local depression within that structure. The driving force for the history of the region is the 4 major and numerous minor glaciations that have occurred in the last million years. As each glaciation developed, sea level fell and the lake Okeechobee basin became a fresh water lake in which fresh water sediments were deposited. When the glaciers retreated, sea level rose and the sea covered the Okeechobee basin. Marine sediments were then deposited. This cycle was repeated time and time again forming alternating fresh water deposits and marine deposits. The depositional sequence is imperfect because of erosional periods that would remove some of the previous depositions during each glacial cycle.

The continuous changes in sea level led to conditions that encouraged the formation of caliche, hard pans, and cap rocks within the sediments. This process has created hardened seams, stringers, and rock layers within the sediments at Herbert Hoover Dike. The cap rock and hardened seams are common in the Fines Horizon which typically underlay the peat horizon.

Currently we are recovering from the last glaciation. Sea level is rising and Lake Okeechobee is a fresh water lake. When sea level rises another 20 feet, Lake Okeechobee will once again become a marine environment.

4.1.1. Geologic Units. Geologic Units as reported by the USGS (USGS, 1971) are as follows.

ORGANIC SOILS. Holocene. 0-10 feet thick. Peat. Low permeability.

LAKE FLIRT MARL. Pleistocene. 0-10 feet thick. Sandy marl. Low permeability.

TERRACE DEPOSITS. Pleistocene. 0-10 feet thick. Quartz sands. Low permeability.

FORT THOMPSON FORMATION. Pleistocene. 0-30 feet thick. Alternating marine and fresh-water limestones and/or marls. Variable permeability; low in dense crystalline limestones and high in shelly limestones.

CALOOSAHATCHEE MARL. Pleistocene. 0-30 feet thick. Shell, sandy clay, and sandy limestone. Variable permeability; high in shell beds and low in clay.

TAMIAMI FORMATION. Miocene. 30 to 110 feet thick. Clay, sand, and sandy limestones. Variable permeability; high in sandstones beds and low in sands and clay.

4.2. Geology of Reach 3, Herbert Hoover Dike.

Reach 3 is located in the southeastern section of Herbert Hoover Dike. It is approximately 7 miles long and runs between Structure 351 on the eastern end and Structure 354/Structure 3 on the western end (Lake Harbor). A total of 142 core borings were analyzed in determining the existing geology beneath and near the dike. A cross section of Reach 3 was created using 20 representative core borings. The borings chosen represent the most consistent geology the deepest elevations. On occasion, 2 closely spaced borings will be merged to provide the most information. The borings range from approximately elevation +40.0 NGVD (centerline borings) down to the deepest boring at elevation -42.0 NGVD. Due to the horizontal length of the reach and the relatively shallow depths, the vertical exaggeration of the cross section is 200V:1H.

4.2.1. Geologic Units in Reach 3

4.2.1.1. Peat Horizon. Typically black, sometimes brown in color. May be fibrous to intensely decomposed. The peat horizon is sometimes identified as an organic silt. The peat horizon is continuous throughout most of Reach 3. Samples taken in the Everglades by the USGS tested to be 5,000 years old. The Peat Horizon is about 8 feet thick at Belle Glade and gradually thins out both to the northeast and west. The peat horizon in Reach 3 varies in thickness from 1-8 feet and averages around 5 feet. An absence of the peat horizon is usually an indication that it was locally excavated or the result of local topographic highs or sand ridges when the peat horizon was being formed. The peat horizon sometimes appears to be too thick, too thin, or it is found out of the natural geologic sequence; this is usually the result of local excavations, fill placement, or spoil disposals. It is typically the upper natural material present. Any materials overlying the peat horizon in Reach 3 are probably fill.

The Peat Horizon corresponds to the ORGANIC SOILS described by the USGS (USGS, 1946).

4.2.1.2. Fines Horizon. Typically tan calcareous silts and clays formed from decomposed limestone. The Fines Horizon is not continuous. It is present in the eastern half of the reach but thins and appears only occasionally in the western half of Reach 3. Where it does occur, it typically forms an impermeable layer between the Peat Horizon and the Rock Horizon. Where present, it ranges from 1 - 5 feet thick. Where absent, the Rock Horizon would then be in contact with the Peat Horizon.

The Fines Horizon generally corresponds to the FORT THOMPSON FORMATION described by the USGS (USGS, 1971).

An important feature of the Fines Horizon is a Limestone layer that is sometimes found at the base of the Peat Horizon. USGS has identified this formation as the Lake Flirt Marl. Refer to Figure H-4.1. This is a thin crystalline limestone typically a few inches to 2 feet thick. It is often not identified in core boring logs. In core logs that did not identify this limestone, its existence can often be inferred by high blow counts encountered at the base of the peat. In core logs not showing the high blow counts, the limestone may be thinner or weathered. It may have been pushed out of the way by the sampler, or it is locally absent. It is exposed in fields where the peat layer has been farmed out. The local people commonly refer to it as the "cap rock".

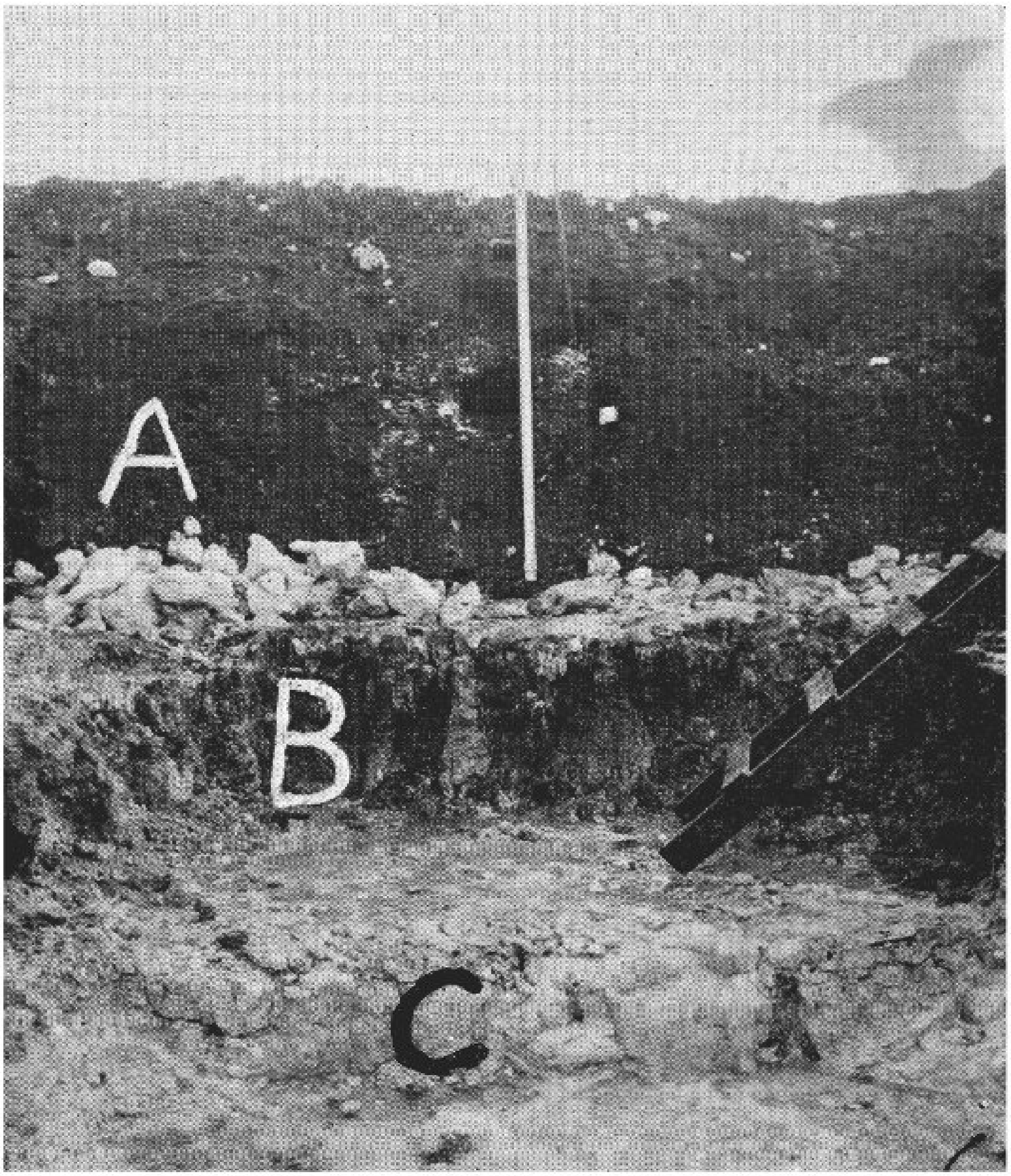

Figure H-4.1.-- Pit showing profile of sediments and peat in the Everglades near the northern part of the Hillsborough Canal. A. Saw-grass peat, 4 feet thick. B. Lake Flirt marl, 20 inches thick. C. Fort Thompson formation limestone.
[Courtesy U.S. Soil Conservation Service, Ft. Lauderdale]

In an investigation of levee L-8 (located east of Herbert Hoover Dike), this limestone was exposed at the base of the peat in a ditch. The limestone layer did not show up in the investigative core borings that were drilled. The driller was then told to use special care when drilling through the base of the peat and then the limestone was recovered. It was reported that the limestone layer was continuous for miles.

4.2.1.3. Rock Horizon. The Rock Horizon occurs throughout Reach 3. It is typically 10 to 20 feet thick. The top of the Rock Horizon usually occurs at elevation 5.0 and continues to approximately -15.0. This horizon thins to the west toward Structures 3/354. The rock horizon is composed of interbedded limestone and sand layers. The limestones within the Rock Horizon vary from dense crystalline limestones to sandy limestones to shelly limestones. Some of the limestones are essentially impermeable while others are highly permeable, containing voids and solutioning features. There were sometimes sudden and complete losses of drill water when coring the limestone. In some areas the rock horizon is essentially all limestone. In other areas the limestone grades into sand deposits. The sands are usually clayey calcareous sands. Fine deposits such as silt and clay are interrbedded within the rock horizon, formed from decomposing limestone.

The Rock Horizon generally corresponds to the CALOOSAHATCHEE FORMATION described by the USGS.

4.2.1.4. Sand Horizon. Greater than 20 feet thick beginning around -15. Typically fine to medium grained quartz sands and quartz silty sands. Usually has a significant shell component. Occasional shell layers are present. Limestone beds are common.

The Sand Horizon generally corresponds to the TAMIAMI FORMATION described by the USGS.

4.2.2. Typical geology. Refer to Figure H-5.2.

Upper levee fill. Sandy/rocky materials

Lower levee fill Silty/clayey materials

Peat Horizon.

Fines Horizon. Upper limestone, fines silts/clays, sandy silts and clays

Rock Horizon. Limestone and sandy layers. Depending on location the horizon can vary from being predominately a Rock Horizon to being predominately sands.

Sand Horizon. Sands with occasional layers of limestone.

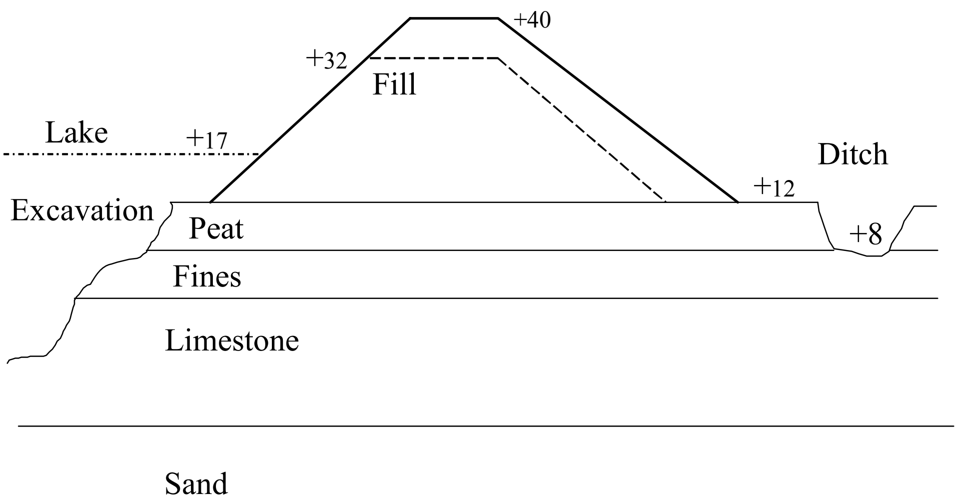

Figure H-5.2. General Geology in Reach 3.

4.3. Geology of Reach 2, Herbert Hoover Dike.

Reach 2 is located in the southern section of Herbert Hoover Dike. It is approximately 20.5 miles long and runs between Structures 3/ 354 on the eastern end (Lake Harbor) to Structure 77 (Moorehaven Lock) to the west. A total of 300 core borings were analyzed in determining the existing geology beneath and near the dike. A cross section of Reach 3 was created using 97 representative core borings. The borings chosen represent the most consistent geology the deepest elevations. On occasion, 2 closely spaced borings will be merged to provide the most information. The borings range from approximately elevation +40.0 NGVD (centerline borings) down to the deepest boring at elevation -60.0 NGVD. Due to the horizontal length of the reach and the relatively shallow depths, the vertical exaggeration of the cross section is 200V:1H.

4.3.1. Geologic Units in Reach 2

4.3.1.1. Peat Horizon. The peat composition is similar to that of Reach 3. The peat horizon is continuous from Structures 3/354 (Lake Harbor) east to approximately 2.5 miles west of Culvert C-3. The peat is absent for about 2 miles until it starts reappearing in a continuous fashion 2 miles west of Structure 310 at Clewiston. The peat does appear sporatically in 2 borings in-between these areas. The Peat Horizon is mostly continuous for 2 miles west of Culvert C1A or Approximately midway between Culvert C1A and Mooorehaven Lock. The Peat is thickest on the eastern end of Reach 2 where it averages approximately 5 feet. The peat thins to 1-2 feet from midway between Structure 4 and Culvert 1A and continues west until it pinches out between Moorehaven lock and Culvert C1A. Any materials overlying the peat horizon in Reach 2 are probably fill.

4.3.1.2. Fines Horizon. Typically tan calcareous silts and clays formed from decomposed limestone. The Fines Horizon is almost non-existent in Reach 2. For the most part, the peat overlies limestone or sand.

4.3.1.3. Rock Horizon. The Rock Horizon occurs throughout Reach 2, however, it thins substantially from east to west and is sometimes completely absent in the lithology. The Rock Horizon continuous it's characterization from Reach 3 for the first 1.5 miles where it is typically 20 feet thick. After 2 miles the rock thins to 10 feet or less and ranges from elevation +10.0 to 0.0. The rock ceases to be continuous 0.5 miles east of Structure 310 and becomes patchy throughout the rest of Reach 2 with a local concentration between Structure 4 and Culvert 1A.

4.3.1.4. Sand Horizon. With the thinning out of the Peat Horizon, the absence of a Fines Horizon and thinning and patchiness of the Rock Horizon, the Sand Horizon is the dominant feature in Reach 2. Core borings have shown the thickness of this horizon to be in excess of 50 feet and is often present at or near the surface. This horizon is typically fine to medium grained quartz sands and quartz silty sands. Limestone beds are common along with lenses of clay and silt. The sand often has a significant shell component. Occasional shell layers are present.

4.3.1.5. Below the Sand Horizon. Approximately 7000 feet west of Structures 3/354 (Lake Harbor) to Culvert C-3, a thick layer of silt (ML) and clay (CL) is present starting as high as elevation -20. This layer is 10 to 15 feet thick, runs at least 12,000 feet and underlies the Sand Horizon. Below this fines layer, moderately hard limestone reappears starting around elevation -36. The thickness or true extent is unknown due to the lack of information at this depth. The limestone continues to Structure 310 in Clewiston and terminates. Before reaching Structure 310, the limestone rises to elevation -25 with a thickness of 10 feet. In addition several large shell areas exist within the limestone in this area. The fine layer reappears and runs for approximately 2 miles west until it also terminates at Structure 310. This layer is composed of silt (ML) and is 10 to 15 feet thick overlying the limestone.

4.3.1.6. Within the Sand Horizon. Small areas of silt, clay, shell and rock exist with no definite consistency within the Sand Horizon from Structure 310 to 1 mile east of Culvert 1A. A shell layer up to 25 feet thick exists from elevation +5.0 to -20.0. The shell bed is present for 3 miles starting at Culvert 1A. Underlying the shell bed and extending 1 mile east of Culvert 1A is a clay layer (CL) with an average thickness of 10 feet and thickest at 15 feet. The bottom of the clay layer terminates at elevation -25 where it may be underlain by a thin (2 foot) layer of limestone. These layers are sandwiched between the Sand Horizon.

4.4. Evaluation of Soil Classifications.

4.4.1. Comparison of Samples to Core Logs. Inspections of core samples were made at the District warehouse prior to the seepage model calibrations. Comparisons were made between the samples in the jar and the descriptions and classifications on the core logs. Where obvious errors existed, or another interpretation seemed more appropriate, a change to the model was made. The materials have been classified from samples recovered from core borings.

Hundreds of core borings have been drilled over the last 40 years. Care must be used when interpreting the core boring logs because the quality of the drilling/logging of materials can affect how the materials are classified. In general, the geology of the area is well behaved and predictable; but, if one were to select any isolated group of core boring logs, the geology may appear erratic or chaotic. There are 2 principal reasons for the apparent lack of correlation:

First, a significant number of core borings were drilled in disturbed soil horizons. Core borings drilled here would sample fill materials and/or in shoaling that is filling old borrow areas.

Secondly, hundreds of core borings were drilled over a 40 year time period, drilled by a dozen different drillers and or agencies, logged by a dozen different geologists, and drilled by different equipment. The same materials can be classified differently.

4.4.2. Examples of Classifications Problems. The same material in the Fines Horizon could be classified as a sandy clay, a sandy silt, a clayey sand, a silty sand, or a marl by different geologists.

Two different core logs may classify an apparent sand layer. In one core boring we may determine that it is actually a limestone layer because it is in a horizon in which other nearby core boring logs have identified the limestone layer. In addition, high blow counts were encountered when drilling through this "sand".

In another core boring, there was also a high blow count; which could suggest a rock layer rather than sand; but, on closer examination the material is fine quartz (SP) sand in which it is not unusual to have high blows counts. Additionally, we note that surrounding core boring logs indicate that this is a high blow count sand deposit and not a rock horizon.

4.5. Embankment Materials

4.5.1. Excavation. Excavations adjacent to the dike were used to construct the embankment. Therefore, the embankment (fill) was built from the same materials the embankment sits on.

Where the foundation materials are predominately silts/clays, the levee was constructed out of silty/clayey fill.

Where the foundation materials were predominately sand, the levee was constructed out of sandy fill.

Where the foundation materials were predominately rock, the levee was constructed out of rocky/gravelly fill (potentially highly pervious).

Where the foundation materials were predominately shell, the levee was constructed out of shelly fill (potentially highly pervious). Shell (whole or sand to gravel sized fragments) is often present in other materials. There is both sand and sand with shell, silt and silt with shell, clay and clay with shell. There are shell and shelly horizons in which appreciable amounts of shell are present, regardless of the principal classification. Example: shelly sands, shelly silts, shelly clays, and shelly limestones.

4.5.2. Method of Herbert Hoover Dike Construction. The general construction method was to strip and spoil the peat from the continuous borrow area adjacent to the levee and then construct the levee using the borrow trench excavation. An exception to this plan is that some peat** was placed at the land side toe of the levee and some peat was probably also placed at the lake side toe of the levee. This was done to form longitudinal dikes used to contain hydraulically placed fill.

The embankment was placed as hydraulic fill. Hydraulic fill placement will separate coarse materials which settle out quickly from fines which settle some distance away. When dredging the Rock Horizon, the hydraulic fill placement would have created layers and lenses of gravelly materials in the Herbert Hoover embankment that would forms zones of high permeability within the embankment.

note: **The peat horizon was typically left in place beneath the footprint of the dike. Some of the peat under the footprint of the dam was probably pushed up to form the lateral dikes.

4.5.3. Inverted Fill Sequence. A typical section of the levee embankment can often be seen to be an inversion of the natural sequence of foundation materials. If the foundation is layered from top to bottom as :

peat horizon
silt horizon
limestone horizon
sand horizon

the levee fill will be the inverted sequence of that; from top to bottom:

sand horizon
gravel (limestone) horizon
silt horizon
peat horizon

4.6. Ground Water Condition.

4.6.1. **General.** The report by USGS, 1971 presents a detailed study of the seepage beneath the Dike and its effect on the ground water table.

There are three principal factors controlling the surface ground water table in at Herbert Hoove Dike. These are Lake Okeechobee, the drainage canal complex, and rainfall.

Before the construction of Herbert Hoover Dike and the extensive drainage control ditch system, the project area was part of an extensive flow-way which transported water from the Kissimmee River watershed to the Everglades in the south. The project area was an extensive wetland with Lake Okeechobee enlarging and flooding onto the marshy plains during wet periods. During dry periods, Lake Okeechobee would shrink in size.

With the construction of the Herbert Hoover Dike system, Lake Okeechobee became a flood control reservoir holding back flood waters. With the addition of the extensive drainage canal system, the ground water of the marshlands south of the Lake Okeechobee was lowered to the point where agricultural activities were possible.

The current surface water table is controlled by operations of the drainage ditches which are operated for the benefit of agricultural interests. During rainy periods, when the water table rises, water is directed out of the agricultural lands and pumped into Lake Okeechobee. During dry periods, when the surface water table falls and the fields dry out, water is taken from Lake Okeechobee to irrigate the fields. Excess waters not needed for agriculture are discharged through control structures and principal canals out of the region.

4.6.2. Underseepage from Lake Okeechobee. Underseepage from the lake has minimal affect on the ground water table in the agricultural lands. Normally, Lake Okeechobee is higher than the controlled water tables in the agricultural lands. Seepage would then occur under the Dike towards the agricultural lands. The seepage paths are principally through limestone layers and shelly horizons. The limestones and shelly horizons were exposed to direct contact with the Lake waters by deep borrow areas within the Lake that were excavated for the construction of Herbert Hoover Dike.

There is often a substantial decrease in seepage from the Lake by the silting in of the reservoir. Over time, fines and muck settle in the deep borrow area excavations and form a barrier to seepage. Another process known as filtercaking occurs where seepage waters carry fines with them that plug the voids that are carrying the seepage. Our piezometric studies indicate that the silting in of the reservoir and the filtercake process is significantly restricting seepage under the Dike. For seepage under the Dike, two paths are possible:

The first path is where the seepage in the limestone beds and shell layers is confined by the Fines Horizon and maintains artesian pressures. The seepage is discharged gradually some distance away in the agricultural lands. A variation on this model is where the limestone and shell layers act as drains (no artesian pressures) and the Fines Horizon allows a perched watertable condition to exist. An example of this condition occurs at culvert C-10A where the piezometric pressures below the Fines Horizon are lower than the water level in the canal. The subsurface water is draining toward the fields some distance away.

The second path is where the seepage finds a break in the Fines Horizon at the toe of the Dike and the waters immediately discharges to ditches or lakes or canals located at the toe of the levee. The breaks in the Fines Horizon are caused by excavation (canals, ditches, lakes, a quarry, ditches) through the Fines Horizon, or in some cases by artesian pressures that were sufficient to force open paths through the Fines Horizon.

4.6.3. Landside Water Surface Elevations. This is a complicated issue. For the purposes of this report, the water elevations of concern are those in the ditches running parallel to the embankment. These are called by several names, "toe ditches", seepage collector ditches", etc. Except for very few areas, no ditches are instrumented. Therefore, no comprehensive data exists. In an effort to provide the best estimates of landside water surface elevations between Clewiston and Port Mayaca, a meeting of representatives from CESAJ, South Florida Water Management District (SFWMD), and Chapter 298 Drainage Districts was held at CESAJ's South Florida Operations Office (SFOO) in Clewiston on 24 September 1996. Attendees included Ron Graydon (Superintendent, Ch. 298 Drainage Districts), Steve Ciulla (SFWMD), Marlyn Harn (SFOO), Tony Dipiero and Sam Honeycutt (CESAJ-EN-GS), Jim Vearil and Sue Sofia (CESAJ-EN-HW), and Pete Grace (CESAJ-EN-HC). Results of the meeting and subsequent site inspections are summarized below. It should be noted that topics of discussion included the Everglades Protection efforts. Although proposed water management strategies involve increased flow diversion to stormwater treatment areas south of Lake Okeechobeechobee, it was agreed that local drainage districts would still need to pump waters into the lake under certain conditions.

4.6.3.1. No-Pumping Threshold Lake Level. The Chapter 298 Drainage Districts' pump stations are not operational if the level of Lake Okeechobee equals or exceeds 19 feet, NGVD. These pump stations typically pump water into a relatively small diked containment area adjacent to the landside face of Herbert Hoover Dike. The diked area is connected to the lake by a flap-gated culvert; therefore, as the water surface elevation in the diked containment area increases to a level which exceeds the lake level, the flap gate opens and water passes into the lake. The 19 foot, NGVD, pumping limitation is related primarily to the elevation of the spur dikes which surround the pump outflow containment areas. Due to the spur dike crest elevations, if the lake stage equals or exceeds 19 feet, the water surface in the containment areas can not be raised to levels needed to force open the culvert flapgates; therefore pumping operations would be discontinued under such conditions. It should be noted that during the high water events of 1994, New Hope Sugar pumping operations at Culvert 12A were unable to pump against the 18.6 foot, NGVD, lake stage. As a result, fields in that area were flooded.

4.6.3.2. Head Criteria. Critical heads at specific Chapter 298 pump stations were identified as:

East Shore DD PS at Culvert 12 - 8 feet
South Shore DD (Bean City) PS at Culvert 4A - 12 feet
East Beach DD PS at Culvert 10 - 12 feet
South FL Conservancy Dist PS P-5-N at S-236 - 19 feet
New Hope Sugar PS at Culvert 12A - 18 feet

These heads define the maximum difference in intake and outflow water levels against which the pumps are capable of operating.

4.6.3.3. Clewiston Industrial Canal East to S-236. Landside water levels in this area are dependent on the toe ditch which parallels the dike. Water levels in that toe ditch are controlled by the inverts of approximately 6 culverts which convey water southward under the highway. During wet periods, the least possible toe ditch water level would be equivalent to the lowest culvert invert elevation. CESAJ-EN-GS personnel indicated that invert elevations for specific culverts are available in their records (DOT drawings). During extreme conditions (e.g., when piping problems are a concern), the head across the embankment could be reduced by blockage of the highway culverts, thereby raising the toe ditch water surface elevation. No measured landside water level data is available.

4.6.3.4. S-236 East to S-3. In this area, a toe ditch lies between the embankment and highway 27. This ditch drains westward; therefore, toe ditch water levels are controlled by the invert elevation of a culvert which links the ditch to the C-3 intake basin. Approximately 8 culverts, with invert elevations around +10 feet, NGVD, provide drainage under the highway. Measured water level data should be available from staff gages at S-236, C-3, and South Florida Conservancy PS-5-N. A new staff gage should be installed in the toe ditch east of C-3 when possible. At the east end of this area, the toe ditch follows the highway alignment and a swampy wooded area with a borrow pit, then a park/picnic facility, separates the embankment from the highway. The existence of a drainage connection between the borrow pit/wooded area and toe ditch should be investigated further. Under extreme conditions, blockage of the highway culverts and control of flow (via riser) into the C-3 intake should be considered for raising tailwaters.

4.6.3.5. S-3/S-354 East to Culvert 4A. Landside water levels in this area are again defined by toe ditch conditions. The ditch flows westward from C-4A and empties into Miami Canal through three 60(?)-inch diameter culvert barrels. Measurements recorded at S-354 can be used to identify toe ditch water levels. Approximately 17 culverts, many of which were apparently boarded shut in the fall of 1995 (and are now reopened), provide drainage under the highway. A slag toe berm (crest elevation 18 feet, NGVD) has been constructed along two sections of embankment in this area. The east and west berm sections are about 0.3 and 0.6 miles in length, respectively. During extreme conditions, tailwater elevations could be increased by blockage of highway culverts and control measures at the culverts linking the toe ditch to S-354.

4.6.3.6. Culvert 4A (Bean City PS) East to S-2. A toe ditch drains from S-2 westward and empties through a 78-inch diameter culvert into the intake basin for the Bean City pump station. Toe ditch water levels are controlled by the +3.65 foot, NGVD, culvert invert elevation on the west end. Measured water surface data is available from the intake staff gage at the Bean City pump station. During extreme conditions, toe ditch water levels may be maximized by control of flows through the culvert at Bean City pump station.

4.6.3.7. S-2/S-351 North to Culvert 12. Immediately north of S-351, there is no drainage ditch paralleling the embankment toe. The landside water surface conditions in this area are controlled by the local groundwater elevation. Sugar cane fields which border the embankment toe are drained by ditches which carry flows southward, then westward to Hillsboro Canal. The northern ends of these north-south drainage ditches originate at the embankment toe; therefore, the best approximation of landside water levels is equivalent to the water level in the north end of these ditches. During the site investigation, water in the ditches suggested that the water table was about 2 to 3 feet below ground elevation at the toe. A staff gage at the north end of one of these north-south drainage ditches would provide valuable information relative to landside water levels in this area, which extends for approximately 6,000 feet north of S-351. North of this area, a toe ditch collects drainage from as far north as Culvert 12 and carries it south to Hillsboro Canal. Pump stations in this area are capable of pumping internal drainage canals down to levels lower than water levels in Hillsboro Canal; therefore, characteristic elevations (invert and top of bank) of the toe ditch should be used to approximate landside water levels in this area. A rock quarry is located at the extreme north end of this area. Water levels in the quarry pit best define the landside conditions immediately south of C-12; however, little information is available.

4.6.3.8. Culvert 12 North to Culvert 12A. A toe ditch extends along this entire area, from Paul Bardin Park to C-12A. This ditch collects seepage and runoff between the dike and highway 715. Site inspection revealed only one culvert which passes flows beneath the highway. A small pump and staff gage are located at the extreme north end of the toe ditch. When operated, this pump passes water from the toe ditch into the intake basin for the New Hope Sugar Pump Station. Measured toe ditch water level data is available from the staff gage mentioned above.

4.6.3.9. Culvert 12A North to Culvert 10. Landside water levels in this area correspond to conditions in a toe ditch which borders the Palm Beach County Glades Airport. The ditch drains to the south and empties through a culvert into the New Hope Sugar Pump Station intake basin; therefore, when toe ditch water levels exceed +7 feet, NGVD, they correspond to measured intake water levels at the pump station. During extreme conditions, tailwaters could be maximized by control of flows through the culvert at the south end of the toe ditch.

4.6.3.10. Culvert 10 North to Okeechobee State Park. A toe ditch extends along the base of the embankment throughout this area. The ditch drains from Okeechobee State Park southward and empties through a 36-in diameter French drain system into the intake basin of the East Beach Water Control District Pump Station 1, where water level measurements are recorded; therefore, when toe ditch water levels exceed +10 feet, NGVD, they correspond to measured levels at the pump station intake. During extreme events, tailwaters could be maximized by control of flows at the culvert which links the French drain system to the pump station intake basin.

4.6.3.11. Okeechobee State Park North to S-352. North of Okeechobee State Park, a toe ditch conveys flows northward to the West Palm Beach Canal at S-352; therefore, S-352 water level measurements will be used as indicators of the toe ditch water surface elevations. Along approximately half of this 3 to 4 mile drainage zone, a Florida East Coast Railroad track parallels the embankment. Under extreme circumstances, measures to raise tailwaters in this area could include ponding of water between the railroad and embankment (i.e., the railroad bed might be used as a sublevee).

4.6.3.12. S-352 North to Culvert 13. In this area, a toe ditch transfers flows from a point just south of C-13 southward directly into the West Palm Beach Canal. S-352 water level measurements may be interpreted as toe ditch water levels.
Tailwater control could be attempted during extreme conditions through blockage of flows at the toe ditch intersection with West Palm Beach Canal.

4.6.3.13. Culvert 13 North to Culvert 10A. A toe ditch controls drainage from C-13 north to C-10A. Flow proceeds from south to north and empties directly into L-8 Canal at C-10A; therefore water level measurements at C-10A may be used to approximate water levels in this toe ditch. It should be noted that the installation of a gated structure (e.g., stop log riser or screw gate) on each side (north and south) of Culvert 13 would provide beneficial toe ditch water level control during extreme events. Since CESAJ controls toe ditch outflows (i.e., at S-352 and at C-10A), the gates would allow for higher tailwaters in the toe ditches with no detrimental effects to the Chapter 298 controlled drainage which is transferred to C-13 from the east.

4.6.3.14. Culvert 10A North to Port Mayaca. Drainage along the base of the embankment is controlled by a toe ditch between C-10A and Port Mayaca (i.e., St. Lucie Canal). In this area, the Florida East Coast Railroad track and/or highway 98 parallel the dike alignment. During periods of excessive rainfall, this area is subject to ponding; therefore, landside water surface elevations will approach (and sometimes exceed) the elevation of the highway crown. During normal conditions, the landside water surface elevation can be approximated as the toe ditch bottom elevation. Measured water level data at culverts C-14, C-16, C-11, and S-308-B (Port Mayaca Lock) may provide additional insight relative to landside water levels in this area.

4.6.3.15. During the 25 September 1996 return to Jacksonville, CESAJ-EN-H personnel made tailwater site inspections at various locations between Clewiston and Okeechobee (i.e., along the west shore). Those areas are typically characterized by a large landside borrow canal in which tailwater elevations are controlled by USACE water control structures.

4.7. Engineering and Geologic Features Seen Along Different Reaches of the Herbert Hoover Dike.

Following is a list of features observed being present at Herbert Hoover Dike. At any location along the levee one or a combination of the listed features may exist.

Refer to Figure H-4.3 to key numbered items to locations.

4.7.1. Peat/Limestone Interface. A 6-inch layer of limestone at the base of the peat is a potential path of seepage/erosion. This peat/limestone condition is very wide spread. Sometimes the limestone is shown on the core boring logs. Sometimes the limestone only shows up as a high blow count seen at the base of the peat. Sometimes there doesn't appear to be any evidence of the limestone layer at the base of the peat. We believe it can exist even where there is no indication of it seen on the core logs.

4.7.2. Artesian Flow. Some piezometers in the limestone at the toe of the dike show artesian conditions. The existence of artesian pressures indicates that the Fines Horizon is not breached. The artesian pressures have a potential to heave the levee toe.

4.7.3. Blown Ditch. Piezometers show direct connection to the deep limestone. The Fines Horizon has been breached.

4.7.4. Ditch Drawdowns. In some areas, pumps can rapidly drawn down land side ditch water levels and increase differential heads between the lake and the ditch. Pumping the ditches down during a high lake stage could fail the levee.

4.7.5. Blocked Land Side Toe. Clayey land side toe fill blocks seepage through the embankment and creates a high piezometric level within the embankment.

4.7.6. Soft Toe, Springs. The blocked land side toe results in a soft toe and water seeps at the land side toe of the embankment. These are indications of high piezometric levels at the toe of the levee. Soft toes can be located by driving a vehicle along the toe of the dike; you have located a soft toe when you bog down. They can also be located by the grass mowing patterns; the tractors avoid these areas and leave patches of unmowed grass.

4.7.7. Gravel Layers. Gravel and shell layers in the embankment create seepage paths. These layers come about because the borrow area used to construct the levee contained rock and/or shell horizons and the material was placed as hydraulic fill.

4.7.8. Pervious Zones. Piezometers show sections of the embankment are highly pervious. This is probably related to gravel/ shell layers, erosion or voids. The size of these pervious zones can not be determined. Their existence is principally a function of the materials that were locally available at any given time when the fill was being placed by hydraulic methods. Shell deposits are common at the site and significant portions of the levee would have been built out of highly shelly material. Additionally, rock deposits placed as fill would produce a gravelly embankment.

4.7.9. Soft Embankment. Soft embankment zones are identified by abnormally low blow counts encountered during drilling. They could be related to non-compaction of the materials due to an arching effect that prevents compaction of the foundation materials. They could also be an indication of internal embankment erosion which has removed material from the foundation creating seepage/piping paths.

4.7.10. Soft Foundation. Soft foundation zones are identified by abnormally low blow counts encountered during drilling. They could be related to non-compaction of materials due to an arching effect or could be an indication of foundation erosion which has removed material from the foundation creating seepage/piping paths.

4.7.11. Filtercake Control. Deep borrow excavations in the lake connect the deep limestone directly to the lake. Subsequent filling of the borrow area excavation by shoaling and muck usually seals off the limestone and limits seepage under the embankment.

4.7.12. Clayey Upstream Toe. Clayey lake side toe acts as an upstream clay blanket. This feature is a result of the original construction methods used to construct the levee. Longitudinal dikes were pushed up from whatever materials (including clayey/silty/peaty materials) were locally available to act as a containment dike to hold the hydraulic fill being placed.

4.7.13. Overflow. Blocked clayey upstream toe acting as a clay blanket causes the embankment to have a low piezometric surface until water overtops the clay. Then there will be a step increase in the water level. A section of levee that looks good at a given elevation can have significantly different performance characteristics when the clayey upstream toe is overtopped.

4.7.14. Sinkholes. Numerous sinkholes are seen along the crest of the levee in the lake Harbor area. This occurred in the same reach of the embankment where significant piping of materials occurred at the toe of the levee during the 1995 high water event. Sand is settling into the gravelly layers deeper in the embankment, filling up voids and/or the material is being piped out of the embankment.

4.7.15. Quick Conditions. Low blow counts at the toe of the levee indicate an active quick condition (unstable) and that materials at the toe are at the critical piping condition.

4.7.16. Deep Excavations. Deep excavations at the land side toe of the levee expose the Rock Horizon. This shortens the seepage paths and increases the seepage potential. Additionally, since seepage paths would be under water, we are not able to monitor any damages that may be occurring. A serious erosion problem could be occurring under the Herbert Hoover Dike without any observable signs. A dike failure could occur without any warning.

4.7.17. Fire Toe Trench. A construction feature that breaches the peat to prevent peat fires from burning under the embankment. They provide a direct connection from the fill to the limestone at the base of the peat. This allows a seepage path to jump from the embankment to the peat/limestone interface or visa versa.

4.7.18. Seepage Trench. An unusual construction feature that breaches the peat on the upstream toe of the levee similar to the fire toe trench. This may also allows a seepage path to jump from the embankment to the peat/limestone interface or visa versa

4.7.19. Low Density Peat Horizon. The peat located at the toe of the levee will heave/float with high tail water.

4.7.20. **<u>Two Phases of Levee Construction</u>.** The embankment was built to elevation +34 in 1937. The embankment was raised to +38 feet in 1964. This adds more complexity to understanding the embankment.

4.7.21. **<u>Cemented Horizons</u>.** Cemented horizons within the Fines Horizon could serve as roofs that would allow erosion paths to form and propagate horizontal piping paths.

4.7.22. **<u>Erodeable Shell Layer</u>.** An erodeable shell layer composed of very small rounded shell about the size of coarse sand. This thin, wet layer was recovered, but not logged, in borings CB-HHDR-6B and CB-HHDR-6C (Reach 1, Line 6, quarry site). There is no reason to expect it is limited to this single occurrence. It could easily be overlooked in other core borings. The material has no cohesion and its shape and uniform size would make it easily erodeable.

4.7.23. **<u>Power Pole / Shallow Well Installations</u>.** These man made features breach the confining layer and provide a path for water under artesian pressure to erode materials. At the Florida Power & Light embankment failure, there were power poles installed at the downstream toe of the embankment in the area where the breach occurred. These power poles would have penetrated a sandstone layer that was probably associated with the embankment failure.

4.7.24. **<u>Horizontal Conduits Through the Enbankment</u>.** Either culverts or water supply pipelines active or abandoned. Some are unknown (S-352N site) and can provide a path for piping.

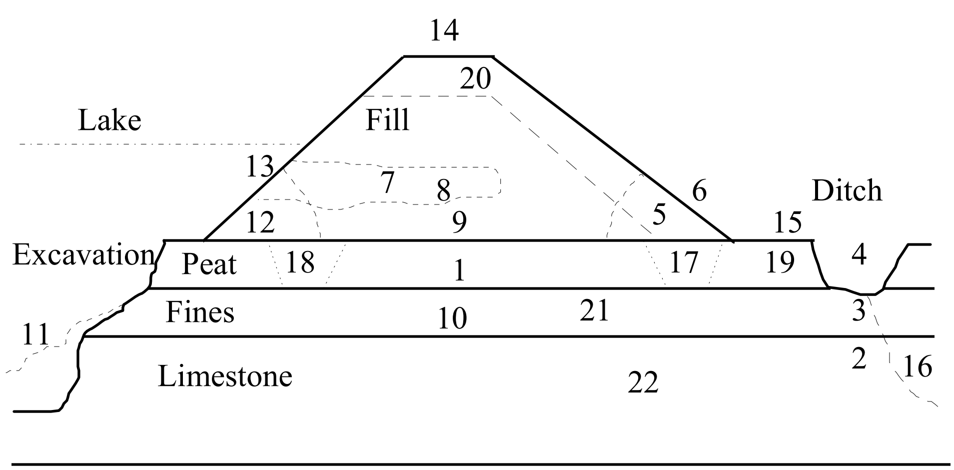

Figure H-4.3. Engineering and Geologic Features.

5. SEEPAGE AND SLOPE STABILITY ANALYSES.

5.0 Notice of Incomplete Engineering Analyses and Geotech Appendix

This Appendix is being provided in advance of the final. The reader should be aware that it is incomplete at this time, with some additional analyses pending and write-up. This Appendix has not been peer-reviewed. The enclosed analyses, results, and recommendations as such should be considered preliminary and subject to revision pending review comments.

5.1. Available Data

Laboratory and field hydraulic conductivity tests for the soils and rocks in Reaches 2 and 3 were compiled and analyzed in original MRR. The expected values from the MRR for the soil and rock types that make up the analysis sections were used in the seepage analyses. Additional field investigations were conducted after the original MRR was published, and those data were utilized in the creation of idealized analysis sections.

The analysis cross sections were simplified from the actual field conditions for the purposes of these seepage analyses. Materials of similar characteristics were grouped together to form soil units, and the soil or rock of a given unit was assigned one hydraulic conductivity value. This has the effect of modeling a soil layer as if it were homogeneous.

Field studies have identified the presence of a “filtercake” in some areas of the rim canal (USACE 2000). This very soft silt and clay that has been deposited in the canal has not been documented for the entire length of the canal and the actual thickness at the cross sections are not known. If present, the filtercake would act as an upstream blanket within the rim canal of relatively impermeable material and would help to prevent both through and underseepage. It is possible that storm activity and maintenance dredging has removed the filtercake or will disturb it in the future. For the purposes of these analyses, therefore, the filtercake was assumed to not be present in the analysis sections.

5.2. Selection of Critical Gradients

Critical gradients were estimated for the cross section soils. The vertical critical gradients (I_{cv}) were defined as the ratio of the submerged unit weight to the unit weight of water. Horizontal critical gradients (I_{ch}) were calculated using the following equation (Al-Hussaini, et. Al. 1997):

$$I_{ch} = I_{cv}\tan\phi$$

The critical gradients for the materials found in the cross sections were calculated using the assumed unit weights of the embankment and foundation soils and are presented in the table G-5.1.

Table G-5.2: Critical Gradients Used in Analyses

Soil Type	Vertical Critical Gradient (I_{cv})	Soil ϕ-Angle	Horizontal Critical Gradient (I_{ch})
Embankment Fill	0.92	30	0.53
Peat	0.12	20	0.04
Sand	0.92	30	0.53
Silts and Clays	0.60	29	0.33
Limestone	1.2	45	1.2
Shell	0.92	29	0.51

Previously published reports have identified the fill soils as having critical vertical gradients of 0.7 to 1.1 and horizontal critical gradients of 0.5 to 0.9. Critical vertical gradients for peat have been identified as 0.1 to 0.25, and critical vertical gradients for the silt and clay soils as 0.4 to 0.6. The critical gradient values contained in Table G-5.1 are on the conservative side of the spectrum of previously published values.

5.3. Seepage Analyses.

Previous Geotechnical evaluations of the levee have concluded that a section of HHD would breach due to piping at a lake elevation of +21 feet-NGVD. An engineering firm contracted to perform an independent analysis of the seepage problem also determined there was a significant risk of breach of HHD. A board of expert consultants reviewed both the Corps of Engineers' analyses and the independent engineering firm's analyses and concluded that an unacceptable risk of HHD failure existed. The consultants recommended rehabilitation of HHD.

The Geotechnical analyses contained herein serves two purposes: 1) to demonstrate that under existing conditions, the modeling would reflect what has been documented in the field with respect to on-going seepage and piping; and 2) model and develop remedial measures that would provide for a stable solution under the SPF event. Seepage analyses of the typical cross sections were completed and are documented in this report. Models were constructed for lake elevations 17.5 and 26 (SPF level), referenced to vertical datum NGVD29. Exit gradients, both X and Y components, were selected directly from within the SEEP/W output by clicking on an individual element within a soil unit where the model showed the phreatic surface daylighting on the ground surface. These exit gradients were then used to compare against the critical gradients for the soil unit and the factor of safety against piping was calculated in accordance with the following equation:

$$FS = I_c/I$$

Where: I_c = critical horizontal or vertical gradient
I = horizontal or vertical gradient selected from model
FS = Factor of Safety (USACE criteria says minimum=2.8)

The choice of which lake elevations to model was based in part on time constraints imposed on us to develop this report, but mostly based on experiences during the high water events of 1995 and 1998 coupled with subsequent emergency responses to seepage and piping at lower lake elevations ranging from 15.3 up to 17.1. In fact, during the high water events of 1995 and 1998, seepage and piping began at lower elevations than the maximum elevations recorded for the events 18.6 and 18.5, respectively. During the original MRR and subsequent design reports, most modeling was performed at a lake elevation of 18.5 (approximately 30-year flood event). The decision to model a lake of 17.5 for this report is in a sense a compromise between experiences of seepage occurring at lower elevations and the extreme seepage conditions that occurred during 1995 and 1998. Further, efforts are concurrently underway to revise the Lake Okeechobee regulation schedule to a peak of 17.57.

The idealized cross sections developed from the available drilling logs were used as the basis for the seepage analysis. The hydrogeologic conditions of the HHD and foundation soils were modeled in cross sections at Stations 3866+00, 3826+00, 3726+00, 3606+00, 3246+00, 3127+00, 3016+00, hh, ii, jj, and 2600+00. Hydraulic conductivity values were assigned from recommended values from the MRR. Each cross section was evaluated for the steady-state seepage condition at lake elevations of 17.5 (approximately 10-year flood level) and 26 (SPF level). Sections analyzed within each Reach are summarized below in Table G-5.2.

Finite element analyses were carried out utilizing the methods and procedures contained in the GeoStudio 2004 software package created by GEO-SLOPE out of Alberta, Canada. This package allows for the integration of previously separate seepage analyses, performed with SEEP/W, and slope stability analyses, performed with SLOPE/W.

Table G-5.3: Sections Analyzed Within Reaches 2 and 3

Reach	Station Location
2	3866+00
2	3826+00
2	3726+00
2	3606+00
2	3246+00
2	3127+00
2	3016+00
3	Sec1
3	Sec2
3	Sec3
3	2600+00

In all cases where a toe ditch was present in the cross section, the toe ditches were modeled empty. Operations personnel routinely take note of and monitor numerous seeps, and occasionally boils, in a section of the toe ditch that becomes unwatered by the agricultural pumping that occurs in the area. The drawdown of agricultural fields and toe ditches in the area has the effect of increasing the head differential across the HHD and aggravating the occurrence of seepage and piping-related incidences. The boundary conditions for the nodes along the toe ditch were therefore set as a potential exit seepage face to mimic the conditions experienced in the field of empty toe ditches.

5.4. Seepage Analyses Results.

Reach 2 - Station 3016 - The seepage analyses of the cross section at Station 3016 shows [explain conditions modeled and model results]. . . Table G-5.3 shows the exit gradients and calculated factors of safety for the different conditions modeled.

Table G-5.4: Results of Seepage Analyses for Reach 2 Station 3016+00

Lake Elev (ft)	Modification to HHD	Flux @ Toe Ditch (ft^3/d/ft)	Max Y Exit Gradient	Critical Vertical Exit Gradient	Factor of Safety (= i_c/i_v)	Max X Exit Gradient	Critical Horizontal Exit Gradient	Factor of Safety (= i_c/i_h)	Satisfy X and Y Gradients? (FS>=2.8)	Berm Distance Away from Toe Ditch
17.5	None	5.63	2.53	0.12	0.05	0.67	0.04	0.06	No	NA
26	None	15.27	4.39	0.12	0.03	1.01	0.04	0.04	No	NA
26	Wall	9.63	3.43	0.12	0.03	0.83	0.04	0.05	No	NA
26	Wall	7.40	2.96	0.12	0.04	0.74	0.04	0.05	No	NA
26	Wall	6.18	2.68	0.12	0.04	0.69	0.04	0.06	No	NA
26	Berm	9.01	0.78	0.12	0.15	0.15	0.58	3.95	No	24
26	Berm + Drain	12.69	0.76	0.12	0.16	0.19	0.58	2.99	No	24
26	Berm + Drain	15.69	0.77	0.12	0.16	0.19	0.58	3.10	No	200
26	Berm + Exc.	228.00	1.71	0.92	0.54	0.33	0.58	1.76	No	
26	Berm + Exc.	93.29	0.61	0.92	1.51	0.30	0.58	1.93	No	
26	Berm + Exc.	102.00	0.48	0.12	0.25	0.10	0.58	6.04	No	
26	Wall + Berm + Drain	7.50	0.38	0.12	0.32	0.13	0.58	4.53	No	200
26	Wall + Berm + Drain	4.52	0.18	0.12	0.67	0.07	0.58	8.92	No	200
26	Wall + Berm + Drain +	96.50	0.12	0.92	7.67	0.17	0.58	3.41	Yes	

	Exc.									
26	Wall + Berm +Exc.		0.21	0.92	4.38	0.12	0.04	0.33	No	
26	Wall + Berm +Exc.	119.00	0.22	0.92	4.18	0.11	0.58	5.27	Yes	
17.5	Wall + Berm + Drain + Exc.	35.90	0.07	0.92	13.94	0.10	0.58	5.80	Yes	

Reach 3 - Station 2600 - The seepage analysis representing existing conditions of the cross section at Station 2600 shows that the highest flows occur through the limestone layers and that the presence of a toe ditch invites flow, producing high exit gradients which indicate seepage and piping would most likely occur. This section has a relatively thin layer of peat at the ground surface which overlies the transmissive limestone layers. Connectivity, even limited, between the limestone unit and the ground surface is highly probable given the variable thicknesses of surficial peat and toe ditch geometry.

Table G-5.4 shows the exit gradients and calculated factors of safety for the different conditions modeled. Analyses were carried out considering three alternative remedial scenarios: partial cutoff wall alone, seepage berm alone, and combined partial cutoff wall with seepage berm. As shown in the table, the partial cutoff wall alone does not sufficiently reduce hydraulic gradients in the vicinity of the toe ditch to prevent piping. The seepage berm-only solution resulted in the berm needing to extend almost 300 feet away from the toe of HHD in order to satisfy factor of safety criteria. The combined alternative in this section consists of a partial cutoff wall to an elevation of -35 combined with a seepage berm extending to approximately 15 feet landward of the existing toe ditch, or about 110 feet from the toe of HHD, and resulted in a factor of safety against piping greater than the minimum required.

Table G-5.5: Seepage Analyses Results for Reach 3 - Station 2600

Lake Elev (ft)	Modification to HHD	Flux @ Toe Ditch (ft^3/d/ft)	Max Y Exit Gradient	Critical Vertical Exit Gradient	Factor of Safety (= i_c/i_v)	Max X Exit Gradient	Critical Horizontal Exit Gradient	Factor of Safety (= i_c/i_h)	Satisfy X and Y Gradients? (FS>=2.8)	Berm Distance Away from Toe of HHD (ft)
17.5	None	67.9	2.80	0.60	0.21	2.70	0.30	0.11	No	n/a
26	None	143	4.70	0.60	0.13	4.40	0.30	0.07	No	n/a
26	Wall	63	3.30	0.60	0.24	2.39	0.30	0.11	No	n/a
26	Berm	n/a	0.17	0.60	3.53	0.04	0.30	6.82	Yes	300
26	Wall+Berm	n/a	0.06	0.60	10.00	0.02	0.30	15.79	Yes	110
17.5	Wall+Berm	n/a		0.60	3.33		0.30	1.43	No	n/a

5.5. Slope Stability Analyses and Results.

Once seepage analyses were completed for each section, slope stability analyses were conducted with the lake at elevation 26. It was generally believed that if the HHD was stable under existing conditions with the lake at an elevation of 26, then no further analyses would be needed because any rehabilitation solution would add stability to HHD. Pore pressures generated from the seepage analyses were used in the slope stability analyses. The limit equilibrium method was used in the slope stability analyses according to Spencer's Method of slices which satisfies all conditions of equilibrium.

In general, side slopes of HHD are comprised of lakeside slopes approximately 1 vertical on 5 horizontal (1:5), and landside slopes 1:3. Crest widths are variable, depending on proximity to structure crossings, but were generally taken as 15 feet in width. The base width of HHD also varies, but is approximately 200 feet in width.

Analyses only considered slip surfaces (circular shape) with radii sufficiently large that would result in deep-seated failures. Shallow slip surfaces are indicative of minor sloughing and are only maintenance-related nuisance issues. The minimum Factor of Safety called for in EM dam guidance for the maximum storage pool is 1.5, and the minimum Factor of Safety called for in EM levee guidance for existing levees is 1.4. Table G-5.x shows the resultant Factors of Safety for slope stability.

Table G-5.x: Slope Stability Results for Lake Elevation 26

Reach - Station	Factor of Safety	Factor of Safety with HHD modification*
2 – 3866+00	1.75	n/a
2 – 3826+00	1.91	n/a
2 – 3726+00	2.50	n/a
2 – 3606+00	1.92	n/a
2 – 3246+00		
2 – 3127+00	1.54	n/a
2 – 3016+00	1.34	2.47
3 - Sec1	1.4	2.5
3 – 2723+00	1.61	n/a
3 - Sec3	2.1	n/a
3 – 2600+00	1.7	n/a

* This analysis only performed if FS less than 1.5 with lake at 26 under existing conditions.

5.6. Recommended Rehabilitation Solution

At this time, with limited geotechnical data and engineering analyses, and no cost comparison of alternatives with which an argument can be made to justify one solution over another based on economic considerations, the recommended solution will be based on which solution is least impactive upon the community. Due to variations in both dike and landside geometries, subsurface geological conditions, and analysis results, the recommended solution is not the same for each section analyzed. As the seepage analyses results indicate above, there are two recommended solutions. A partial cutoff wall will be continuous in all of Reaches 2 and 3, but the tip elevation will vary based mostly on geologic conditions. In some sections, the partial cutoff wall alone does not satisfy the factor of safety against piping so it will need to be complemented with a seepage berm to further reduce the hydraulic gradients to an acceptable level. The combined solution of a partial cutoff wall with a seepage berm satisfies all conditions of stability and increased factor of safety against seepage and piping. Table G-5.x below summarizes the recommended solution. See plate G-x for a plan view of the lake and Reaches 2 and 3 which depicts where the recommended solutions should be constructed. Figure 1 below shows some preliminary details for the recommended rehabilitation solution for an example cross-section.

Table G-5.x: Recommended Rehabilitation Solutions

Reach - Station	Recommended HHD Rehabilitation Solution	Approx Distance (ft) Landward from HHD Toe Needed for Berm
2 – 3866+00	Partial Cutoff Wall + Seepage Berm	150
2 – 3826+00	Partial Cutoff Wall	n/a
2 – 3726+00	Partial Cutoff Wall	n/a
2 – 3606+00	Partial Cutoff Wall + Seepage Berm	140
2 – 3246+00	Partial Cutoff Wall	n/a
2 – 3127+00	Partial Cutoff Wall	n/a
2 – 3016+00	Partial Cutoff Wall + Seepage Berm + Excavation	165
3 - Sec1	Partial Cutoff Wall + Seepage Berm	110
3 – 2723+00	Partial Cutoff Wall + Seepage Berm	110
3 - Sec3	Partial Cutoff Wall + Seepage Berm	110
3 – 2600+00	Partial Cutoff Wall + Seepage Berm	110

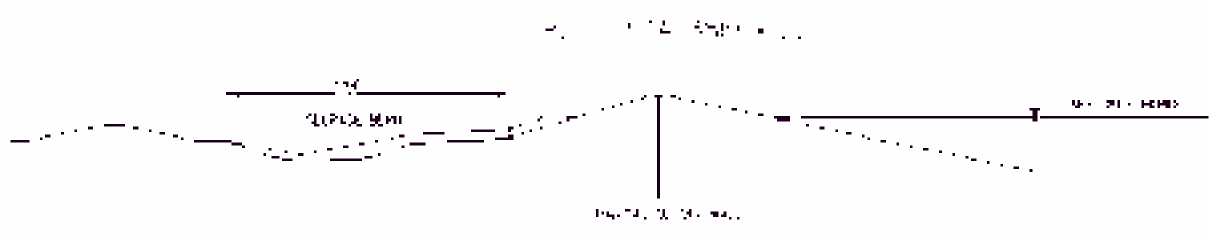

Figure 1: Example Cross-Section Details for Recommended Solution

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